J.P. MORGAN CENTER FOR COMMODITIES
UNIVERSITY OF COLORADO DENVER BUSINESS SCHOOL

GLOBAL COMMODITIES
APPLIED RESEARCH DIGEST

WINTER 2020

Supported by funding from CME Group

Business School
UNIVERSITY OF COLORADO DENVER

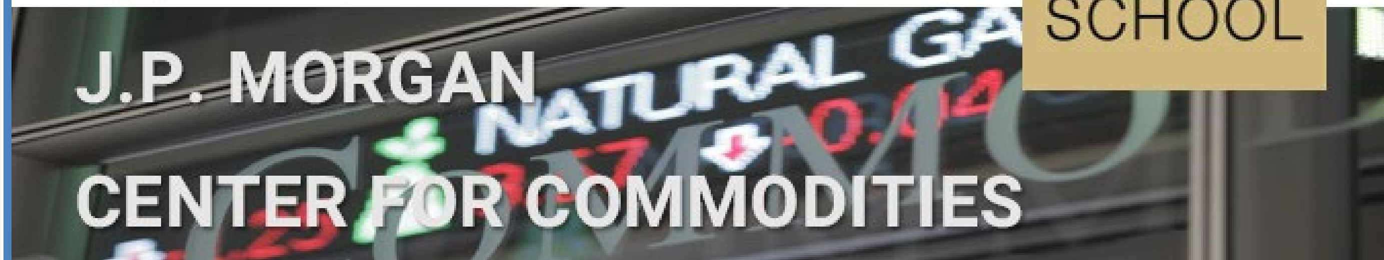
GLOBAL COMMODITIES APPLIED RESEARCH DIGEST

Vol. 5, No. 2: Winter 2020

Index of Articles

Denver

BUSINESS SCHOOL



The JPMCC is positioned as a collaboration between business and academia across the broad agriculture, metals, and energy commodity sectors. Our focuses include Commodity Business Education, Applied Commodity Research, and Commodity-Related Public Forums & Discourse.

Undergraduate & Graduate Specializations in Commodities

Our commodity classes cover the dynamics of the physical commodity markets, supply chains, data analytics & forecasting, risk management and trading.

4 Courses – 12 Credit Hours – Evening Courses

Professional Education Opportunities

We are offering 2, four-week online data analytics courses for commodity professionals.
April & June 2021

Energy & Commodity Analytics for Analysts

Energy Analytics & Big Data for Managers

Commodity Research

In addition to the *GCARD*, the JPMCC sponsors an annual Commodities Research Symposium where global commodity thought leaders and prominent stakeholders from both academia and industry convene to discuss critical thinking and new research related to commodities.

Upcoming Webinars & Recorded Sessions

Follow us on LinkedIn and our Website for information.

Contact Erica Hyman for more information or to schedule a visit to the Business School.
Erica.Hyman@ucdenver.edu; 303-315-8019

Professional Education

Sponsored by a Collaboration of CU Denver Business School's Global Energy Management (GEM) program and the J.P. Morgan Center for Commodities (JPMCC)

Energy and Commodity Analytics for Analysts

This 4-week, online course for analysts and technical professionals will take a deep dive into energy and commodities analytics. Designed for those who want to learn best practices around commodity data analytics, visualization, and forecasting, the course offers hands-on projects and real-world data. You will learn commodity data analysis utilizing EViews, an industry-leading data management and analysis software.

Schedule and Curriculum

The next course offerings are in April and June 2021 (4 weeks each).

The curriculum for the course spans complex topics including data transformation and visualization, regression analysis, model estimation (including vector autoregression and error-correction) and forecasting across the broad commodity sector.

- Introduction to data analysis and EViews "bootcamp"
- Applied introduction to time-series modeling and forecasting
- Case studies and real-world applications for data analysis

About the Instructor

Daniel Jerrett, Ph.D., has more than 15 years of experience developing and implementing forecasting models, spanning both the private and public sectors. He has spent time in the investment management industry, state, and local governments as well as consulting with Fortune 500 companies.

Dr. Jerrett continues to be active in academia and teaches courses in econometrics and forecasting at the University of Colorado Denver's J.P. Morgan Center for Commodities.

How to Apply

Admission is open to all applicants, with no prerequisites to register. A fundamental knowledge of business statistics and strong quantitative skills are highly recommended.

Discounts apply for professionals participating in both the Energy and Commodity Analytics for Analysts and Energy Analytics and Big Data for Managers certificates.

For any questions about registration, please contact Michele Cooper, *Associate Director of Student Success and Analytics* for the Global Energy Management Program, at michele.cooper@ucdenver.edu or 303-315-8066.

For more information visit: business.ucdenver.edu/analysts-energy-analytics

Professional Education

Sponsored by a Collaboration of CU Denver Business School's Global Energy Management (GEM) program and the J.P. Morgan Center for Commodities (JPMCC)

Energy Analytics and Big Data for Managers

This 4-week, online course for managers and new data professionals offers a broad-based, but gentle, introduction to the rapidly expanding disciplines of analytics and Big Data in the energy and commodity industries. The course focuses on developing quantitative data literacy and establishing the foundation of analytics, algorithms, and models. You will be able to comfortably discuss the issues, impacts, and tools of energy analytics.

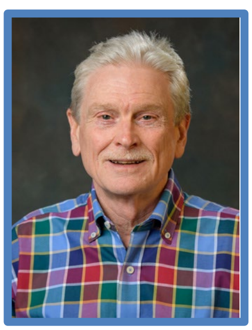
Schedule and Curriculum

The next course offerings are in April and June 2021 (4 weeks each).

This program will offer an overview of Big Data and energy analytics, including the roles of management, and demonstrate the link to corporate performance indicators and operational efficiency.

Course topics include:

- Introduction to Big Data
- Data is the new currency
- Prediction and predictive analytics
- Industry case studies in energy and commodities



About the Instructor

Tim Coburn, Ph.D., has a career that intersects various aspects of the energy industry, including oil and gas, renewables, coal, transportation, electricity, infrastructure, and human factors. In addition to his extensive research in energy analytics, Dr. Coburn has worked for Phillips Petroleum, Marathon Oil Company, and the National Renewable Energy Laboratory. Dr. Coburn has held professorship roles at numerous universities and is an instructor for CU Denver's Masters in Global Energy Management.

How to Apply

Admission is open to all applicants, with no prerequisites to register. A fundamental knowledge of business statistics and strong quantitative skills are highly recommended.

Discounts apply for professionals participating in both the Energy and Commodity Analytics for Analysts and Energy Analytics and Big Data for Managers certificates.

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For more information visit: business.ucdenver.edu/managers-energy-analytics

The *Global Commodities Applied Research Digest* (*GCARD*) is produced by the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School.

The JPMCC's leadership team is as follows. Thomas Brady, Ph.D., is the JPMCC's Executive Director. The JPMCC's Research Director is Jian Yang, Ph.D., CFA, who is also the J.P. Morgan Endowed Research Chair, and Discipline Director and Professor of Finance and Risk Management at the University of Colorado Denver Business School. The JPMCC's Program Director is Yosef Bonaparte, Ph.D., who is also an Associate Professor of Finance at the University of Colorado Denver Business School. The JPMCC's Program Manager, in turn, is Erica Hyman. Periodic updates on the JPMCC's activities can be found at https://www.linkedin.com/school/cu-denver-center-for-commodities/.

In addition, the Chairman of the JPMCC's Industry Advisory Council is Chris Calger, Managing Director, Global Commodities, J.P. Morgan.

The aim of the *GCARD* is to serve the JPMCC's applied research mission by informing commodity industry practitioners on innovative research that will either directly impact their businesses or will impact public policy in the near future. The digest covers topical issues in the agricultural, metals and mining, and energy markets as well as in commodity finance.

The *GCARD* was seeded by a generous grant from the CME Group Foundation and is published twice per year. Complimentary subscriptions to the *GCARD* are available at: http://www.jpmcc-gcard.com/subscribe. Periodic updates on *GCARD*-related activities can be found at https://www.linkedin.com/company/jpmcc-gcard/.

Since the Spring of 2016, the *GCARD*'s editorial and project management staff has been as follows. The *GCARD's* Contributing Editor is Ms. Hilary Till, M.Sc. (Statistics), Solich Scholar at the JPMCC and Member of the JPMCC's Research Council. In addition, Ms. Till is a Principal of Premia Research LLC. The *GCARD's* Editorial Assistant is Ms. Katherine Farren, CAIA, whom, in turn, is also a Research Associate at Premia Research LLC.

For the Winter 2020 edition, CU Denver graduate student, Michael Carringi, was the *GCARD*'s Research Assistant.

The *GCARD* benefits from the involvement of its distinguished Editorial Advisory Board. This international advisory board consists of experts from across all commodity segments. The board is composed of academics, researchers, educators, policy advisors, and practitioners, all of whom have an interest in disseminating thoughtful research on commodities to a wider audience. Board members provide the Contributing Editor with recommendations on articles that would be of particular relevance to commodity industry participants as well as author articles in their particular areas of commodity expertise.

The *GCARD* also benefits from its academic and professional society partnerships in furthering the international recognition of the digest. These partners include ECOMFIN, the IAQF, and CAIA. Specifically, the Director of the Energy and Commodity Finance Research Center (ECOMFIN) at the ESSEC Business School (France, Singapore) serves on the *GCARD*'s Editorial Advisory Board while the *GCARD*'s professional society partners, in turn, are the International Association for Quantitative Finance (IAQF) and the Chartered Alternative Investment Analyst (CAIA) Association.

The *GCARD*'s logo and cover designs were produced by Jell Creative, and its website was created by PS.Design. The *GCARD*'s layout was conceived by Ms. Barbara Mack, MPA, of Pingry Hill Enterprises.

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Advisory Council

The JPMCC's Advisory Council consists of members of the business community who provide guidance and financial support for the activities of the JPMCC, including unique opportunities for students. Advisory Council members also contribute practitioner-oriented articles to the *GCARD*.

Research Council

The JPMCC is honored to have a distinguished Research Council that provides advice on shaping the research agenda of the Center. Amongst its articles, the *GCARD* periodically draws from insightful work by the JPMCC's Research Council members.

Editorial Advisory Board

The *GCARD*'s international Editorial Advisory Board consists of experts from across all commodity segments, each of whom have an interest in disseminating thoughtful research on commodities to a wider audience.

Research Council Corner

The article discusses the uneven impact of the COVID-19 pandemic across the commodity market sectors. The author concludes that COVID-19's impact on energy markets is likely to leave a permanent scar while the impact on other commodity markets will likely be transitory. In particular, the pandemic is likely to induce some longer term impacts on commodity markets, including lower oil consumption, changes in the cost of transport, unwinding of supply chains, and, in the longer term, substitution among commodities due to changes in consumer preferences.

Research Digest Article

This paper investigates the impact of enormous capital inflows into commodity futures markets in China. Mimicking the positions of both passive long and systematic long-short speculators, the study (Continued on the next page)

Research Digest Article
(Continued)

Contributing Editor's Section

Advisory Council Analysis

Editorial Advisory Board Analysis

Systematic commodity risk-premia strategies have been popular among asset allocators and extensively studied by researchers. It is not as widely known, though, that the disproportionally large share of returns in such diversified commodity portfolios is attributed to energy futures. We show that even simple signals supported by the economics of oil storage and transportation arbitrage generate superior returns when applied to oil futures alone. The challenge is to be mindful of structural regime shifts that are prevalent in oil markets.

Industry Analyses

The oil market went through a tumultuous period in early 2020. The price of the West Texas Intermediate Blend hit a peak of over $60 per barrel and then plunged for the first time in history to a negative price for both the front-month futures contract and spot price at Cushing on 4/20/2020. This paper focuses on the apparent stability of the market during this time period and the financial engineering challenges that options and futures traders addressed to ensure the markets remained orderly and operating. The authors provide evidence that the market functioned normally in the face of a negative futures price and the listing of negative strike options. The paper specifically focuses on the difficulties in pricing and hedging of options under the traditional Black option model. The authors then explore two alternative model formulations and comment on their applicability.

Forecasts play a vital role in decision-making in the energy sector. Forecasting in the energy sector is a challenging task due to the large number of highly uncertain variables that is typically needed to forecast. On top of this, the energy transition is introducing new uncertainties which elevate the importance of accurate forecasting while making the task more difficult. The paper examines the key forecasting challenges against this backdrop from the perspective of an industry practitioner and introduces a systematic five-step approach to understanding, evaluating, and improving forecasts. Simplified use cases are presented which demonstrate that the five-step approach can generate commercial insights and improvements in forecast performance.

Industry Analyses
(Continued)

(Continued on the next page)

Industry Analyses
(Continued)

Interview

CU Denver Business School Global Energy Management (GEM) Program

Special Report: Economist's Edge

Updates from the J.P. Morgan Center for Commodities' Leadership Team

We are delighted to welcome you to the tenth issue of the *GCARD*! We are grateful that members of the JPMCC's Research Council, Advisory Council, and the *GCARD*'s Editorial Advisory Board continue to support this publication by providing insightful articles from both academia and industry, and which are included in this issue.

New Advisory Council Members

The J.P. Morgan Center for Commodities is happy to announce that seven commodity leaders have joined our Industry Advisory Council. We look forward to learning from their expertise and working together to improve our Center offerings in areas from classes to internship opportunities, research and scholarships. Our new Advisory Council members are (in alphabetical order):

- David Alfano, Vice President, Risk Management, Cargill Incorporated
- Jodie Gunzberg, CFA, Managing Director, Chief Investment Strategist, Wealth Management Institutional, Morgan Stanley
- Wouter Jacobs, Ph.D., Academic Director, Commodity Trade & Supply Networks, Erasmus University
- Nic Johnson, Managing Director and Portfolio Manager, PIMCO
- Julie Lerner, CEO, PanXchange, Inc.
- Peter O'Neill, CFA, Director, Risk Analytics, Archer Daniels Midland Company
- Karl Skold, Ph.D., Head of Agricultural Economics, JBS

Program Manager Appointment

We are pleased to announce that Erica Hyman has been selected as the JPMCC's Program Manager and started with us in February 2020. Erica's career has focused on higher education. She previously worked at the University of Colorado School of Medicine as well as the University of Michigan Ross School of Business in Ann Arbor, Michigan.

Center Outreach

Over the past few months, Dr. Tom Brady, Executive Director of the J.P. Morgan Center for Commodities, has worked extensively to increase the Center's recognition through webinars, partnerships, and outreach. He co-hosted a commodities focused podcast with London-based commodity artificial intelligence startup, ChAI, participated in a *Reuters* webinar on the outlook for metal markets and trading (with the London Metal Exchange), and had several media interviews with the China Global Television Network and with the *Denver Business Journal* on the outlook for the oil industry. These interviews can be viewed at https://business.ucdenver.edu/commodities/news-events.

CU Denver Classes

Our academic year class offerings are listed below. JPMCC classes can be taken in conjunction with a CU Undergraduate degree, M.B.A., or M.S. in Finance, as well as a separate Certificate in Commodities for those looking for a focused Commodities education.

Fall Semester

Introduction to Commodities: This is a new course that aims to introduce undergraduate students in the Business School to commodities and related careers. This course is taught by Tom Brady, Ph.D.

Foundations of Commodities: The course content for Foundations has been updated this semester to include a larger emphasis on Bloomberg as well as current event examples from the commodities sector. This course is being taught in a synchronous online format this semester and co-instructed by Lance Titus (a JPMCC Advisory Council member), Mike Miller (also a JPMCC Advisory Council member), and Tom Brady, Ph.D.

Commodity Supply Chains: This course provides a deeper dive into the analysis of commodity supply chains and is taught through asynchronous classes and online support by CU Denver Faculty, Mike Harper, Ph.D.

Upcoming Spring Semester – Course Formats are To Be Determined

Introduction to Commodities: We will be teaching this course again in the Spring to provide more undergraduate students in the Business School with a base knowledge in commodities and related careers. This course is taught by Tom Brady, Ph.D.

Commodity and Equity Trading Fundamentals: This is a new course that focuses on how securities and futures contracts are designed and traded including trading exchange operations, regulation, trading mechanisms and processes. Students will learn the theory and practice of securities and futures contract trading with a focus on hands-on trading experience using industry software (CQG and Bloomberg) as well use of data sources (Morningstar). This course will be taught by the JPMCC's Program Director, Yosef Bonaparte, Ph.D.

Commodity Valuation and Investment: This course introduces students to the physical aspects of commodities and connects them to the financial markets in which commodities are traded. The course also serves as a foundation for more focused education in the specific commodity sectors, as well as the applied use of marketing and financial trading concepts learned in other courses. This course is taught by Dominick Paoloni, CIMA.

Commodity Data Analysis: This course is an applied introduction to commodity data analysis through the lens of EViews statistical software. Students learn how to analyze commodity prices using quantitative techniques. Relationships between commodities and the global economy will be investigated. Students will be introduced to forecasting techniques and be able to develop and evaluate various forecasting models. This course is taught by Daniel Jerrett, Ph.D., who is also a JPMCC Advisory Council member.

Professional Education Courses

Commodity Data Analytics: Daniel Jerrett, Ph.D., taught Commodity Data Analytics for Analysts online in June/July 2020 and will continue teaching this online, four-week class.

> One of Dr. Jarrett's summer participants commented on the class:
> *"For those who have done econometrics before, but stopped practicing for a while, this seminar is a very good refresher course on time series analysis … widely applied in commodity analysis. The main benefit of the course was the hands-on approach, first learning the basics of the models and … then applying them during the class through worked examples. The course instructor, Daniel Jerrett, was extremely knowledgeable and a very good communicator, pausing regularly for questions and drawing extensively from his vast knowledge as a seasoned practitioner."*

Energy Analytics and Big Data for Managers: This course is taught by Tim Coburn, Ph.D., and offers a broad-based, but gentle, introduction to the rapidly expanding disciplines of analytics and Big Data in the energy and commodity industries. The course focuses on developing quantitative data literacy and establishing the foundation of analytics, algorithms, and models. Students will be able to comfortably discuss the issues, impacts, and tools of energy analytics.

Global Commodity Flows: This will be a 1-year program in collaboration with Erasmus University (The Netherlands) and Singapore Management University. We are slated to launch this course in September 2021.

Dr. Wouter Jacobs (left-hand side), Academic Director, Commodity Trade & Supply Networks, Erasmus University Rotterdam, The Netherlands, symbolically shakes hands with **Dr. Thomas Brady** (right-hand side), the JPMCC's Executive Director, at the conclusion of a memorandum-of-understanding on collaborative efforts in executive and Master's level university education.

Research Symposium

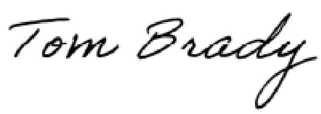
The JPMCC's Research Director, Jian Yang, Ph.D., CFA, noted that with the feedback that the Center received from past conference attendees, advice from our Industry Advisory and Research Council members, and from our Dean's office, we decided to cancel the 2020 Symposium due to COVID-19 concerns. The decision was very difficult for us. We had already received paper submissions from researchers from over fifteen countries and very prestigious universities (Chicago-Booth, Columbia, Oxford, UC-Berkeley, U Penn-Wharton, among others) as well as from policy institutions including the World Bank, United Nations and the U.S. Federal Reserve. We fully anticipate holding the Symposium in August 2021 and look forward to seeing you there!

Executive Director's Concluding Note

I welcome you exploring our many commodity-focused activities at our website, https://business.ucdenver.edu/commodities/, or following us at https://www.linkedin.com/school/cu-denver-center-for-commodities/.

And I hope you have a wonderful, upcoming holiday season!

Best Regards,



Tom Brady, Ph.D.
Executive Director, J.P. Morgan Center for Commodities

Update from the Research Director of the J.P. Morgan Center for Commodities

Jian Yang, Ph.D., CFA
J.P. Morgan Endowed Research Chair, JPMCC Research Director, and Discipline Director and Professor of Finance and Risk Management, University of Colorado Denver Business School

Dr. Jian Yang, Ph.D., CFA, J.P. Morgan Endowed Chair and JPMCC Research Director, presenting at an international conference on derivatives markets and risk management in Shanghai, China.

In this report, the JPMCC research director will provide updates about recent research activities from January 2020 until September 2020 with the focus on recent academic and applied research in commodities. Due to COVID-19, many other activities have been put on hold.

A Study Advancing Research on the Price Discovery Function of Commodity Futures Markets

The article, "Price Discovery in Chinese Agricultural Futures Markets: A Comprehensive Look," coauthored by the research director, advances research on the price discovery function of commodity futures markets on multiple fronts. First, this is the first study to propose and implement in the literature an empirical framework for testing major aspects of price discovery (i.e., the futures price as an unbiased predictor of the cash price) at every point of time, which reveals a more complete picture of futures market performance over time.

Second, this is the first study empirically demonstrating that it is important to use data from the most active futures contracts rather than nearby futures contracts to examine price discovery performance of international futures markets. If not, as shown in our study in the case of China, there may be seriously misleading inferences drawn from using the nearby futures data. Equally importantly, a similar problem potentially may apply to other international futures markets such as Japan, which has a similar strong preference for deferred futures contracts in that country. This is vastly different from the case of the U.S. where nearby futures contracts are typically the most active futures contracts before the expiration month. While a few researchers and industry sources (e.g., Bloomberg) note the fact that nearby futures contracts in China are in many cases not the most active contracts, no empirical evidence has yet existed to shed light on the seriousness of using the nearby futures price data in China (and in other countries.) The paper fills this gap and shows that five out of the 11 major agricultural commodity futures markets in China where futures are found to lead national cash prices unidirectionally in the long run, when using the most active futures prices, can be mistakenly found to have bidirectional feedback with national cash prices if nearby futures data are used instead. The finding is consistent with the argument of less informational content in the nearby futures data in China due to much lower trading volume than the most active futures contracts.

Third, it is the first comprehensive study which covers all eleven actively traded agricultural futures markets in China, which include the top five most traded agricultural commodities in the world according to the Futures Industry Association 2016 annual volume survey.

Organizing the Featured Articles in *China Futures* Magazine

The research director has initiated and then acted upon the invitation of organizing featured articles around the theme of "Meeting with JPMCC" from the research department head of the China Futures Association, whom also serves as the main editor of *China Futures* magazine. The research director worked together with the JPMCC's executive director, Dr. Tom Brady, to review numerous business questions raised by the futures and derivatives industry in China, and identify appropriate experts affiliated with the JPMCC to address many of them. This will greatly help further advance the influence of the JPMCC in Asia, and fulfill the applied research mission of the center to have impact on the business community, in this case globally. This effort is also well aligned with the University of Colorado's strategic goal of elevating our international standing through research.

The authors of these articles come from JPMCC Advisory Council members at J.P. Morgan, Morgan Stanley, and the CME Group; a Research Council member from the World Bank; and two of the JPMCC directors (i.e., the executive director and the research director.) These articles are expected to be translated into Chinese and published in print and online as featured articles in *China Futures* magazine later this year.

Updates about the International Commodities Symposium and Other Research Activities

The JPMCC's 2020 international commodities symposium was cancelled in April 2020 due to COVID-19, which turned out to be a correct decision. While we plan to hold the symposium in 2021, how we would hold it is still under discussion. We will keep everyone posted via various channels in due time.

Nevertheless, as scheduled, the *Journal of Futures Markets* (*JFM*) published a special issue in August 2020 that features four high-quality articles presented at the 2019 symposium with author affiliations from MIT, University of Texas at Austin, Bank of Canada, among others. In the journal editor's note for the special issue, the research director was humbled to be recognized as "an internationally recognized scholar on derivatives securities and markets."

Earlier, in late March and April 2020, partly reflecting the international impact of JPMCC affiliated research, the research director was also honored by similar recognition as "an internationally renowned financial expert" (国际知名金融专家 in Chinese) in various media interviews or media articles by others on commodity futures topics, published in prestigious media outlets in China, including *Economic Daily* (of the State Council of China), *Financial News* (of the People's Bank of China), and *The Economic Observer* (an influential independent Chinese weekly newspaper.) Some of these media articles were reposted on the official websites of China's Ministry of Commerce, China National Petroleum Corp (CNPC) (the fourth largest company in the world in 2020) and the Shanghai International Energy Exchange. The same recognition also appeared in other interviews with the research director on financial topics published in other Chinese newspapers, including *China Banking and Insurance News* (of the China Banking and Insurance Regulatory Commission.)

As a side note, as of September 2020, based on Web of Science citation counts, two of the *JFM* articles coauthored by the research director (also as the lead author), including one on commodity futures, rank among the top 15 most cited among over 2,100 *JFM* articles in about the last forty years since the *JFM*'s inception (1981-2020).

Conclusion

COVID-19 has had a profound impact on the economy, the society and our own personal lives. We are very grateful for the constant support from so many of the world's renowned academics in the field of commodities to serve as members of the JPMCC Research Council or as presenters or discussants at our conferences. We hope we would still meet you virtually next summer, or even better physically.

We wish everyone a healthy and safe winter!

Best Regards,

Jian Yang, Ph.D., CFA

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Commodity Markets in a Post COVID-19 World

John Baffes, Ph.D.
Senior Agriculture Economist, Prospects Group, World Bank[1]

Dr. John Baffes, Ph.D., Senior Agriculture Economist at the World Bank, presenting at the J.P. Morgan Center for Commodities at the University of Colorado Denver Business School. Dr. Baffes is also a member of both the JPMCC's Research Council and the *GCARD*'s Editorial Advisory Board.

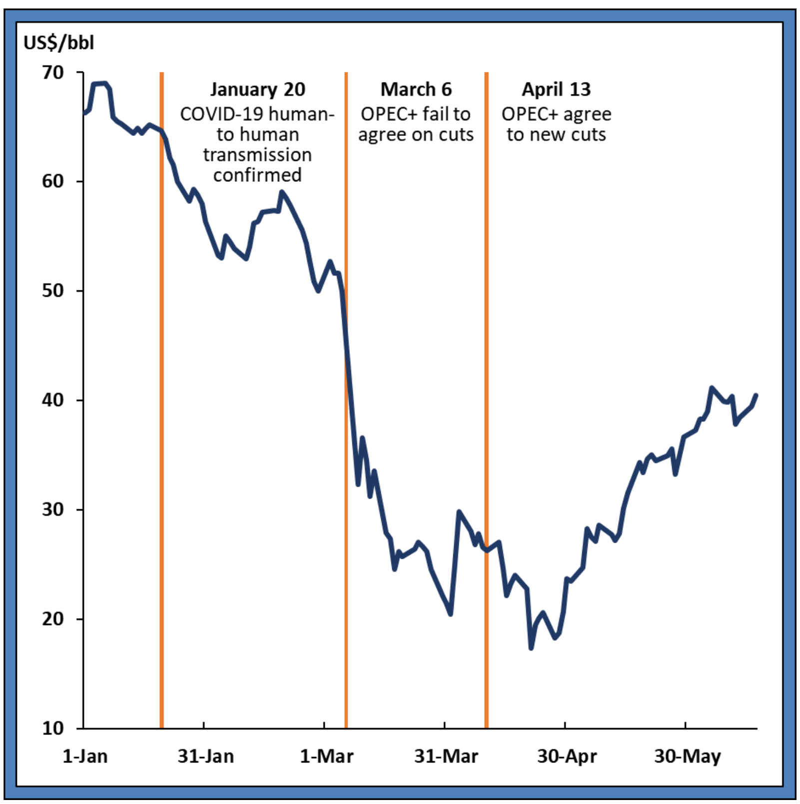
Introduction

The COVID-19 pandemic delivered an enormous shock to the global economy and triggered the deepest global recession since the second world war, far surpassing the recession in 2009 that was triggered by the global financial crisis. The pandemic impacted commodity markets as well, but its effect on prices has been uneven. Oil prices, which dropped 60 percent following the pandemic, recovered somewhat, but are still considerably lower than their pre-pandemic average. Prices for metals experienced a moderate decline initially but recovered relatively quickly, following a quicker-than-expected rebound in China's economic activity. Agricultural and food prices have remained broadly stable, reflecting the fact that markets for most main crops (maize, rice, wheat, and soybeans) are well-supplied and demand for food commodities was not affected as much by the pandemic. However, the wedge between prices paid by consumers with those received by producers widened considerably for some commodities, especially the ones that were subjected to supply chain disruptions. Moving forward, COVID-19's impact on energy markets is likely to leave a permanent scar. Its effect on other commodity markets, however, most likely will be transitory. Nevertheless, the pandemic is likely to have lasting consequences for commodity markets, including lower oil consumption, changes in the cost of transport, unwinding of supply chains, and, in the longer term, substitution among commodities due to changes in consumer preferences. The rest of this essay elaborates on recent developments and how the pandemic is likely to affect the three main commodity markets – energy, agriculture, and metals.

Energy

Crude oil prices have plummeted since the start of the year, dropping 65 percent between January and April. Brent crude oil prices averaged $23/bbl in April, a multi-decade low. Demand for oil collapsed as a result of shutdowns resulting from the coronavirus pandemic (COVID-19), which has sharply reduced transportation. The decline in prices was exacerbated by the breakdown of OPEC+ talks in early March, and a new production agreement announced on April 12 failed to boost prices. Prices recovered modestly during the first week of May as lockdown measures started to be lifted in some countries, but they remain at very low levels. See Figure 1.

Figure 1
Brent Prices During COVID-19

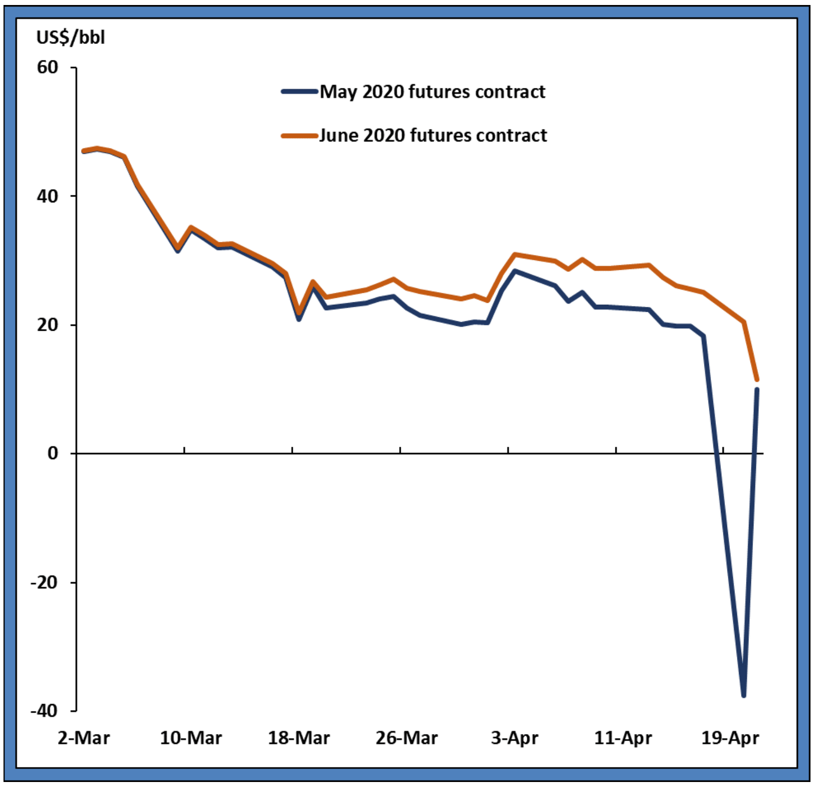


Sources: Bloomberg and World Bank.

Note: Last observation is June 16 (Brent).

Other benchmark prices have seen even more dramatic declines. On April 20, the WTI Cushing contract for delivery in May fell to nearly -$40/barrel. The magnitude of the collapse was due to both fundamentals – weak demand and limited storage capacity – and technical factors associated with the futures market. On the technical side, the drop reflected the fact that the May contract expired on April 21, and there was minimal storage capacity available for physical deliveries for the contract. Prices rebounded the following day, and the contract price for delivery in June (less immediately affected by these issues), did not see a decline of the same magnitude. But the drop nonetheless highlights the immense strain on the market. See Figure 2.

Figure 2
WTI Cushing Prices During COVID-19

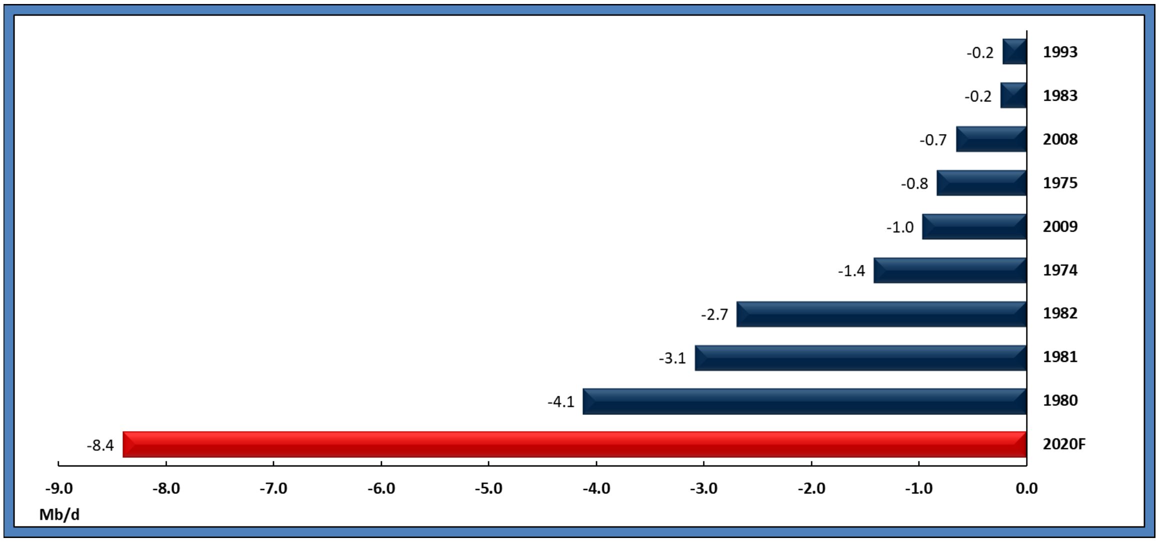


Sources: Bloomberg and World Bank.

Note: Last observation is April 21 (WTI).

The decrease in prices is due to a sharp fall in global consumption of crude oil. The International Energy Agency projects that for 2020 overall, global oil demand will fall by nearly 10 percent. This is more than twice as large as any previous decline, as illustrated in Figure 3. In addition, Figure 4 puts in further perspective the magnitude of the recent drop in oil prices. Mitigation measures to reduce the spread of COVID-19 have halted a large proportion of travel, with widespread flight cancellations, stay-at-home orders, and reduced global trade, all reducing demand for oil. For example, passenger journeys through Transportation Security Administration checkpoints in the United States initially fell to as low as 5 percent of their 2019 level.

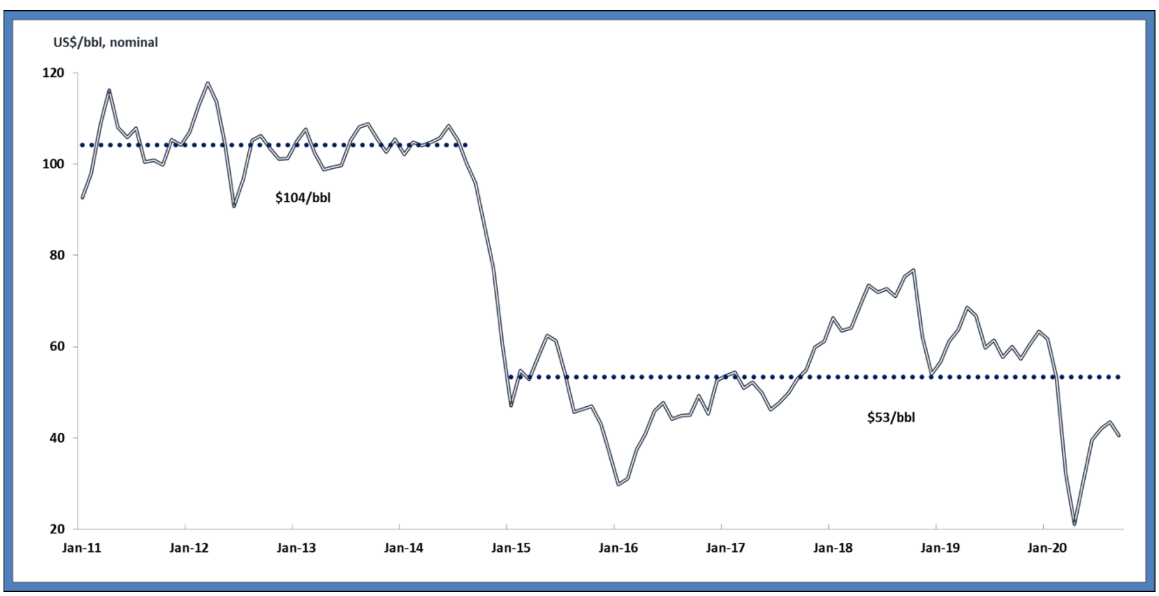
Figure 3
Episodes of Oil Demand Declines



Sources: International Energy Agency (September 2020 monthly report) and World Bank.

Note: The data show declines in oil demand from previous year's consumption levels.

Figure 4
Oil Prices: 2011-2020



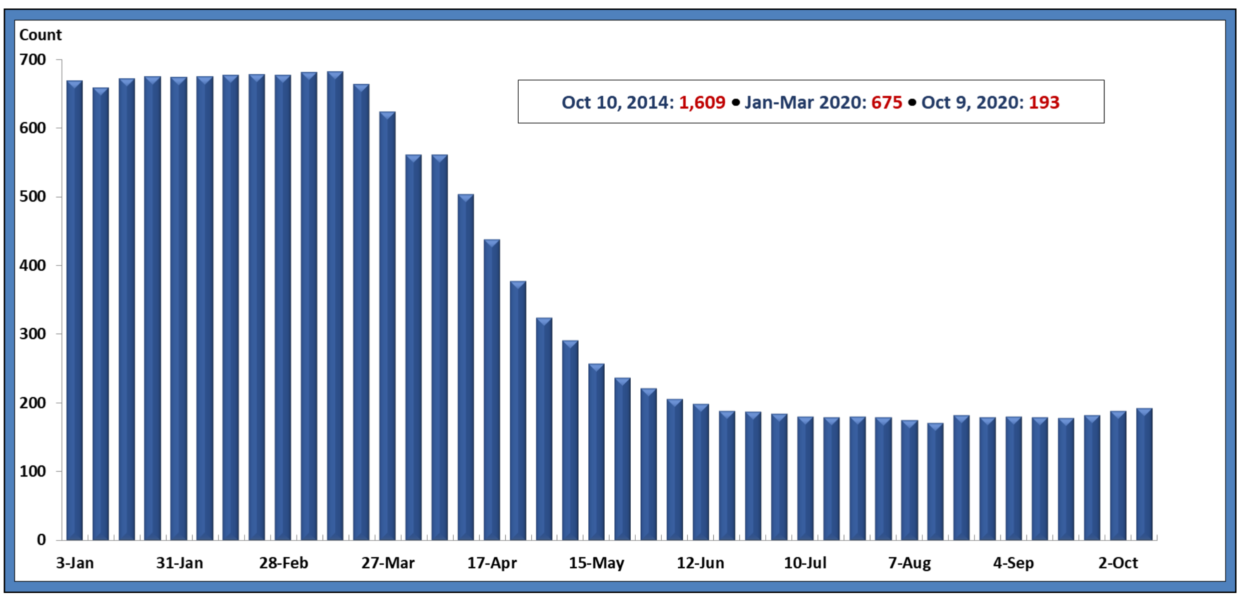
Source: World Bank.

Note: The dotted lines represent averages for January 2011 to August 2014 and January 2015 to September 2020.

Initially, global oil production was slower to fall than demand as producers can be reluctant to close oil wells, even when prices fall below operating costs, as wells can be prohibitively costly to shut down and reopen. Also, the breakdown of the OPEC+ agreement in March triggered an end to their existing production cuts and led to Saudi Arabia announcing it would increase production in April to 12 mb/d.

However, oil production followed suit soon. OPEC+ reached a new production agreement in April that included cuts of 9.7 million barrels per day (mb/d) in May and June 2020, with Russia and Saudi Arabia each reducing production to 8.5 mb/d, a sharp drop from existing levels. The groups' cuts are set to ease to 7.7 mb/d for the second half of 2020 and 5.8 mb/d from January 2021 to April 2022. Among non-OPEC+ countries, most oil companies have implemented substantial cuts in capital expenditure. For example, the rig count in the United States has fallen drastically since March. See Figure 5. Other producers undertook cuts as well. For example, Norway undertook a 0.25 mb/d reduction in June, followed by an expected 0.13 mb/d reduction during the second half of 2020. The U.S. Energy Information Administration expects U.S. production to fall to a low of 11 mb/d in 2020Q4.

Figure 5
Oil Rig Count in the United States



Source: Baker Hughes.

Note: First and last observations are January 3 and October 9, 2020, respectively.

Oil prices have recovered since their April lows, albeit partially, and are projected to average a little higher than $40/bbl in 2020 according to various estimates, followed by a slightly higher average in 2021. These averages stand substantially lower than forecasts made prior to the pandemic. More importantly, the recovery in oil prices may be one of the weakest in history following a major collapse in oil prices (i.e., compared with 1986, 1998, and 2008), reflecting the weakness in oil demand, which dominates any supply response. The price recovery will depend crucially on how much mitigation measures lessen.

However, there are numerous risks to the assumed path of oil prices. These risks include a slower end to the pandemic that could lead to much lower demand than previously forecast. Production could also be higher than expected, particularly if there is non-compliance with cuts among OPEC+ producers. To the upside, substantially weaker investment in new production or a permanent shutdown of some oil wells this year could reduce future production capacity, resulting in a sharper rebound in prices in 2021.

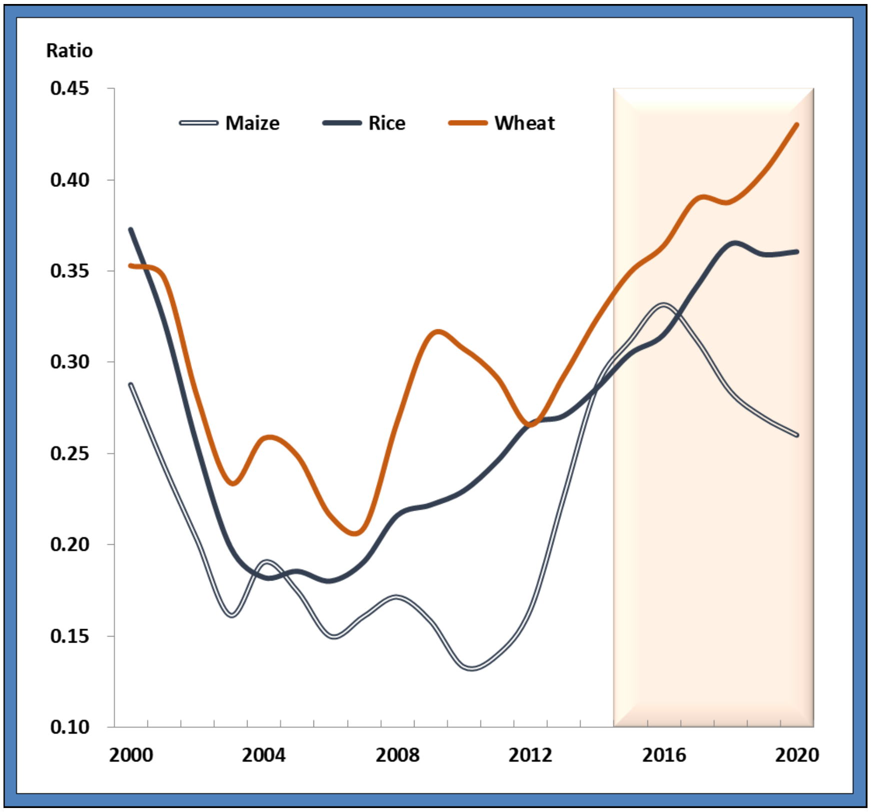
The prices of other energy components declined as well, including natural gas and coal prices, which also fell sharply since the start of 2020 due to weak demand and ample supply. European natural gas prices have fallen to multi-decade lows and are down almost 40 percent since the start of 2020. U.S. natural gas prices experienced smaller declines, in part reflecting their already low levels. Price differentials between regional natural gas benchmarks have continued to decline, helped by the increasing availability of liquefied natural gas (LNG). Coal prices (Australian) declined by around 15 percent over the same period, with weaker demand partially offset by reduced production in China.

However, the fall in natural gas and coal prices has been smaller than for crude oil, which have declined by around 65 percent since January. Natural gas and coal are primarily used for electricity generation and industrial purposes, rather than transport. As such, lockdowns and travel restrictions have had a smaller impact on demand for these commodities than oil.

Agriculture

With a few exceptions, agricultural prices have been remarkably stable since 2015, a reflection of good crops and rebuilding of stocks. The global assessment for the current season (beginning in September 2020), points to abundant supplies for most key grains. According to the U.S. Department of Agriculture's October 2020 update, global production of the three main grains—wheat, maize, and rice—is projected to increase 3.6 percent during this season. Although consumption is set to increase at the same pace, the stocks-to-use ratios for most grains and oilseeds (an approximate measure of supply relative to demand) are expected to reach near historically high levels. See Figures 6 and 7.

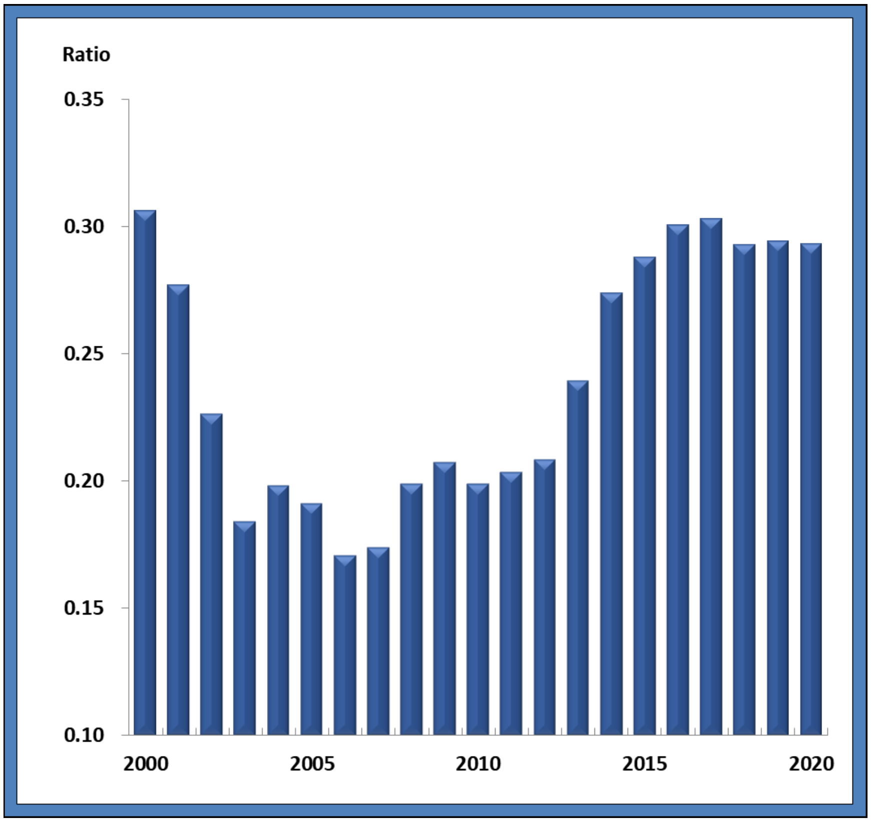
Figure 6
Stocks-to-Use Ratios: Main Grains



Source: U.S. Department of Agriculture (October 2020 update).

Note: Years denote crop seasons (i.e., 2020 refers to the 2020-21 crop season).

Figure 7
Stocks-to-Use Ratios: Aggregate for 12 Commodities



Source: U.S. Department of Agriculture (October 2020 update).

Note: The aggregate stocks-to-use ratio comprises 12 grains and edible oils and has been aggregated according to calorific content. Years denote crop seasons (i.e., 2020 refers to the 2020-21 crop season.)

Numerous factors will affect agricultural commodity markets in the future. The historic decline in energy prices due to the coronavirus is expected to directly impact food commodity markets. Energy is a key input to grains and oilseeds, affecting production directly through fuel costs and indirectly through fertilizers and other chemical inputs. Extended weakness in energy and fertilizer prices could depress food commodity prices, especially grains and oilseeds. Given that the transmission elasticity between energy and food prices is estimated at 0.20, a 30 percent drop in energy prices, for example, could reduce food prices by 6 percent. Although both energy and fertilizer prices are expected to recover (albeit, modestly) in 2021, most of the price risks of these two inputs, especially the former, are on the downside.

Projected stabilization (or even decline) in biofuel production could result in subdued demand for certain food commodities. Biofuels have been a key source of demand growth for some food commodities, especially during 2005-15. In fact, biofuels have often been cited as one of the drivers of the 2007-08 and 2010-11 food price spikes. However, the collapse in the transport sector as a result of the pandemic implies less use of fuel and, hence, biofuels. Depending on the stringency of travel restrictions, the decline in biofuel consumption could exert further downward pressure on some food commodities, especially maize, edible oils, and sugar.

Macroeconomic conditions could exacerbate downward price risks. The U.S. dollar will likely play an important role in most non-energy commodities, especially key grains and oilseeds that are traded internationally and are priced in U.S. dollars. Indeed, the weakness in some commodity prices during the first quarter of 2020 along with the recent recovery can, in part, be attributed to dollar movements. Research has shown that a 10 percent appreciation in the dollar against major currencies is associated with a 5 percent decline in prices of internationally traded commodities. Similarly, the price outlook will be affected by currency depreciations in countries that account for a large share of global trade in individual commodities.

Metals

Metals prices experienced declines following COVID-19 (albeit, much less than oil) but reversed course quickly following a quicker-than-expected rebound in China's industrial activity; China accounts for more than half of global metal demand, thus changes in its industrial activity affect most metal markets considerably. Demand for metals also began to pick up outside of China after lockdown measures eased in Europe and the United States. The improving sentiment for metals has been reflected in a recovery of copper prices – a barometer of the health of the global economy.

Copper and zinc prices have been supported by several pandemic-related mine closures. For example, Peru's zinc production plunged more than 85 percent and copper production fell 35 percent in April. Although Peruvian mines have started to reopen, supply concerns remain elevated due to the possibility of abrupt production stoppages as COVID-19 cases have yet to subside. Supply in Chile, the world's largest producer of copper, has held up relatively well as quarantines and movement restrictions have been less stringent and mines have largely maintained operational continuity. However, copper mine worker unions are demanding more transparency from the government on the COVID-19 outbreak following an alarming rise in COVID-19 cases among miners, leading the state operator Codelco to suspend one of its smelting and refinery operations.

Among base metals, tin has been the least affected by the pandemic. For example, tin prices in June were at about the same levels as the beginning of the year. Global tin supply concerns had already been brewing for some time, particularly after Indonesia tightened export regulations and amid declining mine production in Myanmar. COVID-19 lockdowns in Bolivia, Malaysia, and Peru further added to supply pressures, which have supported tin prices. Tin inventories at the London Metal Exchange and Shanghai Futures Exchange declined sharply during the pandemic. Global supply concerns have re-emerged despite the restart of operations at Vale's iron ore Itabira complex in Brazil. Vale's iron ore production had struggled to recover following a tailings dam accident in early 2019. As noted above, the dominant risk in metals markets emanates from China's industrial production activity, which as of early October turned out to be much more resilient than expected.

Long Term Implications of the Pandemic

Moving forward, the impact of COVID-19 may lead to long-term shifts in global commodity markets, which will affect both commodity exporters and importers. Such shifts relate to oil consumption, transportation, unwinding of supply chains, increasing substitution among commodities, and most importantly, changes in consumer behavior.

Oil Consumption

Global oil consumption is projected to decline by as much as 10 percent in 2020 from its nearly 100 million barrels per day in 2019. Although some recovery is expected in 2020, several analysts have argued (including the 2020 edition of BP's Energy Outlook) that 2019 may have been the year during which global oil consumption peaked, marking a considerable revision to earlier projections which placed the "peak demand" year in the early 2030s. For example, in its 2019 Energy Outlook, the International Energy Agency projected that global oil consumption would plateau around 2030. It is worth noting how quickly the focus has turned to "peak demand" – which emerged after the 2014 price collapse – from "peak oil production" only a few years earlier.

Transport Costs

Enhanced border checks arising from COVID-19 concerns may permanently increase the cost of transporting commodities, thus reducing trade flows. This occurred in the aftermath of the September 11 attacks, when additional border checks and security measures were introduced, increasing transport costs. However, the ultimate effect of COVID-19 on transportation costs will also depend on the balance between office and home-based work arrangements, and the demand for services provided by the hospitality industry.

Unwinding Supply Chains

Companies with complex global supply chains may find that disruptions are too costly and opt to move operations back to their home countries ("reshoring"). This may be exacerbated by national security concerns regarding the reliability of supply of critical equipment, such as personal protective equipment, which would favor local production. These shifts could result in the unwinding of global value. For some commodity markets, such a development could potentially lower transport demand if it reduces shipping distances. All else equal, this would result in permanently lower oil demand, as value chains are more transport-intensive than other forms of trade.

Increasing Substitution among Commodities

Higher transport costs could induce substitution between domestic and imported commodities and thereby promote use of domestic resources. If exact replacements are costly or unavailable domestically, the use of substitutes may occur, such as the use of domestically produced glass in drinks packaging instead of imported aluminum. Substitution could take place within the same group of commodities (say, among metals as some metals are heavily used in transportation while others are used in construction) or between natural and synthetic products.

Changing Consumer Preferences

The mitigation measures implemented in many countries may lead to shifts in consumer habits and the exacerbation of existing trends, especially if partial lockdowns are extended well into 2021. The trend toward remote working is likely to accelerate, as the pandemic has forced companies to invest in necessary equipment, infrastructure, and processes to facilitate it. Once mitigation measures are lifted, a greater number of workers may continue operating remotely, which would reduce commuter journeys and demand for fuel. Similarly, businesses may reduce foreign travel in favor of video conferencing and other remote alternatives. The reduction in pollution resulting from the current restrictions on travel may also lead to greater pressure to implement stricter environmental standards, as the benefits of lower fossil fuel consumption (and lower pollution) become more apparent. Eventually, how much consumer habits will change will depend on whether mitigation measures against COVID-19 (either treatment or vaccine) become effective and widely available.

Endnote

1 This article draws heavily from the April and October 2020 editions of the *Commodity Markets Outlook*. Responsibility for the content remains solely with the author and should not be attributed to the World Bank.

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Dr. John Baffes, currently a member of the World Bank's Prospects Group, heads the Commodities Unit and is in charge of the *Commodity Markets Outlook*, a World Bank publication focusing on commodity market analysis and price forecasts. Dr. Baffes' experience spans several regions and units, including Latin America, South Asia, East Africa, Evaluation, and Research. He specializes in commodity markets analysis and resource economics.

Dr. Baffes, whose work appears in media outlets and academic journals, also teaches an executive M.B.A. course on Applied Econometrics for Commodity Markets. Prior to entering graduate school, Dr. Baffes managed a commodity trading company. He holds degrees in Economics from the University of Athens, Greece (B.S.), University of Georgia, U.S. (M.S.), and University of Maryland, U.S. (Ph.D.).

The "Necessary Evil" in Chinese Commodity Markets

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Available at SSRN: https://ssrn.com/abstract=3459898

The paper investigates the impact of enormous capital inflows into commodity futures markets in China. Mimicking the positions of both passive long and systematic long-short speculators, the study finds increased speculation does not give rise to higher volatilities and co-movements, nor distorts the market's association with economic fundamentals. Moreover, long-short speculators who trade on commodity fundamental information contribute positively to price discovery by reducing the broad market volatility and cross-correlation with stocks. Overall, intensified speculation did not have an adverse impact on the broad Chinese commodity futures market.

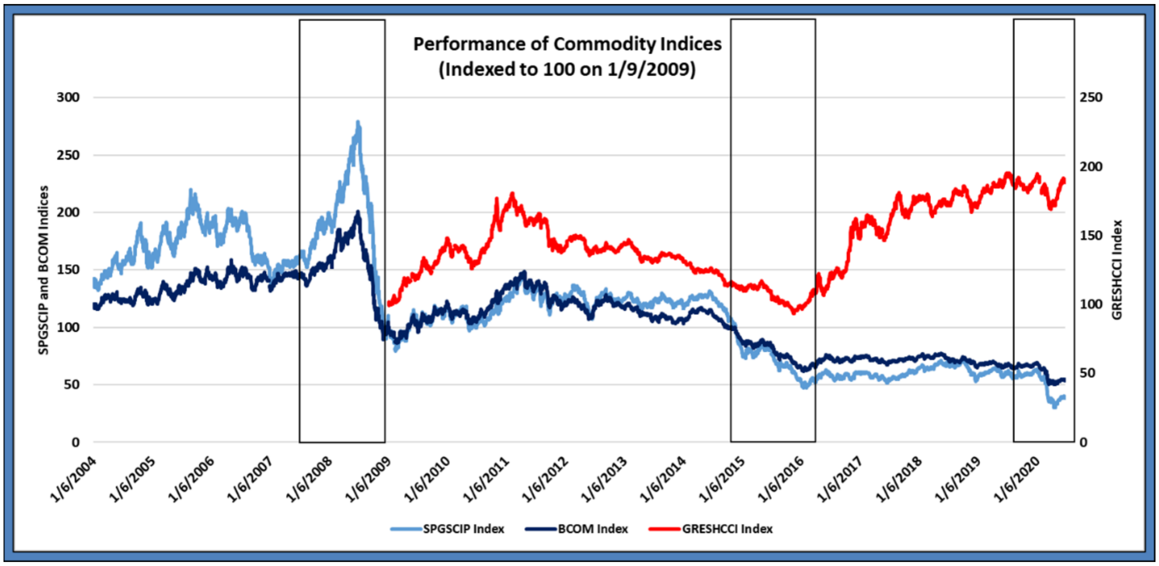
Introduction

From a "market darling" to an "unwanted child," the global commodity futures market has seen dramatic swings since the beginning of the 21st century. Enormous capital inflows pushed prices to all-time-highs in 2008, followed by a steep sell-off during the global financial crisis. In 2014, commodity price benchmarks collapsed as investment banks exited from commodity businesses. While the investment world readied for the return of commodities in 2019, the COVID-19 pandemic sent commodity prices into the ground (see the BCOM and SPGSCIP indices in Figure 1 on the next page).

The dramatic rise and fall of commodity prices over the past decades stirred up intense academic debate around the impact of futures speculation on commodity prices and the economic function of commodity markets. The mainstream media went as far as calling commodity speculators "evil" (*The Economist*, 2010), claimed that speculation "kills people" (*Forbes*, 2011) and has made the "markets impossible to trade" (*Reuters*, 2018).

This digest article was written by John Hua Fan, Ph.D., Senior Lecturer in Finance, Griffith Business School, Griffith University (Australia). Dr. Fan is also a member of the GCARD's Editorial Advisory Board.

Figure 1



Source of Data: The Bloomberg.

Note: The SPGSCIP Index is the S&P GSCI Excess Return Index; the BCOM is the Bloomberg Commodity Excess Return Index; and the GRESHCCI Index is the Caixin Gresham China Commodity Long-Only Index.

While the West ponders the fate of commodity futures as an asset class, a new commodities market has quietly emerged from a seemingly unsusceptible place in the East (see GRESHCCI in Figure 1). Fueled by the enormous growth in trading volume and the colossal demand for physicals, Chinese commodity futures have become increasingly influential. Unlike developed markets, China's commodity futures market is: i) dominated by retail investors; ii) heavily influenced by the state; and iii) highly speculative (Fan and Zhang, 2020). This paper investigates the impact of a "speculative mania" (Sanderson, 2016; Gu, 2016) in Chinese commodity futures since 2004. The findings shed light on the impact of speculation on: (1) the broad commodity market volatility; (2) commodity price co-movements; (3) correlations with traditional assets; and (4) linkages with the macroeconomy in China.

Why the Paper's Research Questions are Important

The research questions are important for two main reasons. First, the dramatic uptake in Chinese commodity futures trading raised concerns about the impact of speculative capital flow on the functioning of commodity markets in China. To provide some context, the aggregate trading volume in China is more than 200 times larger than open interest compared to just over 20 times in North America.[1] However, the complexity of Chinese commodity markets is poorly understood in the literature. This study incorporates the unique liquidity patterns on futures curves (as outlined in Fan and Zhang (2020)), and separately analyzes the roles of passive long-only and systematic long-short speculators in a broad sample of commodities across all sectors. Furthermore, in light of the recent effort on easing market access, this study aids in the development of the regulatory framework that will accommodate future investors outside of China.

Dr. John Hua Fan, Ph.D., Senior Lecturer, Griffith Business School, Griffith University, Australia, and Editorial Advisory Board Member, *Global Commodities Applied Research Digest,* during one of his international lectures.

Second, the literature on commodity financialization is predominately based on developed markets. This debate continues to date, with some studies arguing speculation provides liquidity, decreases the risk premium, cost of hedging and market volatility in the long term (Kim, 2015; Brunetti *et al*., 2016), while other studies criticize speculation for increasing volatility, correlations with traditional assets, and causing price bubbles (Tang and Xiong, 2012; Cheng *et al*., 2015). Therefore, this paper offers fresh insights into the role of speculators from an emerging commodities market that is segmented from the U.S. due to barriers-to-entry.

Data

Futures price, volume and open interest are sourced from Datastream International. The sample consists of 30 commodities traded on the Dalian (DCE), Shanghai (SHFE) and Zhengzhou (ZCE) exchanges, spanning from 2004 to 2017. Financial variables include CSI300, Shanghai, and Shenzhen composite stock indices, the Barclays China Aggregate Bond Index, and the 1-year and 10-year Chinese government bond yields. For Chinese macroeconomic variables, the study employs the GDP growth rate, Economic Climate Index (ECI), Consumer Price Index (CPI), Producer Price Index (PPI) and RMB Effective Exchange Rate Index

(REER). Financial and macroeconomic variables are obtained from China’s National Bureau of Statistics, Bank for International Settlements, Bloomberg and Wind.

Methodology

Investors are assumed to hold the mth (where m = 1, 2, 3, 4) nearest contracts until the last trading day before the front contract enters the delivery month. As highlighted by Fan and Zhang (2020), the study employs the third nearest contracts to analyze speculative activities, because front contracts only account for a small fraction of the total volume in China. Due to the absence of trader positions data (e.g., CFTC Commitments of Traders reports), the speculation ratio (i.e., volume/open interest) is utilized to measure the speculative intensity in the Chinese markets (See Garcia *et al*. (1986)).

To measure the speculative pressure of systematic long-short investors, the authors mimic the trading positions of various well-established styles including momentum (Miffre and Rallis, 2007), term structure (Gorton *et al*., 2013), and hedging pressure (Basu and Miffre, 2013). Following Miffre and Brooks (2013), the study conducts Granger-causality tests to investigate whether increased speculation (both passive-long and long-short) has led to increases in market volatility, inter-commodity co-movements and cross-correlations.

Key Results

The authors conclude that the increased presence of speculators in commodity futures markets in China did not give rise to volatility. While passive speculative positions in twenty of the most actively traded commodities do not elevate the volatility of the broad market or sectors, systematic long-short speculators who trade on roll-yields and hedging pressure exhibit a tendency to decrease the broad market and sector volatilities (Kim, 2015; Brunetti *et al*., 2016). The volatility reductions are more pronounced among energies and metals.

Furthermore, the study finds that increased speculation did not cause individual commodity futures markets to become more correlated. Long-only and long-short speculators who follow trends do not exhibit any significant causal effects on market-wide or sector-specific co-movements. In fact, systematic speculators who trade on hedging pressure reduce the co-movements among grains. Janzen, Smith, and Carter (2017) posit financial speculation causes excessive commodity price co-movements, driving prices away from rational expectations (see also Le Pen and Sévi, (2018)). In this paper, the authors fail to find conclusive evidence indicating that passive long or systematic long-short speculators played a role in affecting commodity price co-movements in China.

Meanwhile, increased speculative pressure did not elevate the broad commodities market’s correlation with traditional assets in China. Tang and Xiong (2012) argue the large inflow of financial capital to the long side of commodity futures markets likely increases the risk-sharing function of the commodities market by integrating the previously segmented commodity markets with outside financial markets. The finding of this study suggests that the increased presence of speculators did not affect the risk-sharing function of commodity markets in China on an aggregate level. This can be explained in part by the absence of commodity investment vehicles readily available to investors. In fact, systematic long-short speculators who were sophisticated enough to exploit mispriced commodity futures using fundamentals such as scarcity (i.e., roll-yield or basis) and hedging pressure signals tend to reduce cross-market correlations.

Finally, the authors point out that evidence indicating speculation distorts the broad commodities market's link with the Chinese macroeconomy is weak. Consistent with U.S. findings (Gorton and Rouwenhorst, 2006), the broad commodity markets in China are related to domestic economic growth, inflation and the RMB. The study finds that long-only speculators exhibit the tendency to decrease the broad market's correlations with GDP and ECI (Economic Climate Index). Furthermore, speculators who trade on commodity fundamentals tend to reduce the market's correlation with the ECI, suggesting that speculative activities may have caused prices to deviate from economic fundamentals. On the other hand, trend-followers tend to intensify the commodities market's correlation with the RMB exchange rate. However, these findings are weak statistically.

Conclusion

In summary, this article examines the impact of the increased speculation on Chinese commodity futures markets. Changes in the speculative pressure of both passive long-only and systematic long-short traders are captured. The increased presence of speculators in China did not lead to higher market volatility, nor elevate commodity co-movements and cross-market correlations, or distort the market's link with the macroeconomy. Long-short systematic speculators likely played a role in stabilizing the broad market volatility and reducing the cross-correlations with stocks. Thus, the authors conclude that speculators are a necessary "evil" in Chinese commodity futures.

Endnote

1 The data on the American markets are from the U.S. Futures Industry Association (FIA): https://fia.org/articles/fia-releases-annual-trading-statistics-showing-record-etd-volume-2018; and the data on the Chinese markets are obtained from the China Futures Association: http://www.cfachina.org/yjycb/hysj/ydjy/201901/t20190102_2636927.html.

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Keywords

China, commodity futures, speculators, volatility, co-movement, correlation.

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The Role of Academics and Empirical Studies in Evaluating Futures Markets

Summarized by Hilary Till
Contributing Editor, *Global Commodities Applied Research Digest*; Solich Scholar, J.P. Morgan Center for Commodities, University of Colorado Denver Business School; and Principal, Premia Research LLC

Hilary Till, (right) Contributing Editor of the *Global Commodities Applied Research Digest* (*GCARD*), presenting on investment opportunities in commodities at the Chicago Mercantile Exchange. To Ms. Till's left, is Liang (Katie) Tian, former Vice President, Nanhua USA Investment in Chicago.

A number of empirical studies, mainly from academic researchers, have been crucial in the debate on the economic role of futures trading. This article briefly summarizes the literature covering these influential studies with a focus on agricultural futures contracts, financial futures contracts, and the transparency of data.

Role of Academics with Respect to Agricultural Futures Contracts

"Starting in the Populist era – the 1880s to 1915 – people began to associate the futures markets with soaring food prices and other economic upheavals that were reshaping society …"; as a result, "[American] federal lawmakers introduced more than one bill per year from 1884 to 1953 to ban futures markets, which were derided as 'engines of wrong and oppression,'" explained Maulsby (2011), citing a presentation by Professor Scott Irwin of the University of Illinois. Irwin named the "three agricultural economists … [who] played a crucial role in changing perceptions of the futures markets as valuable market institutions." These three economists were Holbrook Working, Roger Gray, and Thomas

Hieronymous. "These economists showed that the futures markets are not mere speculative vehicles, but they contribute to the economic welfare of society by making the system more efficient," according to Irwin.

Holbrook Working

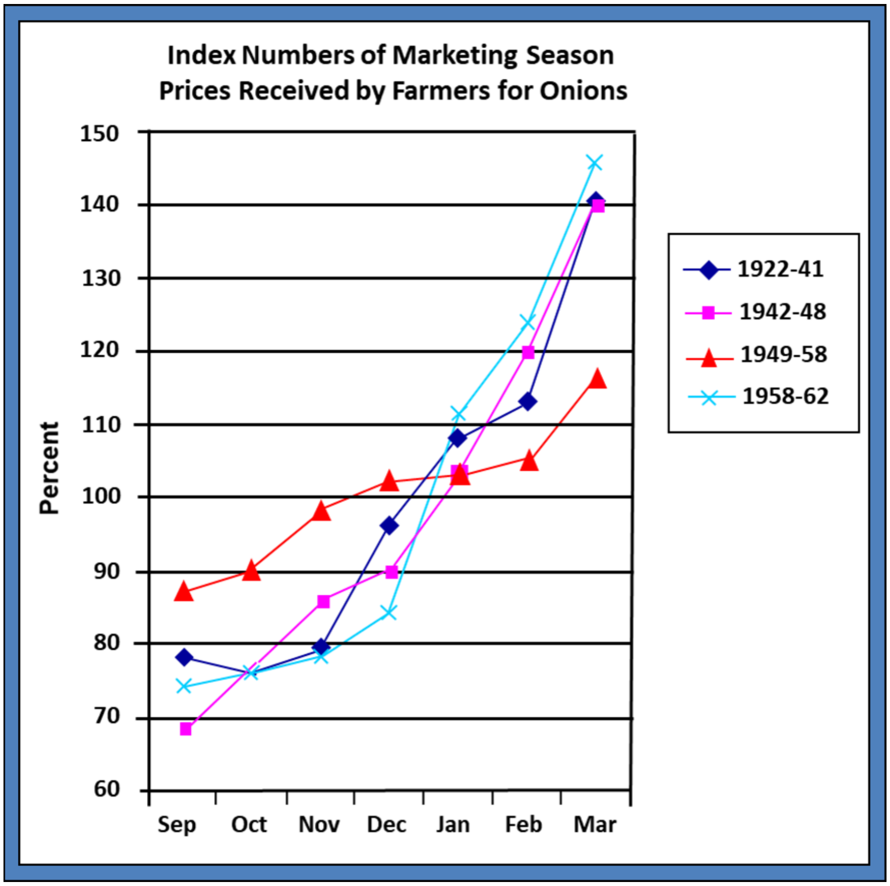
Professor Working "challenged the misperception that futures markets are driven by speculators. His work from the 1950s still resonates today …", noted Irwin in Maulsby (2011). Working (1970) described how fragile the existence of the futures-trading business in Chicago had been since its inception in the nineteenth century. He also described how the Grain Futures Administration[1] in the 1940s had been led by statisticians who were trained in the natural sciences and who therefore allowed the data to provide answers to important policy questions. Judging by the Commodity Futures Trading Commission's (CFTC's) continued exhaustive data-gathering efforts, one can say that this tradition is continuing. A key Working principle is that a futures contract has to be commercially useful to hedgers. Traditionally, once hedgers are attracted to using a futures market, speculation follows, and not the other way around.

Roger Gray

Professor Gray "argued that a futures market widens opportunities to buy a commodity during the harvest surplus and sell the commodity later," explained Irwin in Maulsby (2011). According to Otte (2012), "In the mid-1950s onions represented 20% of U.S. futures trading volume. Demand for onions is highly inelastic. Old-crop onions that have been in extended storage are worthless when new crop becomes available. Harvest delays can create supply shortages. When price volatility skyrocketed, critics blamed speculators. They rallied their legislators. In 1958 Congress outlawed futures trading in onions."

Otte (2012) recalled that "Stanford University economist Roger Gray plotted marketing season cash onion price volatility for time periods before, during and after the 1956 to 1958 period when speculators were charged with boosting price volatility." This chart is reproduced on the next page as Figure 1. "Gray's chart shows onion prices actually had less seasonal volatility during the time when critics were blaming futures for creating more volatility than prices had before that time and after futures were banned," summarized Otte (2012).

Figure 1



Source of Graph: Otte (2012), citing Professor Scott Irwin, based on Gray (1963).

Thomas Hieronymous

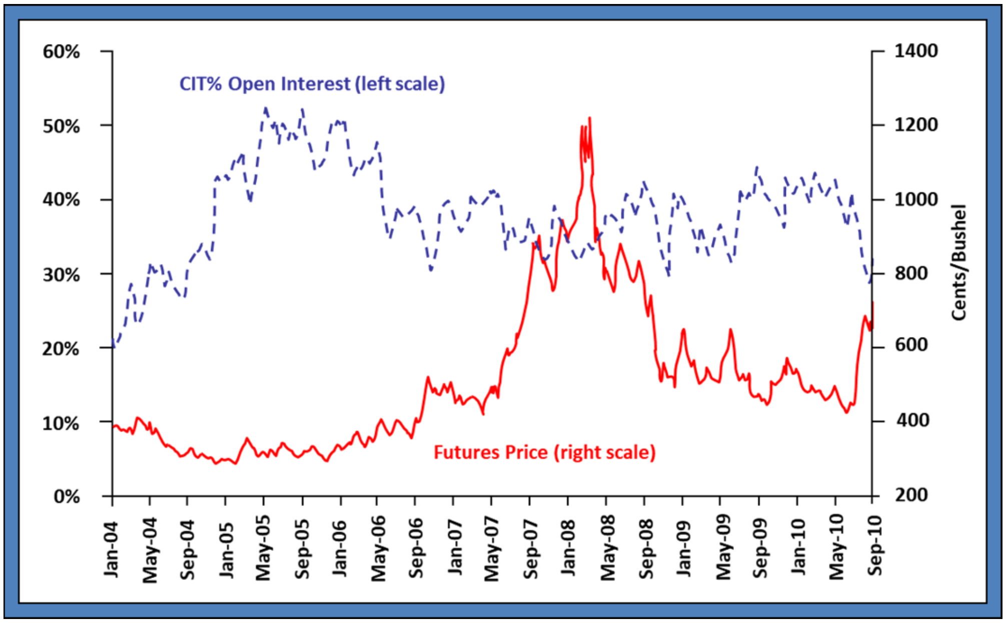
Professor Hieronymous popularized "the futures markets in the 1950s and 1960s … Dr. Hieronymous … [had a] gift for explaining things clearly and … [had a] genius for penetrating the mysteries of the futures markets," according to Irwin in Maulsby (2011).

<u>Scott Irwin</u>

Scott Irwin, Ph.D., Laurence J. Norton Chair of Agricultural Marketing and Professor in the Department of Agricultural and Consumer Economics at the University of Illinois at Urbana-Champaign, presenting at a JPMCC international commodities symposium. Professor Irwin is a member of the JPMCC's Research Council.

More recently, the crucial role for academics has reverted to defending futures markets rather than in pushing the frontiers of innovation. Professor Scott Irwin of the University of Illinois picked up the baton of his agricultural economist predecessors in carrying out empirical studies on the role of various types of market participants in grain price formation. Professor Irwin examined commodity index investor participation in the wheat market, for example. As seen in Figure 2 on the next page, "Irwin plotted holdings of index funds in front-month Chicago soft red winter wheat futures contract and price action of the contract. The funds accumulated positions in 2005 and 2006. Prices really didn't rally until mid-2007. Concluding that fund buying in 2005 and 2006 drove the price rally that occurred two years later is a stretch," stated Otte (2012).

Figure 2
Commodity Index Trader (CIT) % of Open Interest and Nearby Futures Price in CBOT Wheat, January 6, 2004 – September 9, 2009



Source of Graph: Otte (2012), citing Professor Scott Irwin.

Role of Academics with respect to Financial Futures Contracts

Milton Friedman: Currency Futures

Recalled Melamed (1994), "At the behest of the CME, Dr. Milton Friedman authored a study in December 1971 which became the intellectual foundation for the birth of currency futures … His paper, entitled 'The Need for Futures Markets in Currencies,' provided the CME administration with academic authenticity of the highest magnitude to prove that their theory was a viable necessity."

Hilary Till, (left) Contributing Editor of the *Global Commodities Applied Research Digest* (*GCARD*), with **Leo Melamed**, (right) Chairman Emeritus of the CME Group. Mr. Melamed was interviewed in a past issue of the *GCARD* on financial and technological innovation, past and present.

Nathan Report: Chicago Board Options Exchange

Mackenzie (2006) described how the Chicago Board of Trade also "sought legitimacy from economists." "In 1969, it sought an assessment of the proposal for an options exchange from a leading economic consulting firm, Nathan Associates … For its report on [equity] options, Nathan Associates turned for assistance to … MIT's Paul Cootner, the University of Chicago's James Lorie and Merton Miller, and … Princeton['s] … [Burton] Malkiel, [Richard] Quandt, and … William Baumol. [These academics] … provided Nathan Associates with an analysis of the [positive] impact of an options exchange on 'the public interest'," according to Mackenzie (2006).

Transparency of Data for Empirical Studies

Early Work

Thus far, futures trading has survived frequent challenges because market-participant data and positions have been made transparent. This transparency has meant that researchers have been able to carry out objective, empirical studies to prove or disprove the benefits (or burdens) of exchange-traded futures trading, dating back to at least 1941 with the release of the USDA's Hoffman and Duvel report.

Long-Term Study

Professor David Jacks examined what happened to commodity-price volatility, across countries and commodities, before and after specific commodity-contract trading has been prohibited in the past. Jacks (2007) also examined commodity-price volatility before and after the establishment of futures markets, across time and across countries. Jacks' study included data from 1854 through 1990. He generally, but not always, found that commodity-price volatility was greater when there were not futures markets than when they existed over 1-year, 3-year, and 5-year timeframes.

CFTC Data and Studies

The transparency in futures markets has allowed researchers to examine data to determine what precisely is impacting the market. With this data, for example, one can examine the oil price spike of 2008. Could it have been that commodity index investments in 2008 actually caused the 7-month oil-price rally that culminated in July of 2008? This is an unlikely cause, given that total over-the-counter and on-exchange commodity index investment activity in oil-futures-contract-equivalents actually declined from December 31, 2007 through June 30, 2008, as shown in the left-hand-side of Figure 3 on the next page.

An analysis in late 2009 by J.P. Morgan researchers also examined the CFTC's Disaggregated Commitments of Trader data. During the 12 months from July 2007, "when oil prices spiked from $80 to $145 per barrel, banks and fund managers were steadily taking profit on their longs in oil futures contracts, correctly anticipating the eventual fall in oil prices," informed the researchers. This is illustrated on the right-hand-side of Figure 3. Net positions of banks and fund managers are shown in the red line, and oil prices are illustrated in the dark blue line. Again, note that the scale of these speculative positions was decreasing as the price of oil was spiking.

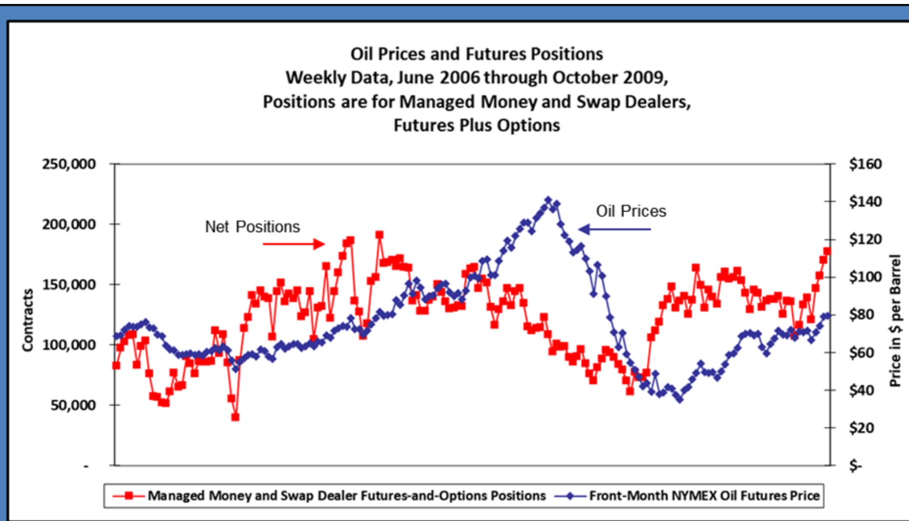
Essentially, the J.P. Morgan researchers found that prices and positions were correlated through common reactions to fundamental information. Specifically, from 2006 to 2009, the variability of oil prices can be shown to be "mostly due to changes in the U.S. Dollar, changes in oil market tightness, and expectations of future changes in oil inventories," concluded Ribeiro *et al.* (2009).

Figure 3
CFTC Data and Studies: Prices and Positions During the Oil Price Spike of 2008

Excerpt From
Staff Report on Commodity Swap
Dealers & Index Traders
With Commission Recommendations

Total OTC and On-Exchange Commodity
Index Investment Activity

	Crude Oil Index Values Measured in Futures [Contract] Equivalents
12/31/2007	408,000
3/31/2008	398,000
6/30/2008	363,000



Source: CFTC (2008). Source: Graph Based on Ribeiro *et al.* (2009), Chart 1.

More evidence on the impact of transparency of data in commodity markets was cited in a May 2010 *Wall Street Journal* article (Lynch, 2010). The reporter obtained unreleased Commodity Futures Trading Commission reports through a Freedom of Information Act request. CFTC staff had found that for crude oil prices from January 2003 to October 2008, price changes led position changes, rather than the other way around. See Figure 4 on the next page. If speculators were indeed driving price changes, one would have expected their position changes, instead, to have led price changes. "Price changes that systemically precede position changes indicate reactive behavior by a particular trading group," noted CFTC researchers in ITF (2009).

Figure 4
CFTC Data and Studies: Oil Futures Price Changes and Position Changes

Trader Classification	Hypothesized Direction of Causality					
	Price Changes lead Position Changes			**Position Changes lead Price Changes**		
	Direction	Significant?	P Value	Direction	Significant?	P Value
All Commercials (includes Manufacturers, Commercial Dealers, Producers, Other Commercial Traders, and Swap Dealers)	+	Yes	.000	-	*No*	.418
Manufacturers	+	Yes	.000	-	*No*	.225
Commercial Dealers	+	Yes	.000	-	*No*	.130
Producers	+	Yes	.036	-	*No*	.160
Other Commercial Traders	-	*No*	.623	-	*No*	.918
Swap Dealer	-	Yes	.001	-	*No*	.582
All Non Commercials (includes Hedge Funds, Floor Brokers & Traders)	-	Yes	. 000	-	*No*	.451
Hedge Funds	-	Yes	.000	-	*No*	.510
Floor Brokers & Traders	-	*No*	.683	-	*No*	.351
Non Registered Participants	-	*No*	.873	-	*No*	.575
All Non Commercials combined with Swap Dealers	-	Yes	.000	-	*No*	.251

Source of Table: Büyükşahin and Harris (2008).

NB: Their study uses daily data from January 2003 to October 2008.

Conclusion

Empirical studies have provided essential information regarding the economic role of futures trading. The key lessons from the past work are to constantly revisit the economic usefulness of commodity futures trading; insist upon transparency in market-participation and position data in a sufficiently disaggregated fashion as to be useful, but also in a sufficiently aggregated fashion as to not violate individual privacy; and that empirical studies should be carried out to confirm or challenge the benefits and/or burdens of futures trading.

Endnotes

This article is excerpted from a seminar that Hilary Till provided in Chicago to staff from the Shanghai Futures Exchange.

1 The Grain Futures Administration (1922 to 1936) and the Grain Futures Commission (1922 to 1936) preceded the Commodity Exchange Administration (1936 to 1942), Commodity Exchange Authority (1947-1974), and the Commodity Exchange Commission (1936 to 1974). The Commodity Exchange Commission and the Commodity Exchange Authority merged in 1974 to form the present Commodity Futures Trading Commission [CFTC].

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Chinese Demand Bailed Out Base Metals Prices But Is A Property Red Flag Rising?

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Gregory Shearer
Vice President, Global Commodities Research, J.P. Morgan

It has been roughly six months since the Bloomberg Industrial Metals Sub-index hit a low on March 23. The nearly 30% rebound from the low has essentially fully unwound the 23% free-fall in prices from late-January through March. The sharp 1Q20 sell-off fully met the technical requirements of a bear market for base metals. However, market developments since have bucked the traditional recession playbook. Typically, a recessionary collapse in commodities demand is so extensive that it pushes prices low enough for long enough to breach through cost support levels, eventually triggering a rebalancing response from supply. Though this time around, the swift and impactful deployment of metals-heavy stimulus in China has driven a sharp V-shaped recovery in base metals prices without significant cuts in global production.

So Very China in 2008-09

The COVID-19 crisis has led many governments to massively boost spending, in as little time as possible. For its part, Beijing has released a flurry of stimulus measures to offset the economic shock caused by the pandemic and revive the economy. Among the measures, the government unveiled a fiscal package of nearly RMB 3.6 trillion ($506 billion) and approved RMB 1 trillion of unconventional special treasury bonds, the first issuance of these types of bonds since 2007. It also boosted the borrowing limits of local governments by another RMB 1 trillion by increasing the total issuance of special purpose bonds to RMB 3.75 trillion, another source of infrastructure funding (see Figure 1 on the next page).

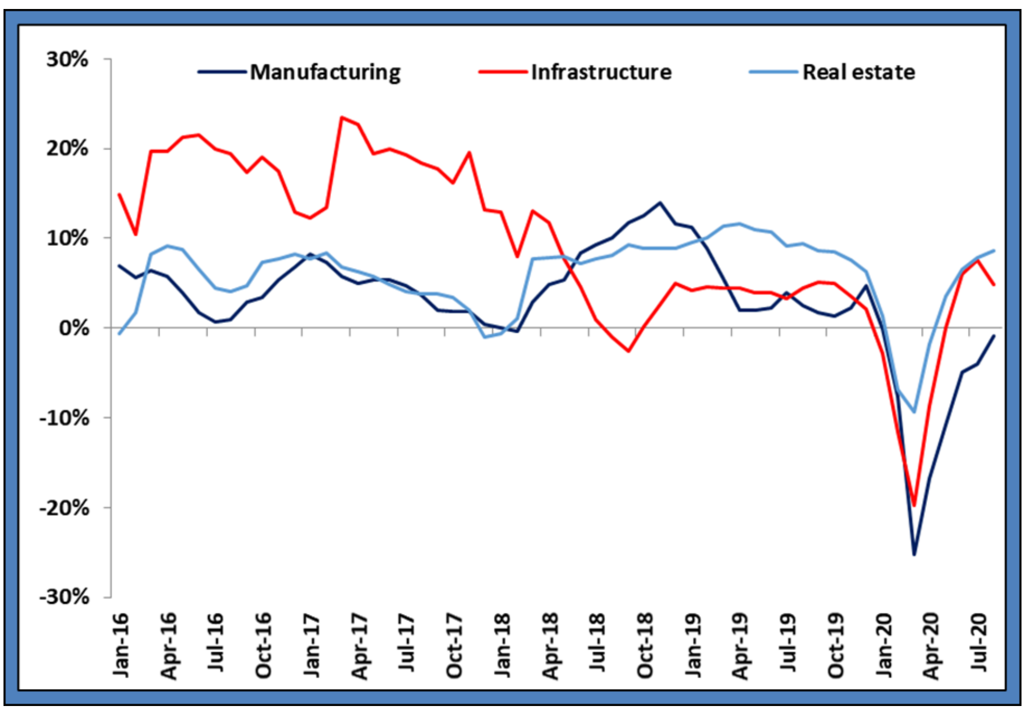
China's fiscal stimulus package is significantly smaller than that of the U.S., which has already approved close to $3 trillion in spending. But unlike the U.S., where the recovery package propped up household incomes (and hence consumption), China's economic performance so far suggests that most of China's policy support has gone to the traditional cyclical drivers of housing and infrastructure – a vital precondition for a cyclical upturn in commodities markets. Although policy support has been conservative in overall size, these sectors are still leading the recovery with August economic activity data showing continued recovery in export, infrastructure, real estate and the auto sector amid a widening recovery in lagging consumer demand (see Figure 2 on the next page).

Figure 1
China's Stimulus Measures

Years	Size of stimulus: Trillion RMB	Size of stimulus: as % of previous year's GDP	Policy focus	Infrastructure investment growth	RRR cuts	Interest rates cuts	TSF growth	Augmented fiscal deficit as % of GDP	Easing in housing regulation?	USD/CNY performance	Base Metals index performance
2008-2009	4.0	11.5%	Infrastructure and real estate	47.2% in 2009	3x, 200bp	5x, 216bp	17.5% in Oct'08 to 35.3% in Jan'10	4.9% in 2008 to 13.7% in 2009	yes	flat	+112%
2012-2013	-	-	Infrastructure	4.3% in 1H12 to 16.7% in 3Q13	3x, 150bp	2x, 56bp	15.7% in May'12 to 21.6% in Apr'13	7.7% in 2013 to 10.6% in 2014	no	~3.0% appreciation	-6.0%
2015-2016	4.0	5.4%	Infrastructure and real estate	17.2% in Dec'15 to 27.3% in Jan'17	5x, 300bp	6x, 165bp	12.3% in May'15 to 16.1% in Apr'16	8.1% in 2Q15 to 11.0% in 2Q16	yes	~12% depreciation	+20%
2018-2019	5.6	5.6%	Consumption through tax cuts	3.8% in 2018 and 2019	6x, 400bp	1x, 5bp	10.3% in 2018 10.7% in 2019	10.5% in 2018 to 11.9% in 2019	no	~7% depreciation over '18 & '19	-16% over '18 & '19
2020 announced to date	8.51	8.6%	Stable employment, protection of market entities, targeted credit support to sectors like SMEs and manufacturing	-0.3%oya ytd in Aug; expect 3.1%oya in full year 2020	1x, 50bp cut in Jan	2x, total 30bp cut in 1Y MLF	13.3%oya ytd; expect 13.5%oya by end-2020	From 11.9% of GDP in 2019 to 15.1% of GDP in 2020	Local support	~2% depreciation ytd	+1% ytd (+25% since end of 1Q20)

Sources: National Bureau of Statistics, J.P. Morgan Commodities Research.

Figure 2
Growth in China Fixed Asset Investment by Type
Percent change, yoy (3mma)

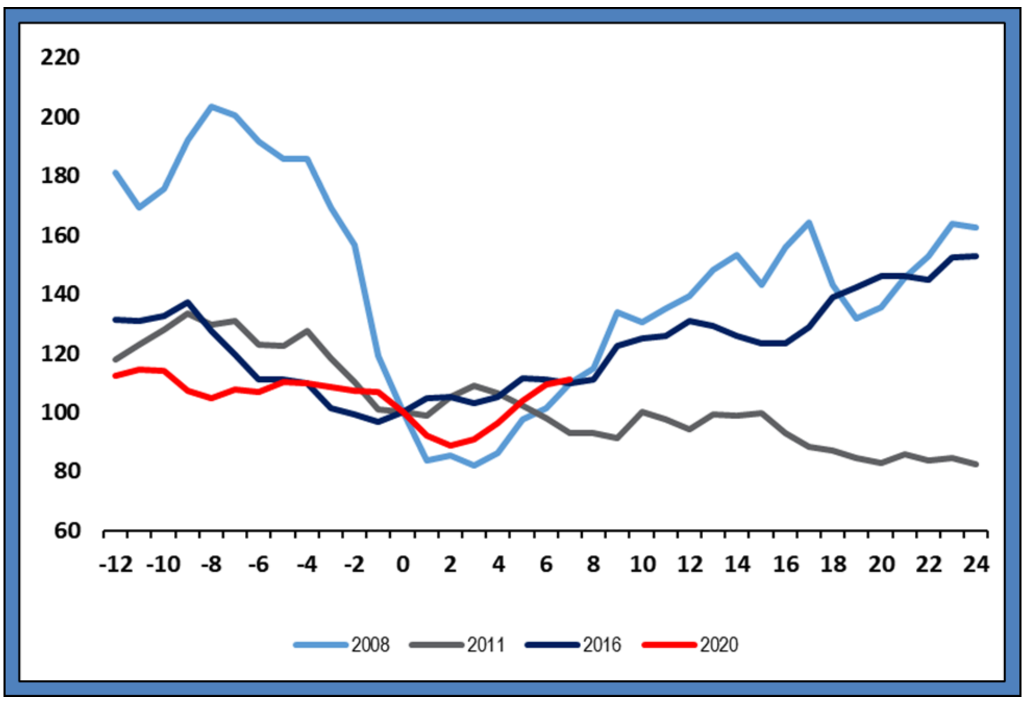


Source: National Bureau of Statistics.

Risk Rising of China's Property Market Overheating

That being said, the latest data out of China also raised a red flag for us: the risk that housing policy support in China could be curtailed amid signs of overheating. China's property market is single-handedly responsible for up to 40% of China's copper demand (if adding supplementary demand sources like home appliances and grid connectors) and 20% of global consumption. As such, the health of the sector is paramount for industrial metals returns. The performance of base metals over three previous episodes of Chinese stimulus (2009, 2012, and 2016) are telling in this regard (see Figure 3). China's reluctance to stimulate the housing market during the 2012 intra-cyclical slowdown was followed by 20% declines in industrial metals prices, one year into the Purchasing Managers' Index (PMI) uplift. During the second intra-cycle rest of 2015-2016, China opted to stimulate the property market. The performance for the industrial metals complex was decisively more impressive, returning 31% one year after the bottom in global manufacturing PMI.

Figure 3
BCOM Industrial Metals Sub-Index Performance 36 months around a Bottoming in China's Manufacturing PMI Index, 100=month of Bottom in Chinese Manufacturing PMI



Source: Bloomberg.

Despite policy rhetoric shifting towards a tightening stance, credit growth accelerated further in August. This is mostly due to local government bond issuances, which more than quadrupled from RMB 272 billion in July to RMB 1.2 trillion in August, ahead of the end-October deadline. With China's recovery solidly on track, local governments have been ordered to stop issuing special-purpose bonds by October 31, with the likely outcome being strong issuances in September and October, but lower levels in the last two months of the year.

In a change of pattern, the funding seems to now be shifting more heavily into the property sector rather than infrastructure. Infrastructure investment growth slowed, decelerating to 7.1% yoy in August, down from 7.7% in July, while property investment stepped up further, rising 11.8% in August, up from July's 11.7%. The frothy state of the market is reflected in property sales but also in housing and land prices. Total property sales volumes rose 14.7% yoy in August, well above the pace averaged before the pandemic broke out. After a small dip in July, the 70-city new housing price index accelerated to a 7.4% mom annualized rate in August, the fastest pace in 12 months.

Surging land prices are of particular concern for the government as they might signal speculative overbuilding by developers similar to the period in 2014-15 that created a massive inventory overhang and took a year and a half to normalize. Land price inflation also usually tends to translate into further acceleration in housing prices. According to Gavekal Dragonomics, the purchase price in land auctions has averaged 15-20% above the starting price in recent weeks – a premium close to levels reached in 2019, which prompted government intervention. We have already observed policy tightening at a local level over the recent months. Already in July, the Hangzhou and Ningbo governments scaled back their local property supports to contain speculation and a few other cities are gradually phasing out their incentive schemes. Moreover, a broader recovery in China's consumer goods and services in August will likely allow policymakers more leeway in cracking down on property speculation without jeopardizing China's wider economic recovery. So while property investment remains strong for now, too much of a good thing can have future consequences and we will be closely watching property policy in the coming months given the potential drag it could add to the base metals sector.

Despite these early red flags rising in the property sector, we expect Chinese metals demand to remain strong until China's credit cycle peaks, somewhere in 3Q21. Coupled with the cyclical post-recessionary demand recovery in the rest of the world, we expect base metals prices to remain well-supported through 1H2021 on the back of these bullish demand dynamics.

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Oil Risk Premia under Changing Regimes

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Systematic commodity risk-premia strategies have been popular among asset allocators and extensively studied by researchers. It is not as widely known though that the disproportionally large share of returns in such diversified commodity portfolios is attributed to energy futures. We show that even simple signals supported by the economics of oil storage and transportation arbitrage generate superior returns when applied to oil futures alone. The challenge is to be mindful of structural regime shifts that are prevalent in oil markets.

The Evolution of Oil Regimes

The widely popular concept of risk premia suggests that over time one can systematically extract positive returns either by holding financial assets like stocks and bonds, or by investing directly in one of the common factors driving returns, such as momentum, carry, and value. Applying these concepts to commodities has turned out to be less straightforward. Long-term commodity prices tend to gravitate towards marginal costs of production while nearby futures fluctuate based on the economics of storage. Specifically in the energy markets, these primary fundamental drivers are anything but stationary.

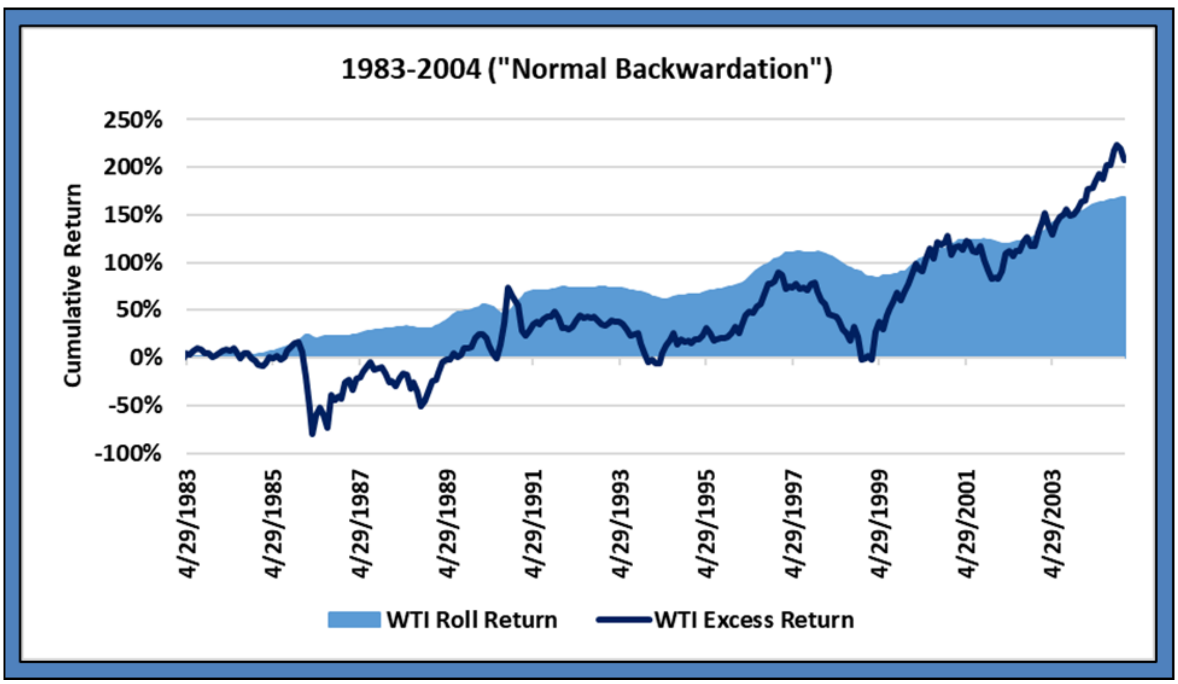
Energy futures play a rather special role even within commodities: not only because they represent the largest tradable commodity market, but also because of their disproportionally large contribution to the performance of many systematic commodity investments, both positive and negative. Energy markets are always changing along with shifts in consumer preferences and new sources of supplies requiring additional infrastructure which, in turn, causes frequent structural changes in the dynamics of prices. Systematic traders call it a regime change, which makes backtesting over long historical lookbacks not only irrelevant, but often even misleading.

The first long-term structural oil regime started with the introduction of futures trading and lasted for over twenty years. It marked the golden age of long-only investors who were able to successfully capture the structural discount offered to them by producer hedgers, as was suggested nearly a century ago by Keynes (1930) and Hicks (1939) in their theory of "normal backwardation." In addition, oil investments brought additional inflation hedging benefits as many financial assets, valued based on their discounted future cash flows, drop when inflation unexpectedly spikes. The story of this industry is well documented, and we refer interested readers to Till and Eagleeye (2007) and Greer *et al*. (2013).

To the big disappointment of long-only investors, however, the entire Keynesian risk premia accrued for over twenty years has been lost during the following decade as their own upward pressure on futures caused energy markets to flip from backwardation to the new regime of the structural contango. The oil risk premium became negative, and investors' losses turned into the remuneration of the storage companies for providing the service of storing oil, effectively outsourced to them by financial investors. Such compensation, effectively realized by investors in the form of negative roll yield, was collected by physical traders via the carry trade which provided the ultimate linkage between physical and financial markets, the regime defined in Bouchouev (2012) as "normal contango." The structural break around 2004 was also confirmed by a more rigorous statistical analysis by Tang and Xiong (2012) and Hamilton and Wu (2014).

Figures 1a and 1b illustrate how drastically different the results of long investments on oil futures were during two regimes of normal backwardation and normal contango. As much as backwardation was behind the gains in early days, contango was responsible for the losses since 2005. All results in this paper are shown for the 3rd nearby contract rolled on the last business day of the month. The difference and the contribution of the roll yield would have been even more pronounced if futures were held closer to expiry.

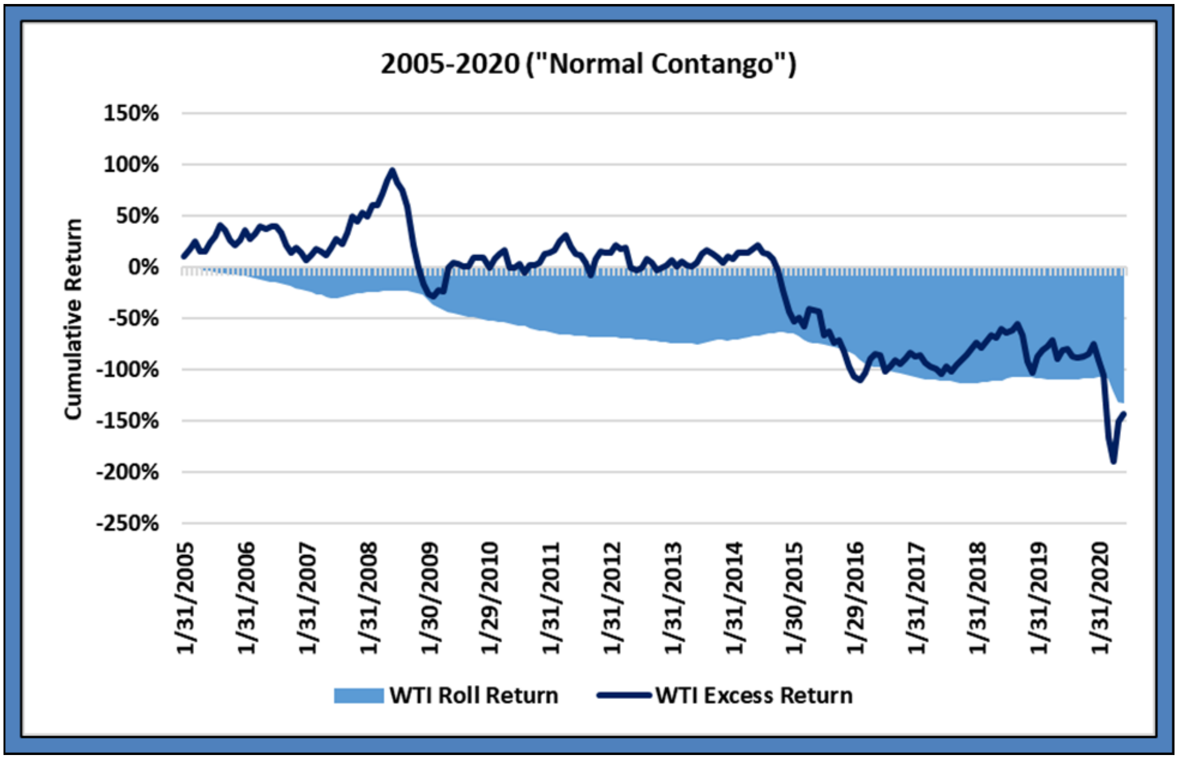
Figure 1a
Cumulative WTI Excess and Roll Returns During "Normal Backwardation" (1983-2004)



Sources: CME, EIA data, authors' calculations and graphic.

Note: Returns are for 3rd nearby WTI contract (m3) rolled on the last business day of the month.

Figure 1b
Cumulative WTI Excess and Roll Returns During "Normal Contango" (2005-6/30/2020)



Sources: CME, EIA data, authors' calculations and graphic.

Note: Returns are for 3rd nearby WTI contract (m3) rolled on the last business day of the month.

In a recent paper, Bouchouev (2020) also suggested that the oil market will likely move into the third structural regime, sort of a Financialization 2.0. It is characterized by the two largest market participants, the inventory hedger, and the inflation hedger, reaching the structural equilibrium between their respective hedging needs and eliminating the existence of any directional risk premium. During this last phase, the speculative capital, forced to look elsewhere, has gradually transitioned away from directional investments towards harvesting so-called, "factor risk premia," embedded instead in certain trading styles such as carry, momentum, and value.

Unfortunately for investors, with only few exceptions the typical life span for factor risk premia in the energy markets is even shorter. The dynamic nature of energy markets makes historical analysis less relevant before enough data could be gathered for a robust historical backtest. By and large, any systematic strategies based on data prior to 2016 must be taken with a great amount of skepticism. While the shale revolution started gradually impacting the energy trading landscape much earlier, another structural break might have occurred around the end of 2015 when the ban on U.S. oil exports was eliminated. Not only did it fundamentally change the relationship between West Texas Intermediate (WTI) and Brent, the industry's largest futures contracts, but it also opened the door to the new regime of broader interconnectedness among energy products and significantly increased product substitutability.

In addition, many of the refined products traded today represent molecules which are very different from their predecessors. At the same time, some of these products retained the same exchange tickers creating convenient but sometimes misleading continuous time series, the fact that some quantitative researchers ignore. Today's diesel and gasoil are vastly different from what they were ten years ago. The gasoline benchmark RBOB, which stands for Reformulated Blendstock for Oxygenate Blending, is just one obscure blending component delivered in a particular location, which has very little to do with the finished gasoline product we use for driving, and equally little to do with the investment product which helped to supercharge Goldman Sachs Commodity Index (GSCI)-like oil investments during the era of normal backwardation. Historical seasonality, another material source of the historical energy risk premia, is also quickly waning, as stronger global linkages and cross-regional flows dilute established seasonality in prior regional demand patterns.

We now recap the recent performance of the main energy risk premia strategies and highlight how they evolved since the beginning of the financialization era and over the last five years which we view as the most relevant period to the current regime. It is also helpful that the cumulative change in energy spot prices during these two periods were small making our conclusions unbiased to any price directionality. This is in contrast with the full sample starting from 1993 also presented for consistency with many academic studies where backtests were conducted over the long forgotten era of normal backwardation when price dynamics and sometimes even the commodities themselves were different.

Storage and Dynamic Carry

The academic literature on the construction of systematic long-short commodity portfolios is broad. It started with strategies based on traditional price-based risk factors of carry and momentum, and subsequently expanded to incorporate non-price and commodity specific factors, including hedging pressure, inventories, congestion, and seasonality. The comprehensive review of this topic is presented by Miffre (2016). Most of the studies focus on cross-sectional properties of diversified portfolios made up of 20 to 30 different commodities, even though the energy sector alone has often been the primary driver of the portfolio performance. For many strategies, the main contribution of most non-energy commodities was in adding diversification and improving the denominator of the portfolio Information Ratios.

In this paper, we only discuss primary petroleum price-based strategies of carry, momentum, and value. The usage of non-price data such as positioning or inventory usage is arguably more interesting, but such strategies are also inherently more complex and presenting them simplistically could cause more harm than add value. While standard non-price data sources, such as weekly fundamental U.S. Energy Information Administration (EIA) reports or U.S. Commodity Futures Trading Commission "Commitments of Traders" (COT) positioning reports do contain some useful information, these signals work much better in combination with other proprietary inputs, including high-frequency storage data and over-the-counter data on hedging flows.

Among many proposed signals, the one that stands out over a long period of time is oil carry. As Figures 1a and 1b highlight, carry drives the roll yield which has been the primary force behind the initial success and subsequent struggle of many directional commodity investments. Our most basic carry strategy goes long or short depending on the direction of the carry, measured in this paper by the spread between the third and the twelfth contracts. We trade the contract defined as the third nearby on the last business day of the month which becomes the second nearby during the following month, thereby avoiding additional noise related to futures expiry. The twelfth nearby contract was chosen as the longest maturity contract with the deepest price history.[1] Even without any optimization such a trivial carry strategy applied to a single WTI contract would have generated an impressive 17.2% annualized return with a 0.50 Information Ratio since 1993. The performance has been very robust over time, including the recent new regime.

Such long-term success of the carry signal is rooted in the theory of storage. Carry is a proxy for inventories which play the crucial role for the dynamics of a storable commodity. A contango market incentivizes storing inventories, while backwardated markets force stocks to draw. The role of inventory hedgers, who are one of the largest energy market traders, is to translate carry signals into the directional price pressure. If contango covers the cost of storage, then the storer can buy physical barrels and sell futures, therefore, putting downward pressure on the futures market. If storage becomes uneconomical, then the inventory hedger starts buying back short futures, causing upward pressure on futures. The cost of storage is directly determined by the carry and the process repeats rather mechanically.

Another popular commodity risk premium strategy, price momentum, lacks any robust foundation despite numerous supporting theories typically borrowed from the equity market but largely rejected in commodities. Perhaps the most viable explanation of the oil momentum is that it often behaves as a side-effect of storage which tends to create some persistence as supply and demand are slow to adjust. Momentum by itself no longer works well in liquid commodity markets with many quantitative hedge funds shifting towards less liquid alternative markets where momentum can still capitalize on relative illiquidity and capture some hedging imbalances. Babbedge and Kerson (2020) provide a good illustration of how the popular measure of the market, inherent trendiness, has shifted from liquid to alternative commodity futures.

Many systematic energy traders now seek the “holy grail” of risk premia in combining and overlaying multiple signals and sometimes applying more complex statistics, including machine learning techniques. One of the best blended signals for oil is so-called carry momentum. Even though price momentum no longer works well by itself, applying it to the term-structure of futures makes more fundamental sense as it adds more dynamism to the proven fundamental signal of carry. The biggest drawback of the basic carry strategy is its slowness as oil markets do not flip between contango and backwardation frequently. The application of the basic momentum signal directly to the annual time spread or to the measure of carry rather than to price forces the carry strategy to become nimbler and keep up with increasing speed of market changes. One can think of the basic carry measuring the current state of the storage while the change in carry functioning as an early signal about likely change in inventories.

Table 1 summarizes our results for traditional price driven systematic energy strategies, comparing their performance over three periods, “full sample” from 1993 until June 2020, the period of “financialization” and the "normal contango" from 2005, and the current "post-shale" regime covering approximately the last five years. The curve momentum strategy continues to achieve a remarkable success. Over the period of nearly thirty years, it generated an unprecedented 25.5% annualized return with a 0.74 Information Ratio for WTI. Moreover, during the latest "post-shale" period the Information Ratios for WTI and Brent were even higher at 1.13 and 1.30, respectively. For completeness, we also present results for refined products which do not materially contribute to the portfolio besides some basic diversification benefits. As mentioned in the endnote, our carry was defined simplistically without capturing any seasonal effects, but the contribution of refined products could potentially be materially improved with a more complicated seasonal carry model.

It has also been recently documented in a rigorous academic study by Boons and Prado (2019) that carry momentum significantly outperformed both carry and momentum even for the broader portfolio of commodity futures. For years, carry momentum has also been a popular strategy among foreign exchange traders.

Table 1

Systematic Carry, Momentum, and Carry-Momentum Strategies for Energy Futures Under Different Regimes

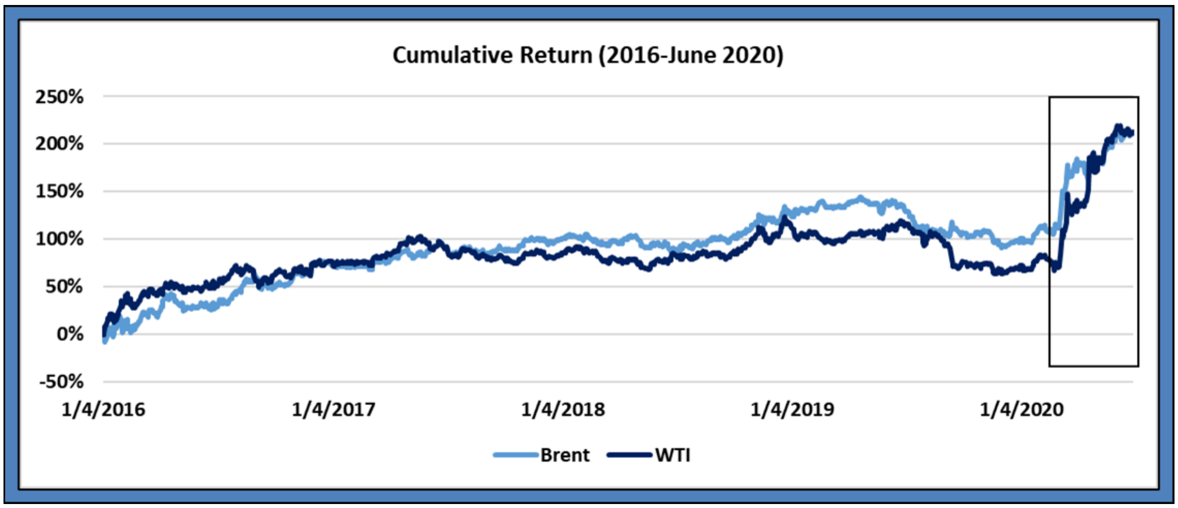
		"Full Sample"			"Financialization"			"Post-Shale"		
		CAR	MOM	CAR-MOM	CAR	MOM	CAR-MOM	CAR	MOM	CAR-MOM
WTI	Return	17.15%	7.71%	25.51%	15.57%	11.81%	33.65%	8.86%	12.34%	52.61%
	Vol	34.49%	34.50%	34.47%	37.83%	37.84%	37.79%	46.69%	46.69%	46.58%
	IR	0.50	0.22	0.74	0.41	0.31	0.89	0.19	0.26	1.13
Brent	Return	16.56%	2.85%	17.99%	14.18%	3.97%	26.33%	5.01%	1.89%	52.84%
	Vol	32.39%	32.41%	32.39%	34.44%	34.45%	34.42%	40.77%	40.77%	40.64%
	IR	0.51	0.09	0.56	0.41	0.12	0.77	0.12	0.05	1.30
ULSD	Return	8.41%	2.28%	8.92%	8.61%	3.59%	7.10%	10.37%	11.59%	22.63%
	Vol	32.00%	32.00%	32.00%	32.34%	32.34%	32.34%	35.50%	35.50%	35.48%
	IR	0.26	0.07	0.28	0.27	0.11	0.22	0.29	0.33	0.64
RBOB	Return	6.90%	5.99%	5.11%	2.36%	4.65%	-3.02%	-13.57%	13.15%	7.05%
	Vol	34.98%	34.98%	34.98%	37.73%	37.73%	37.73%	44.04%	44.04%	44.05%
	IR	0.20	0.17	0.15	0.06	0.12	-0.08	-0.31	0.30	0.16
Portfolio	Return	12.26%	4.70%	14.38%	10.18%	6.00%	16.02%	2.67%	9.74%	33.78%
	Vol	26.63%	28.39%	24.30%	27.74%	30.12%	25.18%	33.16%	34.59%	32.20%
	IR	0.46	0.17	0.59	0.37	0.20	0.64	0.08	0.28	1.05

Sources: CME, ICE, EIA data, authors' analysis, and calculations.

Note: The data set is from January 1993 through June 2020. Log-returns are for 3rd nearby (m3) contract rolled on the last business day of the month. Information Ratio (IR) is Return / Annualized Volatility. Carry (CAR) is measured by m3-m12. Heating Oil and Unleaded Gasoline were used as predecessors for Ultra Low Sulfur Diesel (ULSD) and RBOB, respectively. Momentum (MOM) and Carry-Momentum (CAR-MOM) compare the current price and carry, respectively, to their 20-day moving averages.

As good as the recent abnormal performance of the carry momentum is, it also highlights the problem that many statistical studies hide. Energy futures have much larger tails which make cumulative statistics sensitive to whether the strategy was right or wrong during the extreme event like the one that happened in the spring of 2020. Such disproportionally large contributions from extreme events often makes strategies based on historical moving averages easy to overfit. Figure 2 shows that about half of five-year profits from our simple carry momentum strategy came from correctly capturing both the large move down in prices in Mar-Apr 2020 along with the equally fast recovery.

Figure 2
Cumulative Return of Carry-Momentum Strategies for WTI and Brent Futures



Sources: CME, ICE, EIA data, authors' calculations and graphic.

Nevertheless, even if one discounts the contribution from this abnormal period, the carry momentum strategy continues to stand out among many permutations of popular signals. This signal has also been successfully used for over a decade by one of the authors in practice as an overlay to fundamental trading strategies.

Value and Mean-Reversion

In simple terms, the value strategy for a single asset can roughly be defined as the opposite of the time series momentum. In other words, value is just the contrarian signal, which sells an appreciated asset and buys the depreciated one. Therefore, when momentum works then the value signal typically does not, and vice versa. One exception is a blended signal where momentum trades up to a certain threshold beyond which the strategy flips to the contrarian signal. Another way to combine momentum with value is to blend trading frequencies as oil momentum tends to work better on shorter frequencies which are followed by some mean-reversion.

Unlike momentum, value does have a fundamental rationale as prolonged high and low prices force not only change in a physical supply and demand, but also incentivize financial hedgers to lock in increasingly better economics of production and consumption, pressuring prices to return back to their normal range. The challenge is that such fundamental adjustments often take time and one is typically facing the headwind of the negative carry while waiting for prices to mean-revert. High spot prices tend to be associated with backwardated markets when the contrarian value signal indicates selling futures often below the spot price. Likewise, low prices tend to occur when the market is in contango, so the contrarian value signal would lead to buying futures typically above spot prices. In both cases, fading the previous market moves must overcome the pressure from the negative carry.

Where the value style works much better is in trading closely related energy pairs, sometimes referred to as a commodity statistical arbitrage. The rationale makes perfect sense as many energy commodities are linked via strong economic relationships. After the U.S. lifted the ban on oil exports, WTI and Brent became much tighter linked by the economics of the shipping arbitrage, incentivizing flows in both directions depending on the level of the spread. Likewise, the spread between refined products and crude oil is largely driven by the profit margin of a refiner, and the spread between different grades of crude oil is dictated by the economics of the oil blender. Cross-commodity spreads are often driven by the optionality owned by the asset owner. Asset owners are then incentivized to monetize their optionality leading to the price dynamics akin to delta-hedging of the long option on the spread. For example, the refinery will increase (decrease) run rates as the spread between the basket of refined products and crude oil widens (narrows). The behavior of these primary market participants creates statistical boundaries which approximate the economics of the option's owner.

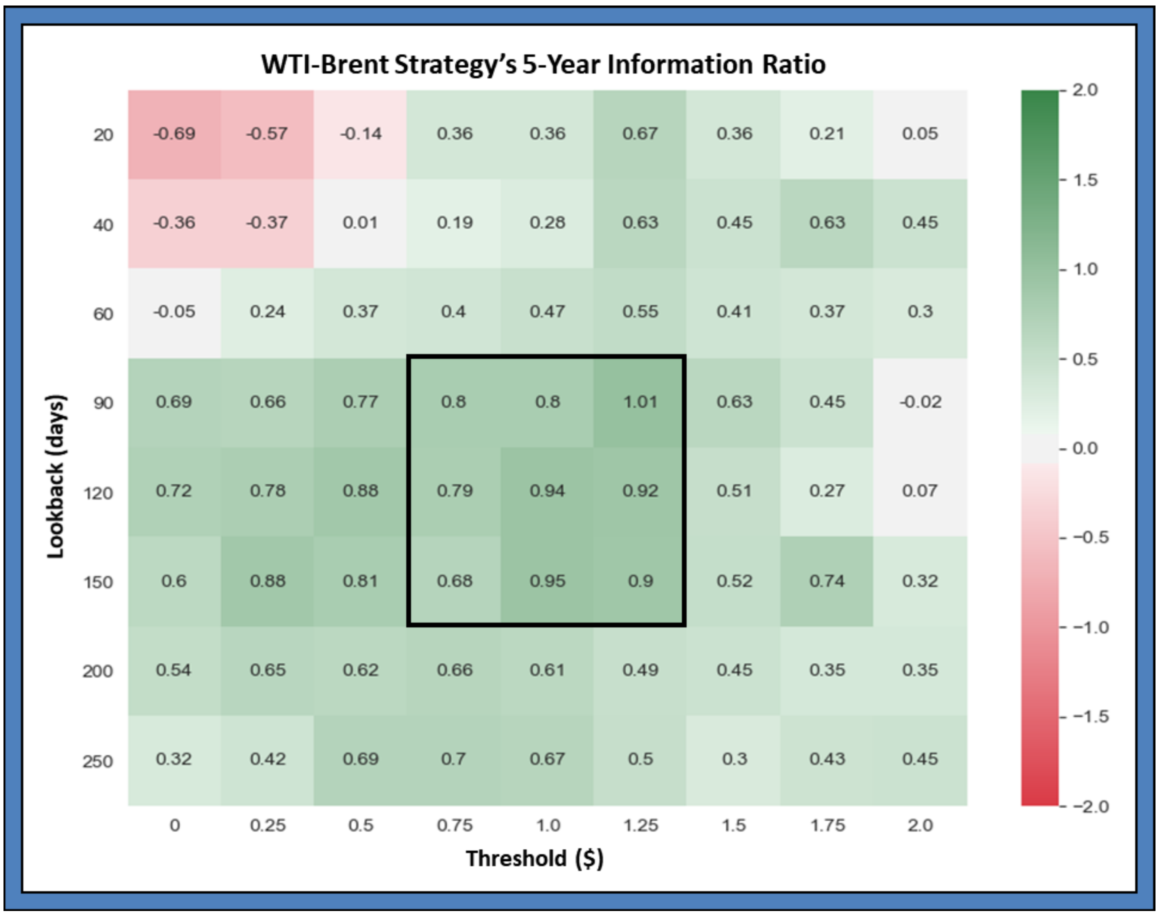
Despite its popularity and success among physical traders, statistical arbitrage in commodities has largely stayed below the radar of systematic traders. Historically, quantitative backtests generated by such contrarian rules did not look very appealing. Contrary to momentum, the distribution of returns from mean-reversion strategies tends to have a negative left tail, much like being short an option which makes them difficult to market to potential investors. These strategies often generate steady profits but incur infrequent but large losses during extreme events when one of the legs in the pair disconnects because of short-term fundamental squeezes or logistical bottlenecks. In the past, physical traders with access to some other fundamental data were able to forecast such events with reasonable probabilities which was sufficient to turn these strategies from neutral to very profitable.

We now posit that such pair strategies rooted in the economics of asset owners could become the hallmark of the new oil regime, the regime of cross-product integration. With the shale revolution, enormous amounts of new energy infrastructure have been built. Not only is WTI now better connected with Brent, but the same applies to refined products and even natural gas. Shale also increased product substitutability as many refined products can now be used for multiple competing usages. In addition, the proliferation of many new pricing points connected with recently built pipelines allows one to potentially create a sufficiently diversified statistical arbitrage portfolio just within the energy sector alone. More unique fundamental data, such as local inventories, pipeline flows, or cargo tracking are now available to support and backtest the performance of these "quantamental" statistical arbitrage strategies.

As an example, we show the results of a convergence strategy for the spread between WTI and Brent. The strategy sells and buys the spread when its current level exceeds or falls under its moving average by a certain threshold. Figure 3 shows the volatility-adjusted profit/loss (Information Ratio) and its robustness with respect to the chosen threshold on the x-axis and to the lookback period on the y-axis. The strategy is not optimized and can be further improved by making the sizing and trading threshold more dynamic, or by conditioning on various fundamental inputs. Our intent here is not to show the best-looking statistics, but rather to highlight the important and often overlooked concept with a solid fundamental rationale, which we expect to work well in the new regime of energy interconnectedness. Similar strategies could also be constructed for other linked energy pairs, including refined products to further improve the performance of such an energy pairs portfolio. We should also note that all of our strategies are based on daily settlements, and given the existence of liquid TAS (trading at settlement) products for WTI and Brent, the slippage and its impact on the performance is minimal, reducing Information Ratios by less than 0.1.

Figure 3

Information Ratios for a WTI-Brent Pairs Convergence Strategy (Jan 2016-Jun 2020) for Different Trading Thresholds and Lookback Periods



Sources: CME, ICE, EIA data, authors' calculations.

Note: Information Ratio is Profit (Loss) / Annualized Volatility, shown for a WTI-Brent convergence strategy for different lookback periods and trading thresholds. The strategy buys/sells 3rd nearby WTI-Brent spread when the current spread value is below/above its moving average by more than a given threshold.

We conclude by emphasizing that for systematic energy trading to succeed, it is so much more important to spend time on identifying relevant regimes than on generating the best looking backtest over any fixed lookback period. Energies are always on the move, and this is the structural property of the sector, where nothing will work for a long time and regimes will continue to change frequently.

Endnote

1 To properly capture seasonality of refined products, it would have been more accurate to replace the twelfth nearby futures with the fifteenth nearby so that the carry is defined for the same calendar month one year apart. However, availability of such data is more limited requiring more complex seasonality models which are beyond the scope of this paper and left for future studies. Our primary focus here is on the crude oil market where our definition of carry is meaningful and widely used by traders.

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Negative Oil Prices, Options, and the Bachelier Model

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The oil market has gone through a tumultuous period in early 2020. The price of the West Texas Intermediate Blend hit a peak of over $60 per barrel and then plunged for the first time in history to a negative price for both the front month future (CLK0) and spot price at Cushing on 4/20/2020. This paper focuses on the apparent stability of the market during this time period and the financial engineering challenges that options and futures traders addressed to ensure the markets remained orderly and operating. We provide evidence that the market functioned normally in the face of a negative futures price (CLK0) and the listing of negative strike options. We specifically focus on the difficulties in pricing and hedging of options under the traditional Black option model. Then, we explore two alternative model formulations and comment on their applicability.

Background

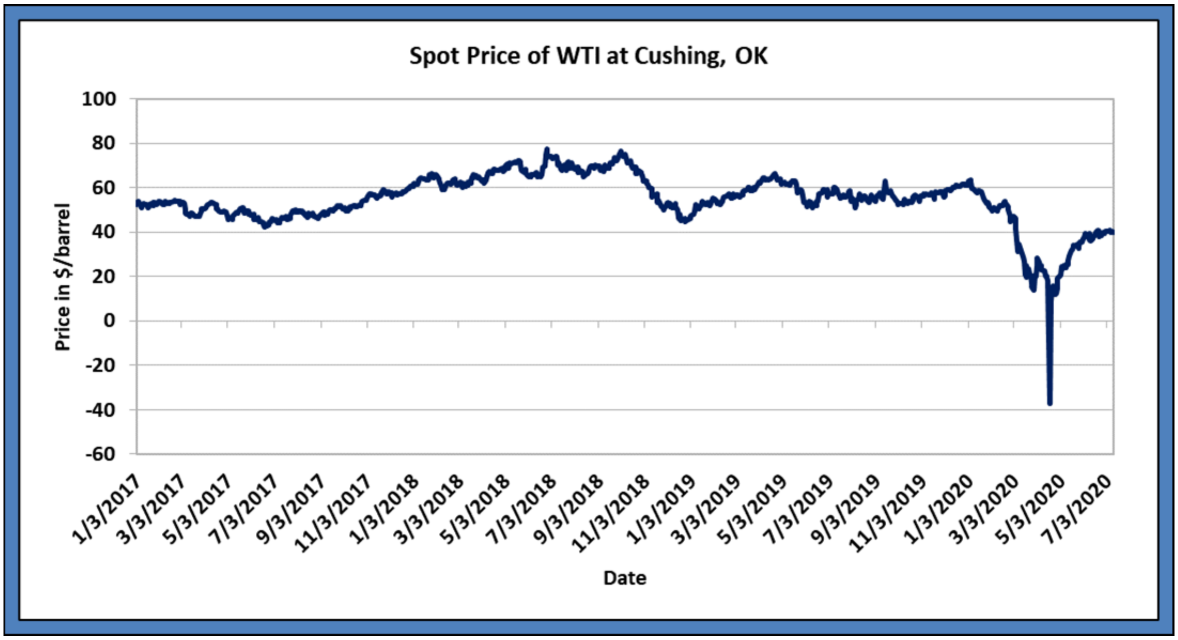
The "oil market" in the public's mind is a monolithic one, with one price quoted per barrel. The reality of the situation is that there are a multiplicity of oil standards and benchmarks. These benchmarks are driven by geography, oil composition, and market needs. The most widely followed benchmark is the so-called West Texas Intermediate (WTI) Blend. In recent years, there are other widely disseminated benchmarks, ranging from the Brent North Sea Crude to the Urals Blend. Each price per barrel reflects a unique supply and demand curve at a specific regional market and a specific point in time.

Additionally, there are different segments to this market. There is a "spot" market where oil is traded for immediate delivery. Most commentators will typically conflate the price of the spot market in Cushing with that of the WTI future, which trades on the NYMEX exchange. In Figure 1, we show the time series of the West Texas Intermediate Blend spot price at Cushing, Oklahoma. Prior to April 20, 2020, the price had a range of $10.25 to $145.31. By any measure, the price of oil is quite volatile. It has a standard deviation of 1.4 when viewed as daily price changes or 2.75% when expressed as a return (see Table 1).

Table 1
Summary Statistics of the WTI Crude Price

	Overall From Jan 2, 1986 to July 13, 2020			Prior To April 20, 2020			Month After April 22, 2020		
	Raw Price	Changes in Price	Changes in Log Price	Raw Price	Changes in Price	Changes in Log Price	Raw Price	Changes in Price	Changes in Log Price
Min	-36.98	-55.29	-40.64%	10.25	-14.76	-40.64%	12.17	-3.82	-27.30%
Max	145.31	45.89	42.58%	145.31	18.56	37.47%	34.30	4.73	42.58%
Average	32.81	-0.03	0.23%	44.14	0.00	0.00%	23.39	1.07	5.76%
Std Dev	29.06	1.40	2.73%	29.12	1.17	2.64%	7.12	1.88	12.70%
Std Dev Ann		22.24	43.33%		18.53	41.89%		29.89	201.61%

Figure 1
The Price of the West Texas Intermediate (WTI) Blend at the Cushing, OK Delivery Point

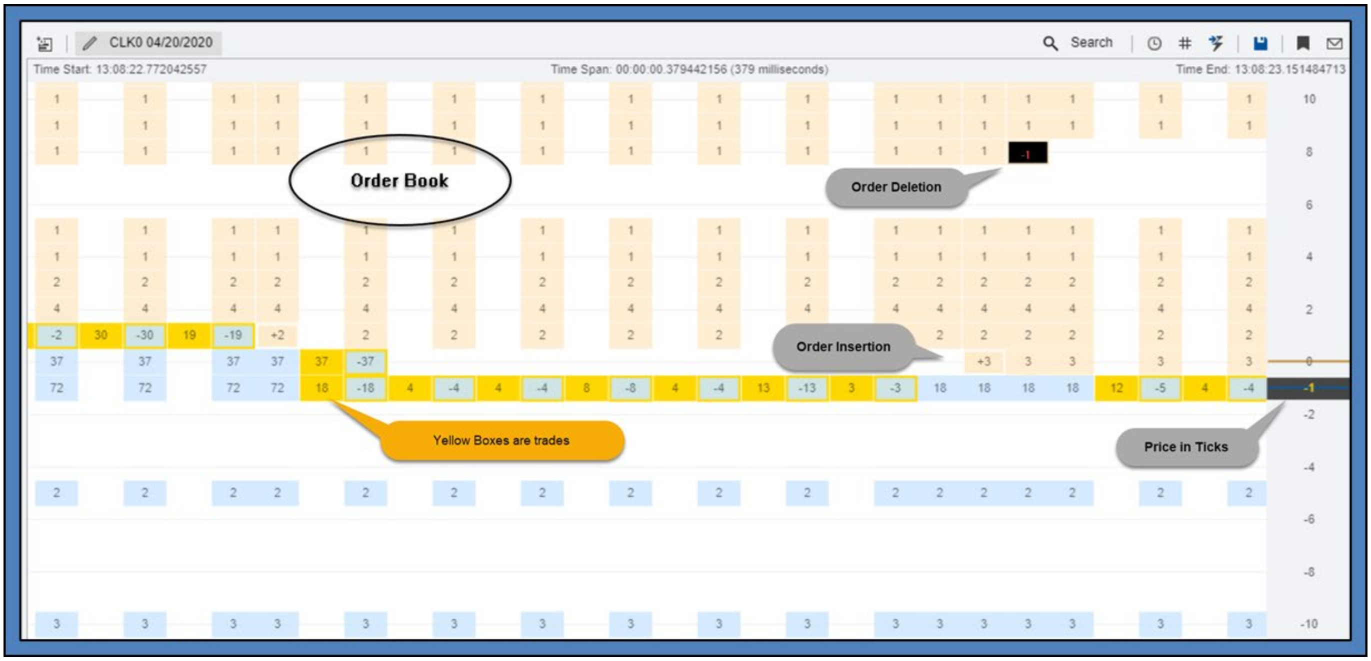


The price of oil is very volatile because of many factors, ranging from the fickleness of end-user demand to limited storage facilities, and producers unable to slow the delivery of oil due to complexity of shipping oil via pipelines and ships. However, prior to April 20, 2020, the price of a *major benchmark* for oil was never observed to be negative.[1] Previously, it had always been assumed that there was a lower bound to prices due to the fact that producers could stop producing when it became marginally uneconomical. Nonetheless, on April 20, 2020, the expiring May crude oil future (CLK0) at the New York Mercantile Exchange traded down to a negative price of -$37.63. The spot price at Cushing also fell to a negative price of -$36.58. Amongst the causes of the negative prices was limited available storage, as discussed in EIA (2020). It would be tempting to believe that such a colossal plunge in the market is indicative of a break down or flash crash.

Using data from Vertex Analytics in Figure 2 on the next page, we see that the microstructure shows an orderly market with books transitioning through the zero boundary as normally as they might transition through any other positive price level. The order book is always present and does not disappear. In fact, 37 futures contracts traded on the move through zero, with an additional 18 contracts trading immediately after the market prices broke into negative territory.

Figure 2

A Screenshot from Vertex Analytics Showing the Microstructure Around the Time the Oil Futures Contract Transitioned to Negative Prices

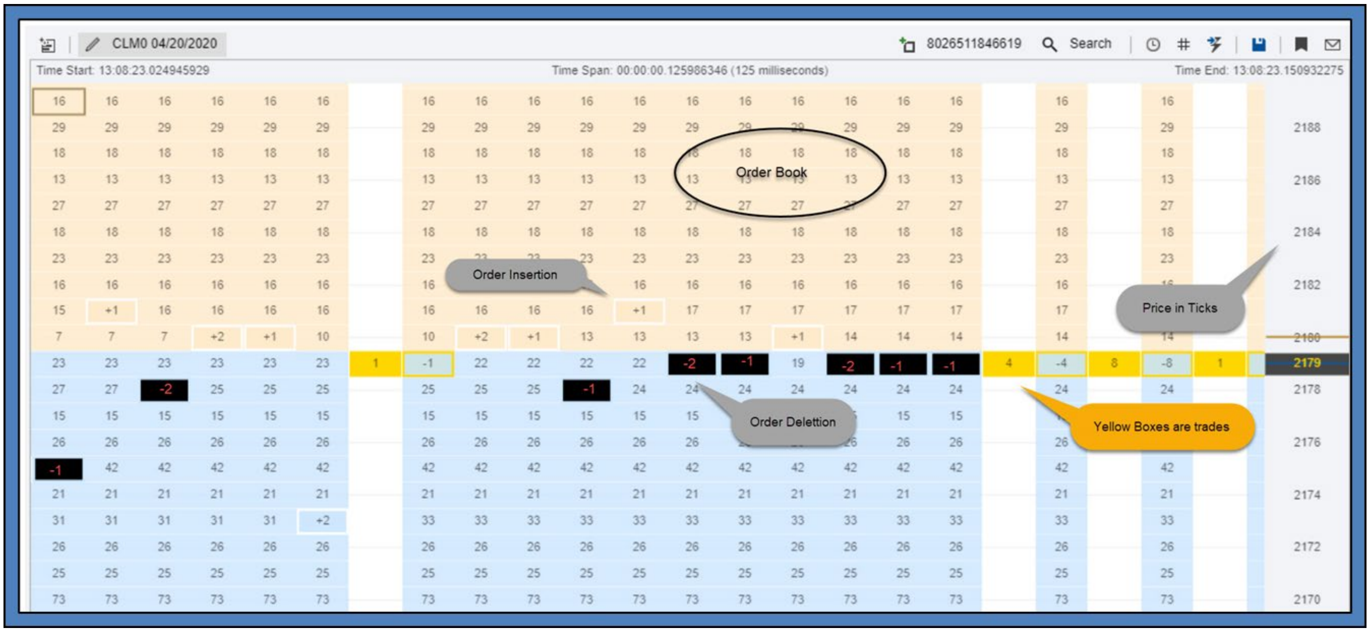


The screen is courtesy of Vertex Analytics.

Notes: Each column represents the order book at each update to the order book. The yellow blocks are the actual trades. The items in blue immediately behind the yellow block are the trade confirmation and the adjustment to the order book. Resting offers in the market are represented by a black number with a beige background. Resting bids are represented by black numbers with a blue background.

Figure 3 on the next page presents the June futures market state as May transitioned over the 0 price threshold. Note that the book is full. There is nothing to suggest a panic. This was a futures market that was not capitulating as an institution because of an unforeseen shock. Market participants' behavior could lead to the assumptions that at least the market makers were prepared for negative oil prices, even if market pundits were not.

Figure 3
The Market State in the June Crude Oil Future

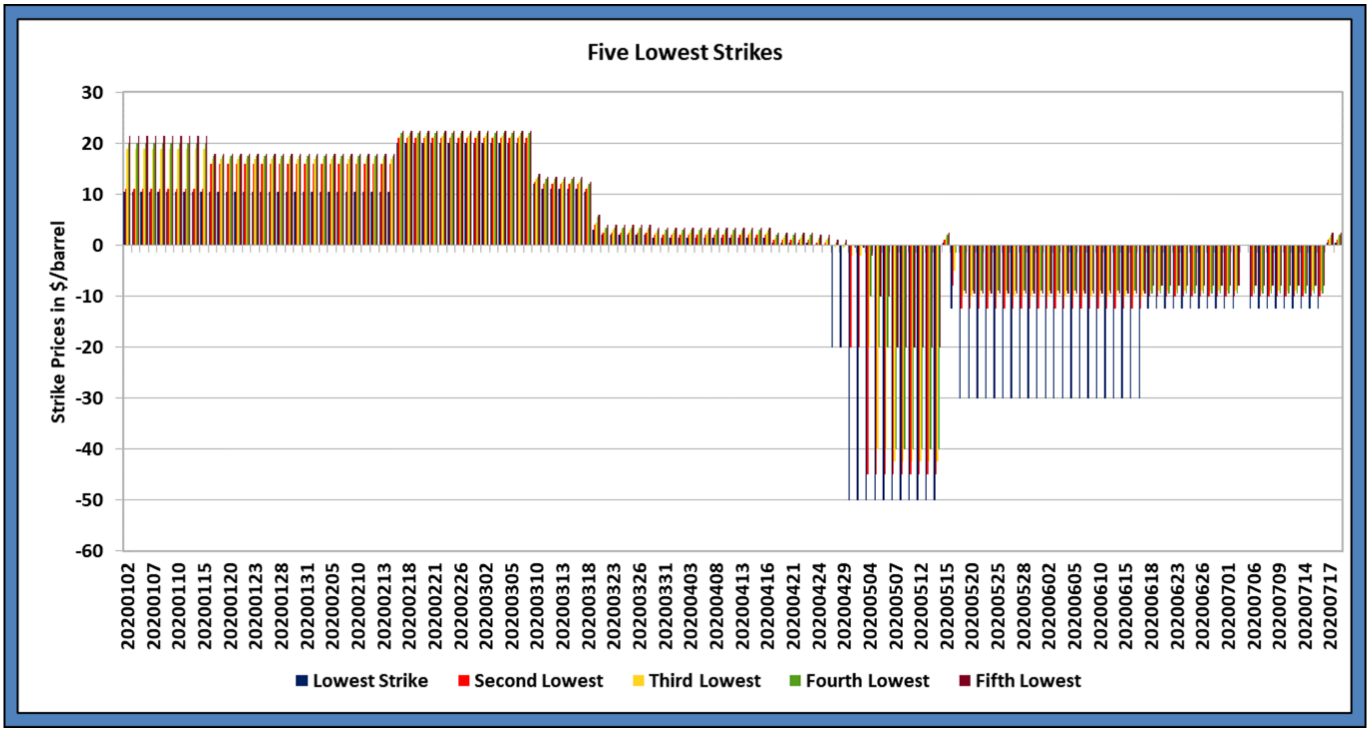


The screen is courtesy of Vertex Analytics.

Note: This is a snapshot of the June crude oil future as May transitioned into negative territory. Notice that the books remain full and there is no erosion in the size.

On the options side of the world, the best evidence that the market functioned was the behavior of the listed strikes during this move. To be clear, the options tied to the May contract (CLK0) had expired one week before the futures went negative. They never directly experienced that shock. However, if we look at the lowest strike prices with traded volume this year (Figure 4 on the next page), we see that they followed the evolution of prices smoothly. The first sub-10 dollar strike trades on March 19, with a negative 20 dollar strike trading on April 28th. The negative strikes trade until July 17th. Trading in negative strikes was real and persisted. Finally the futures options markets continued to function normally with negative strikes for months after the April 20th event. It is clear by the market microstructure behavior that market participants were prepared and had functional option pricing models to price negative strikes prior to April 20th.

Figure 4
The Five Lowest Traded Strikes for Front Month Options in WTI Crude (CL)



The Problem

The options market in crude oil is (primarily) a futures option market. A common way to price these options is through the use of the so-called Black model (Black, 1976) and its derivatives (Barone-Adesi and Whaley, 1987 or Bjerksund and Stensland, 1993). The Black model is a specialization of the Black-Scholes model (Black and Scholes, 1973), which recognizes that the futures price is approximately driftless and so we can write (to price a call with puts following from put/call parity):

$$C = e^{-rt}\{F\,\Phi(d_1) - K\,\Phi(d_2)\} \qquad (1)$$

K	*strike price*
F	*futures price*
σ	*implied volatility*
r	*interest rate*
t	*time*
Φ	*Standard Normal Distribution*
d_1	$\dfrac{\ln(F/K) + (\sigma^2/2)T}{\sigma\sqrt{T}}$
d_2	$d_1 - \sigma\sqrt{T}$

Futures options in the U.S. are mostly American style expiry, so Black's model is an approximation. We choose the Black model because of its analytical tractability and ease of exposition. There were a couple of major shortcomings with the Black formula in the run up and aftermath of the negative prices. We detail those in the next few paragraphs.

The first obvious problem is the existence of a singularity when the asset price drops to or below 0. The logarithm is not defined there and as a result there would be no defined price. Thankfully, this occurred on only one day in the period and that was after the May options had expired.[2] The next concern occurs with very low (but not zero) prices - both for the futures price and the strike price. When either is very small, the sensitivity of the option's price to the change in implied volatility, the so-called Vega, diminishes dramatically. This can be seen in either formulation for the Vega.

$$vega = Fe^{-rt}\phi(d_1)\sqrt{T} = Ke^{-rt}\phi(d_2)\sqrt{T} \quad (2)$$

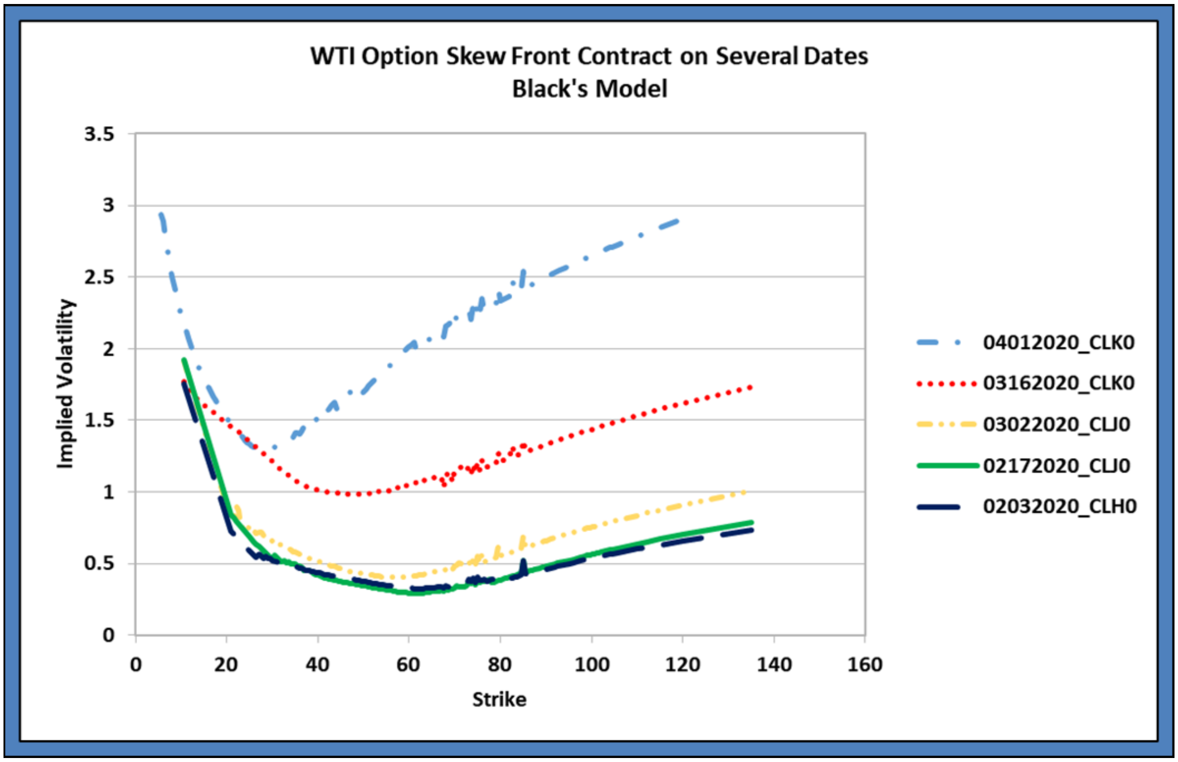
This is a key problem. As the prices decline to near zero, in order for the calls to retain any value, the implied volatility must increase dramatically. Put differently, as the price approaches the absorbing boundary, the moves (anticipated absolute dollar changes) would become smaller according to the model. The moves are limited by zero to the downside and some return on a very small base to the upside.

The fact is that dollar moves in oil did not attenuate as the front futures traded below ten dollars. In the month after the negative settlement, the standard deviation of the dollar move was higher (at 1.8) than it had been in the period prior to the debacle (at 1.07). The daily standard deviation of the return exploded to 12.7% from 2.64%. Clearly, the dollar risk would seem to be a more stable measure of risk.

Two things would affect the option prices. First, since the dollar changes did not attenuate, a log normal model would need to compensate by assuming a higher implied volatility. The dollar moves increased by a factor of 80%, and the return's standard deviation exploded by 600%. Second, at lower prices and strikes, the Black price is insensitive to implied volatility. To account for this insensitivity, option market makers would need to set the implied volatility curve for the Black option pricing model at extreme values, as shown in Figure 5 on the next page.[3] An option seller would have no choice but to increase implied volatility to incredible levels in order to be in the market, as the Black model would expect diminishing volatility in the price changes at a given implied volatility level for diminishing prices.

A further consequence of dragging the implied volatility curve higher and higher is that the "delta gap," the difference between the Black call delta and the Black put delta, will increase dramatically. An options market maker who sells a put will sell less futures than they should because the Black model will give a higher probability to an up move than a down move. For example, assuming zero interest rates and a futures price of 10, the 0.5 strike has 25% delta for the call, while the put has 75% delta under a 100% vol.[4] If the vol moves to 168%, the delta picture is almost reversed with the calls becoming a 75% delta, while the puts are 25%.

Figure 5
The Explosion of the Front Month WTI Crude (CL) Option Implied Curve Utilizing Black's Model



Note: The implied volatility is quite regular until the next strikes are listed. The curve's put wing (the low strikes) sees a massive move upwards. This move continues until the whole curve reacts to the new reality. Initially, the low Vega of low priced strikes is more important - this fades as the underlying is perceived to be more risky and the limitations of geometric Brownian motion manifest themselves.

Abbreviations: CLH0, March 2020 WTI contract; CLJ0, April 2020 WTI contract; and CLK0, May 2020 WTI contract.

The final issue which hinders the ability of the Black model in these market circumstances is the listing of ***negative*** strike options. Around April 24, 2020, the market started actively trading a zero strike option for the June expiration options. Then -20 strikes were listed, leading to a crescendo which peaked with the trading of the -50 strike option on the June future. The standard Black model cannot be applied to negative strikes without modification. The listing of additional strikes is not unusual. The listing of so many strikes suggests there was demand and a willingness to supply options.

To recap, the industry standard Black model of option pricing has serious difficulties in dealing with zero or negative underlying and strike prices. In addition, the Black model experiences difficulties in pricing options even before reaching the zero boundary. In order to cope, an option seller or a risk manager would have had to sharply increase his/her volatility curves. The increasing of the volatility may result in over- or under-hedging their option risk. We witnessed some of these effects if we looked at the markets through the Black paradigm.

The Alternatives

The problem of negative strikes and negative underlying prices is actually not a new problem in finance and option pricing. This is a problem commonly encountered in power trading and spread option pricing. In the case of power, a point on the electrical grid may pay for power at certain times in the day, at other times it might be paid for consuming power. In recent years, the trading of calendar spread options (CSO) has become quite pervasive. The so-called CSOs are options on the price differential between two expiry months (the calendar spread). In many cases the underlying variable, the spread, can be negative. Moreover, these options are often traded with negative strikes.

Using the spread option model as a guide, we take one very popular model. The model is due Bachelier (Bachelier, 1900), and assumes a simple (additive) Brownian motion, unlike the geometric Brownian motion at the heart of the Black model. This deals immediately with both issues of a zero or negative price and a negative strike.

Bachelier's model is often written as:

$$C_t = \sigma\sqrt{t}e^{-rt}\left(\frac{F-K}{\sigma\sqrt{(t)}}\Phi\left(\frac{F-K}{\sigma\sqrt{(t)}}\right)-\phi\left(\frac{F-K}{\sigma\sqrt{t}}\right)\right) \quad (3)$$

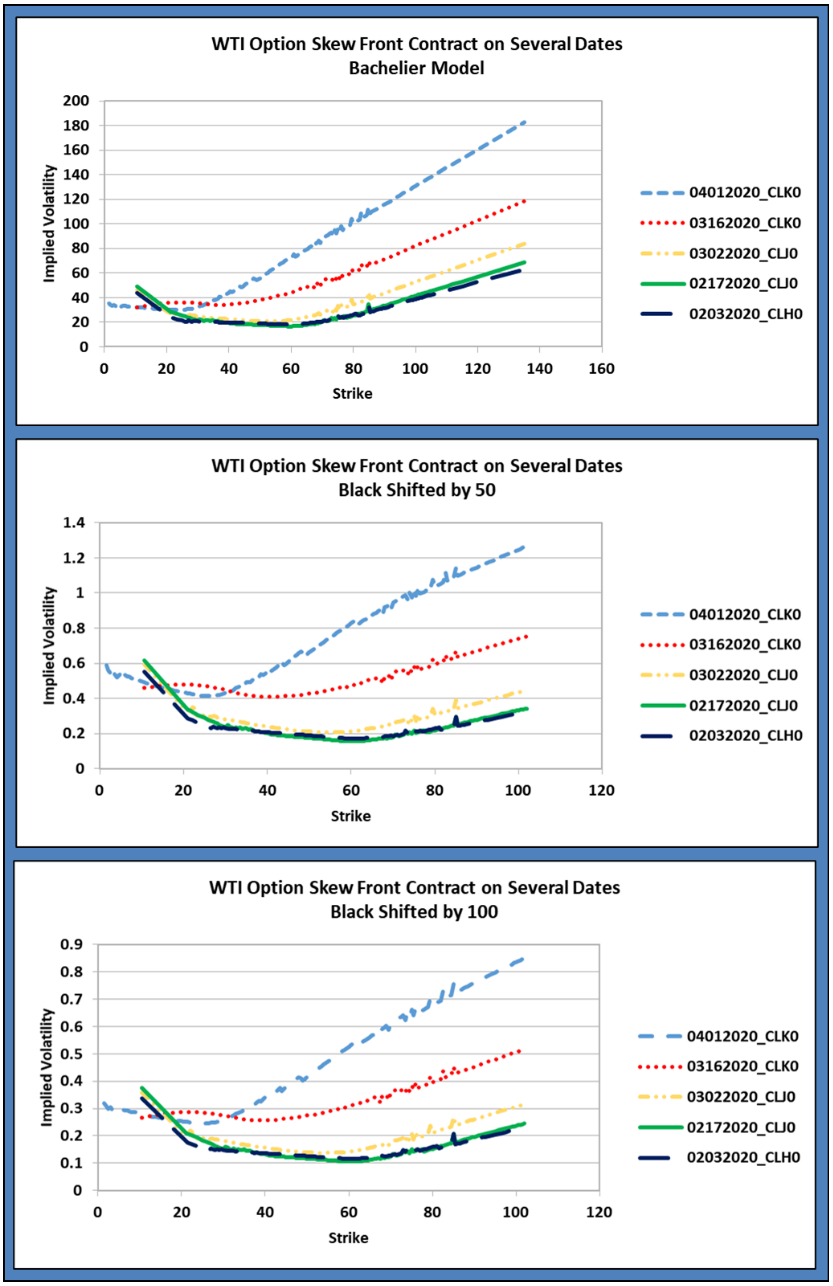
The uppercase phi is the cumulative standard normal while the lowercase phi is the standard normal point density function; all other notations are the same as Eq (1).

There are known modifications that will allow Black's model to price options on products with negative prices. With a very minor change of variables, we can "displace," or shift, the underlying variable of the model. In the case of oil, we could say that the random variable is *M* + the futures price. *M* is an arbitrary constant which is large enough to deal with potential negativity. In order to be consistent, we also shift the strikes by this amount as well.

In Figure 6 on the next page, we show the effect of fitting a standard Bachelier model and Black model with displacements of 50 and 100. The immediate observation that jumps out of the Bachelier model is the difference in the scale of the implied volatility values between the Black and Bachelier. The difference between these two modes is that these models are measuring two different types of price movements. Bachelier measures movement in dollar space and Black measure movements in percentile space. The Bachelier model's implied volatility is on the order of 20-30%. This is in comparison to the Black volatilities, which are 3.0 (or 300%). The implied volatility for the standard Black model appears to be an extreme value, but glancing at Table 1, we see that this is broadly consistent with the annualized standard deviation of differences. What is even more interesting is that when an offset is applied to the Black model, the calculated implied volatility is more consistent with traditional implied volatility values of 0.2 (or 20%) for the longer dated options and 0.60 (or 60%) for the near dated options, which was consistent with the oil market implied volatilities prior to the negative expiring option event.

What is also interesting is that the strong put skew (lower strikes carry a high volatility) is completely eliminated in the displaced Black and Bachelier runs. Furthermore, as we choose a bigger displacement we see a high degree of similarity between the Bachelier view and that of the displaced Black model. This last point is not a totally unexpected outcome. Haug and Taleb (2011) argue that Black's model is a specific application of the Bachelier model's approach towards removing the predictable drift of an underlying variable. By shifting the underlying variable (and strikes) away from 0, we effectively demonstrate their arguments.

Figure 6
Alternative Skews



Conclusion

The move in the May futures price to negative values was historic. The listing of strikes from over +$135 to -$50 was also nothing short of unprecedented (in the June option expiry). The market traded through the 0 dollar boundary with no hesitation. Moreover, the market digested negative strikes with no major breakdowns. This suggests that the market participants were ready for negative prices and negative strikes. Fundamentally, market participants could choose a new model, Bachelier, or stick with a modification of the Black, which is an industry standard. Either competitor (Bachelier and displaced Black) to the industry standard Black model had similar properties. Both exhibited a strong upward slope with respect to the strikes. Both approaches could be used in pricing and hedging. The ease of converting from Black to a displaced Black suggests that most market participants would have made this choice. However, market conditions like this should spur a more generalized view to pricing and risk. In terms of generality, the Bachelier approach has the advantage of being very straightforward.

Endnotes

1 In fact, the other market benchmarks (Brent North Sea, Urals blend and so forth) did not trade negative during this time period. That said, as documented by Blas and Tobben (2020), an "[o]bscure Wyoming crude grade [had been] bid at negative 19 cents a barrel" in mid-March.

2 Some option traders may have priced their June (next month) options using the May future, in which case they would have had to adjust the price using an additive "roll" factor since there was a rather steep upward slope to the price curve at that point.

3 We gratefully acknowledge CommodityVol.com for providing the data for these plots.

4 We assume a 1-year life for simplicity.

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Evaluating Forecasts for Better Decision-Making in Energy Trading and Risk Management:

An Industry Practitioner's View on How to Enhance the Usefulness of Forecasts Including Potential Applications of Machine Learning

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Mr. Nazim Osmancik, Chief Risk Officer, Energy Marketing & Trading, Centrica Plc**,** presenting in Berlin at the Electricity Price Modelling and Forecasting Forum organized by TBM Evolution.

Introduction

Forecasts play a vital role in decision-making in the energy sector as a key input to short-term trading and risk management as well as long-term investment decisions and strategic planning.

The energy transition is bringing new sources of uncertainty such as supply intermittency, demand response, and more volatile spot prices into energy systems that already had a tendency to fall into disequilibrium frequently. This introduces new forecasting challenges. Conversely, as energy systems around the world are transformed and become more dynamic, the commercial importance of having access to accurate forecasts is growing.

This short paper examines some of the key forecasting challenges against this backdrop and introduces ideas on evaluating and enhancing forecasts for better decision-making in the energy trading and risk management context. Case studies are also presented where the ideas are applied and commercial insights or tangible improvements in forecast performance observed.

It is important to note that forecast evaluation and enhancement as well as applications of machine learning to forecasting are large and growing areas of academic research. This article is a non-technical presentation from the perspective of an industry practitioner and does not provide a review of the academic literature. The interested reader is strongly advised to invest time in studying the literature comprehensively.

Emerging Forecasting Challenges in the Energy Sector

One of the key forecasting challenges in our business is the large number of highly variable and interdependent drivers that need to be forecasted. This is due to the fact that energy is a key component of nearly every economic activity and fundamental needs such as heating, which are driven by complex natural systems like weather. Typical energy suppliers or traders, especially those exposed to merchant risk therefore need to understand many complex variables including *inter alia* future commodity prices, market volatility, market positioning of other traders, stocks, weather, maintenance schedules, macroeconomic indicators, FX rates, and so on.

Figure 1
A Large Number of Forecasts are Input to Key Decisions in the Energy Industry

Another challenge comes from the increasing share of intermittent renewable energy and demand side response. The falling cost of renewable energy, ascent of on-site distributed energy, emergence of Internet of Things (IoT), and digitalization of data disrupted the functioning of energy markets designed to serve a predictable future demand load with large centralized generation. In particular, the intermittent nature of renewable generation is creating challenges in system operations as well as driving spot price volatility.

In this environment, the ability to recognize and predict patterns and respond to them in a timely fashion are both harder and more important than ever for maximizing value and managing risks. A typical business would therefore need to have in-house capabilities to produce forecasts or obtain them from external sources to serve their needs.

Apart from being difficult and potentially expensive, this presents yet another challenge, which relates to forecast quality and its variability across forecasters and through time. In the world of energy forecasting, it is not uncommon to find a plus or minus 60% spread around the average forecast for a particular variable, especially if the forecast horizon is longer than a few months. Conversely, for some variables there are very few forecasts. Sometimes the forecast is incomplete or too old.

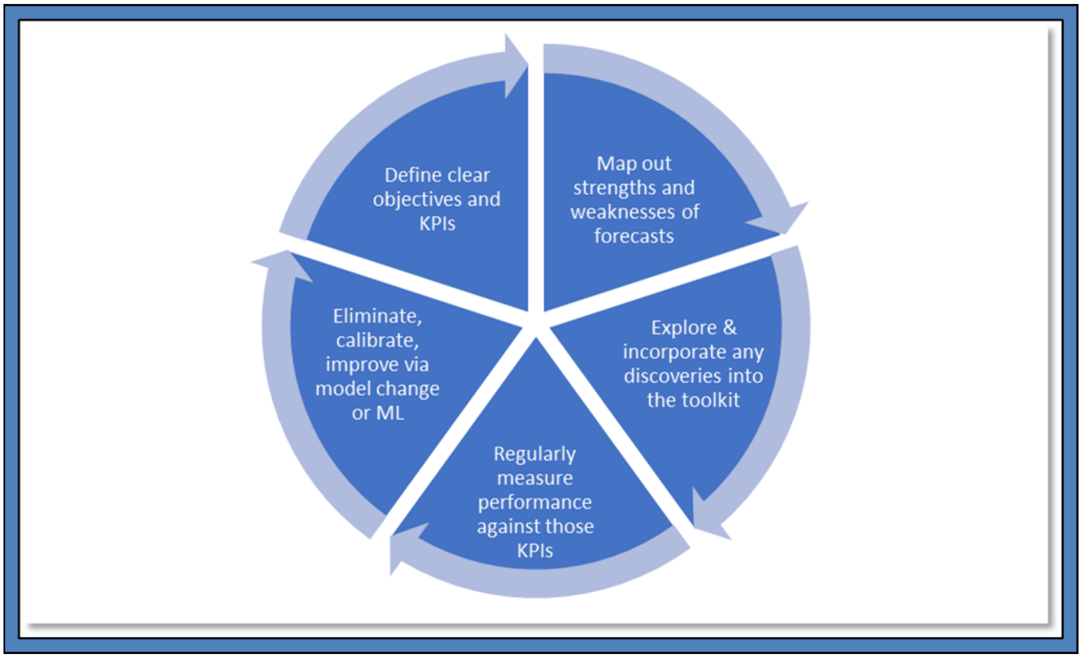
It is of course possible to perform basic modifications such as averaging, taking subsets of our favorite forecasters, or extrapolation. More sophisticated methods that build on Mincer and Zarnowitz (1969) can be used to develop statistical evaluation and backtesting which may be needed to demonstrate adequacy of internal competence. Unfortunately, in practice such methods can prove difficult to connect with commercial or strategic objectives.

It is not all bad news however. While the complexity and scale of the challenges increase, advances in automation, digitalization, predictive techniques including Machine Learning (ML) / Artificial Intelligence (AI) and the ease in implementing them certainly offer new opportunities.

Systematizing Forecast Evaluation and Enhancement

To evaluate the practical usefulness of forecasts and possibly enhance them, developing a systematic approach with a commercial perspective is advisable. This section will cover what such a system might look like and break it down to five processes[1] shown in Figure 2 on the next page.

Figure 2
A Five Step Process of Systematizing Forecast Evaluation and Enhancement



Note: KPI stands for Key Performance Indicator.

Step 1: Defining Objectives and Establishing KPIs

The first step is defining what the business really needs to forecast and what kind of forecast qualities are required. The definition should be as specific as possible. For example, a good definition could look like what is shown in Table 1 below.

Table 1
An Example of How Forecast Requirements Can be Defined

Forecast	Within day movement of the month-ahead futures contract of commodity *X* on day *T*.
Active duration	One day, i.e. forecast to be issued 24 hours before and expire at the end of day *T*.
Primary use	Proprietary trading positions.
Dependencies	Forecasts for commodities *Y*, *Z*; input variables *A, B, C* . . . need to be consistent with this forecast as they are connected.
Desired accuracy	Mean absolute percentage error < *Epsilon*; Hit ratio > *H*
Justification for desired accuracy	Considering transaction costs, VaR limits, counterparties, liquidity, the forecasts within the desired accuracy constraints will generate positive PnL.

Notes: VaR stands for Value-at-Risk, and PnL stands for profit and loss.

Step 2: Understanding the Strengths and Weaknesses of Existing Forecasts and Capabilities

The second step is figuring out whether the forecasts available to the business are adequate using general statistical methods and also with respect to the requirements set out in Step 1. This process should then lead to the identification of any performance gaps.

As part of this process, it is advisable to analyze the behavior and performance of forecasts expansively, e.g., exploring performance in a rising versus falling market, weekdays versus weekends, winters versus summers which may all lead to discoveries that end up being commercially useful. Machine Learning tools such as classification could be very effective for such exploratory tasks.

Step 3: Incorporating Discoveries into the Toolkit

The third step entails identifying "hidden gems" from Step 2 – commercially useful insights carried by forecasts that were unknown and underutilized – and determining what action to take, e.g., allocate risk capital to trade on the insights.

Step 4: Monitoring

The fourth step is building an automation system to monitor the established forecast KPIs with the capability to generate reports, fire signals when performance deteriorates, and integrate into other relevant management information systems.

Step 5: Calibration and Enhancement

In the last step, the rest of the system and data generated can be used to pick the "best" forecasts, or combine and calibrate them to maximize the desired KPIs. As in Step 2, Machine Learning and AI tools can be useful here, though simple econometric methods also perform well.

The impact of this 5-step approach on performance can be significant. The next section will cover some examples where this approach was applied and tangible benefits were observed.

Applications

This section includes a number of examples where publicly available forecasts or forecasts generated by simple econometric models were assessed. Forecasts are anonymized as the purpose of the exercise is to simulate how a generic forecast may be evaluated and enhanced rather than assessing the predictability of a certain market or exploring the capabilities of a forecaster.

Example 1: Understanding the Performance of a Forecast

In this example, it is assumed that the user requires:

1) forecast of a variable that changes through time and expires at a certain date, e.g., a temperature forecast for a future date or a commodity future that expires within a certain number of days;

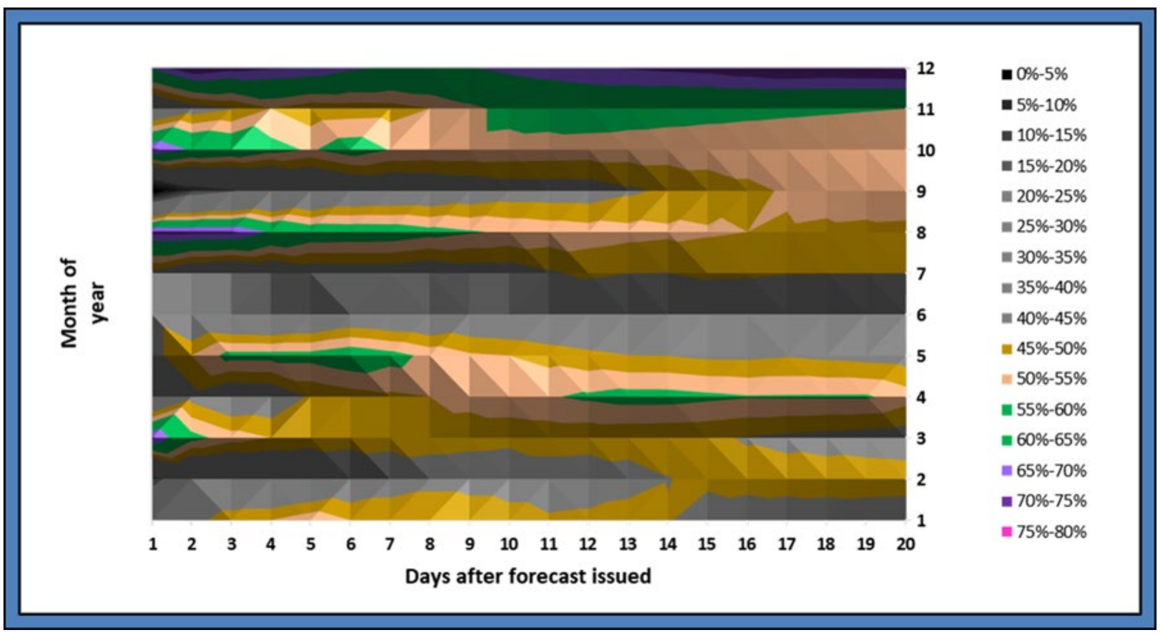
2) prediction of whether the value of the variable will be higher or lower from the time the forecast is published until expiry;

3) prediction accuracy to be higher than 50%, i.e., better than tossing a coin[2]; and

4) an understanding of how forecast performance varies seasonally.

Figure 3 below is an example of a visual that provides pertinent insights. It depicts a forecast's directional accuracy (in predicting whether the variable of interest will rise or fall) for up to 20 days following issuance summarized by month of the year. The sample includes daily data from 2/2/2013 to 5/10/2019 (1724 days).[3]

Figure 3
Forecast Hit Ratio - Number of Days After Issuance by Month of the Year

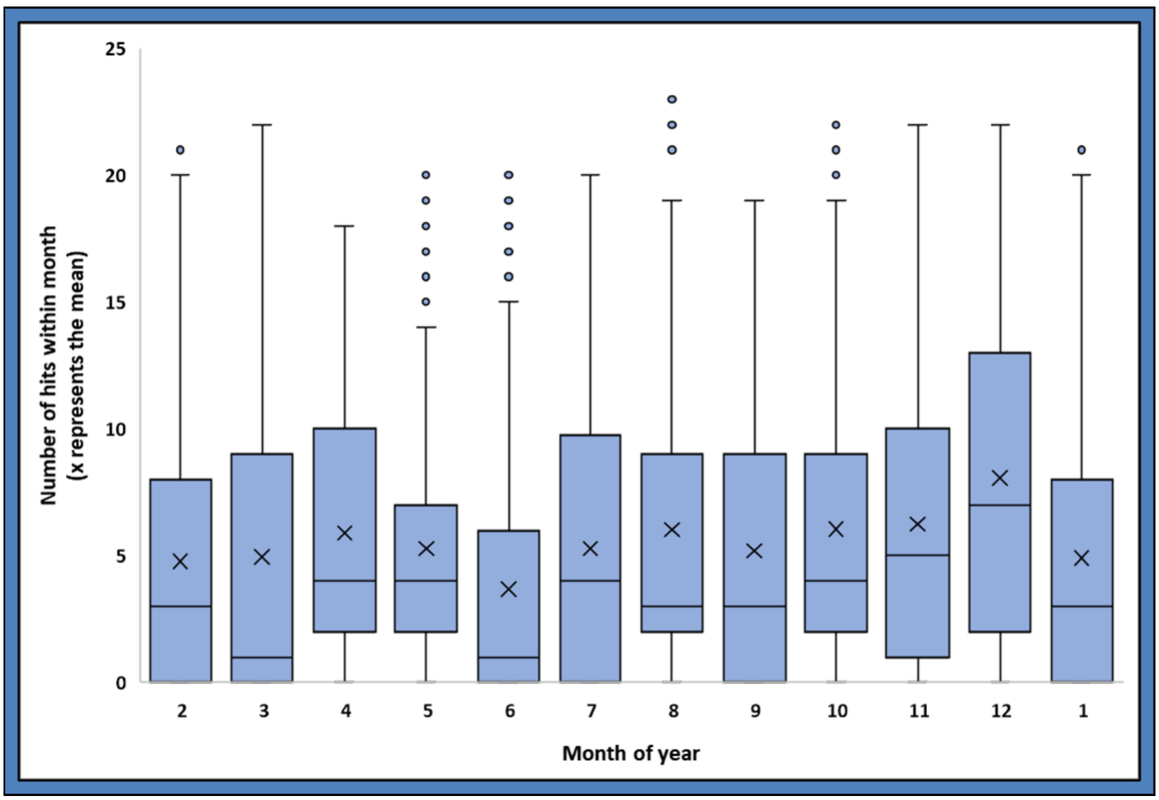


We immediately observe that the forecast tends to perform well in months 4, 5, 8, 10 and 12 but poorly in months 1, 2, 6, 7, and 9. In months 5, 8 and 10 the performance tends to tail off about 9 days after issuance, where in month 3, it does so within 3 days after issuance. Conversely, for months 4, 11, and 12 the forecast attains peak performance 10 days after issuance.

It is difficult to determine whether the pattern is random without deeper knowledge of the underlying process. For example, it could be that in months 6 and 7 quality of input data deteriorates or most forecasters go on vacation which leads to a deterioration of output quality. If the forecasts come from an internal model, this type of analysis can help identify weaknesses and process failures. If the forecasts are sourced from third parties then statistical analysis is required to identify significant patterns.

Using the same data set, Figure 4 then explores the number of days in which a correct prediction was achieved in the format of a box plot to indicate the spread and skewness of the performance by month. One of the key observations here is that within the months where the performance is higher (4, 5, 8, 10, 12), the forecast user will have 5 to 10 opportunities (days) to act on the insight.

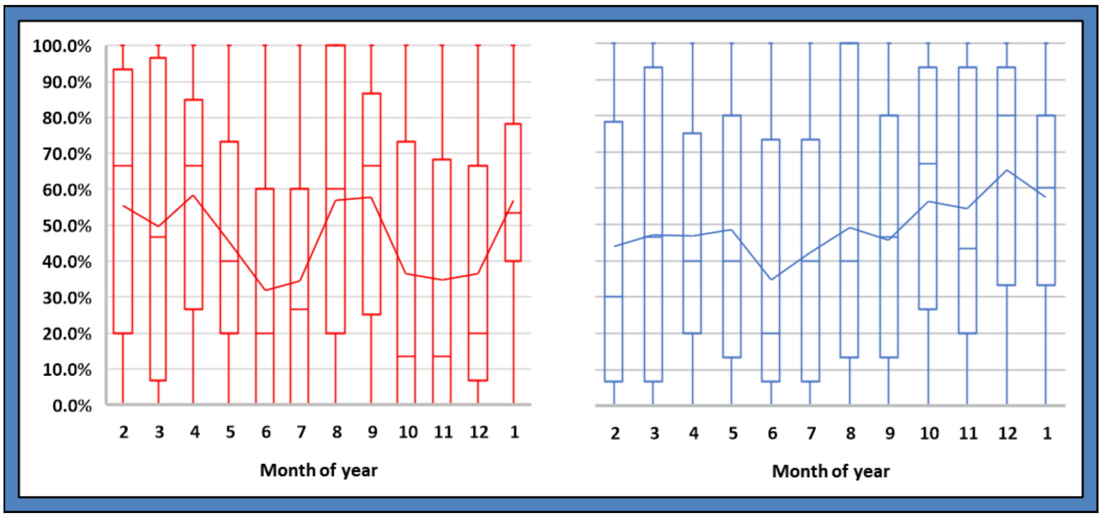
Figure 4
Total Number of Days Within a Month Where the Direction of the Prediction was Correct



Example 2: Enhancing a Forecast

Building on the previous example, we assume the forecast user has similar requirements with access to a forecast that does not seem to perform adequately where the hit ratio is below 50% in summer and winter months as shown on the left-hand side chart in Figure 5 below.

Figure 5
Hit Ratio of Forecast Before (left) and After (right) Adjustment



With no prior knowledge of the underlying process that generated the forecast, historical forecast errors were examined which indicated the forecast was suboptimal as errors exhibited serial correlation as well as episodic periods of bias. Given the lack of information on the underlying process and an obvious theoretical explanation of the biases observed, enhancement was attempted via Machine Learning.

A simple feed-forward neural net was developed to calibrate the forecast using a small number of input variables including the previous day's forecast error, time related variables such as the day of the week, month of the year, and variables that characterized market conditions such as the rolling average of daily volatility. The estimation was set up like a walk-forward backtest where the neural net used historical data to make out-of-sample predictions and was re-estimated regularly as new information became available. No particular care was taken to optimize the size of the neural net or testing the validity of the input variables.

The resulting adjusted forecast performed better under certain conditions (in months 1, 10, 11, 12), attaining higher hit rates, as the chart on the right-hand side of Figure 5 shows. If our hypothetical user was only interested in high performance in winter months, this calibration might have worked well.

More generally, performance of the adjusted forecast was worse than the original forecast in a number of time periods. This often happens in calibrations as improvements come with trade-offs. In this illustrative example, it is likely that the calibration model was not well-specified and could be improved.

Conclusion

The paper examines the key forecasting challenges in the energy sector and introduces a practitioner's approach to understanding, evaluating, and improving forecasts. Simplified use cases are presented, which demonstrate an approach that can generate commercial insights and improvements in forecast performance.

Endnotes

1 In real applications, it is also strongly advisable to define an overarching purpose for implementing this and articulating how it serves a strategic business goal, though this is beyond the scope of this paper.

2 For the sake of simplicity statistical significance requirements are ignored as this is an illustrative example.

3 In order to obtain a smooth picture, a continuous rolling average of the hit ratio has been used.

Disclaimers

Reference

Mincer, J. and V. Zarnowitz, 1969, "The Evaluation of Economic Forecasts," in J. Mincer (Ed) Economic Forecasts and Expectations of Forecasting Behavior and Performance, New York: National Bureau of Economic Research, Inc., pp. 3-46.

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If Data is the New Oil, Nowcasting is the New Drilling Equipment

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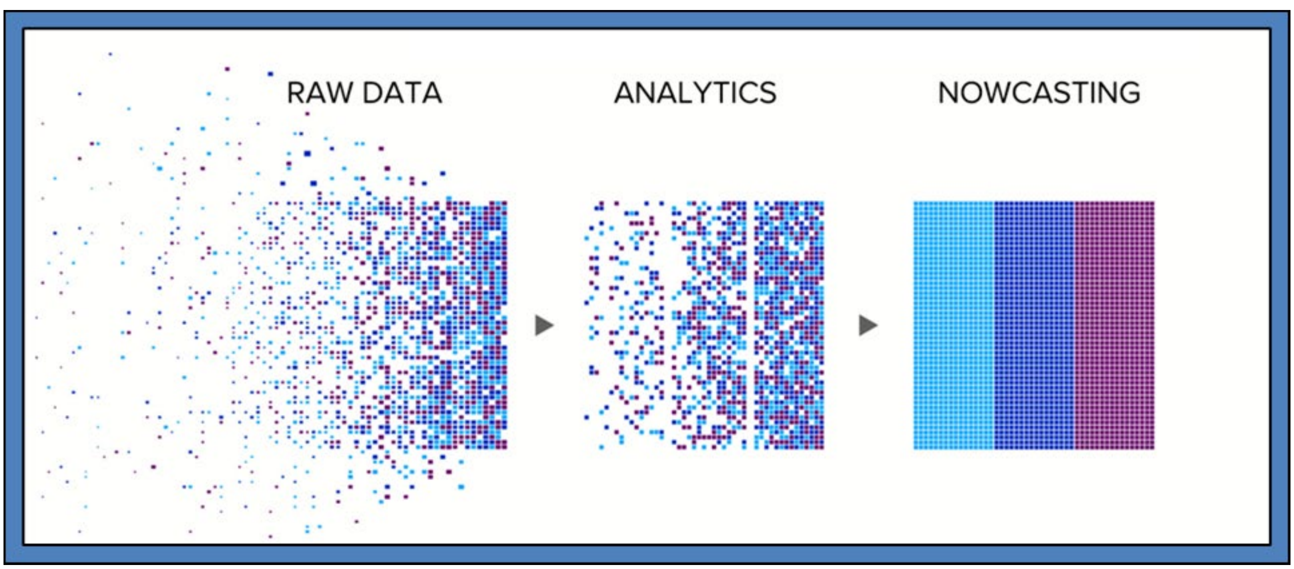
Introduction

Traditional oil market analysis has often relied on applying classical statistical methods to historical data in order to identify possible patterns in the data that may have predictive power for relevant data points. However, this approach has a key limitation. The ever-changing structure of oil markets makes the detection of these relationships a moving target.

Because of the availability of new high-frequency data sets in oil markets, the phrase "data is the new oil" is commonly heard. Nevertheless, just as crude oil needs to be processed in order to be consumed, this new data lacks value without the proper refinement. Properly refined, these new data sets can be leveraged to generate something more reliable than a forecast, a "nowcast." See Figure 1.

Figure 1
Nowcasting Can Turn Big Unstructured Data into Valuable Market Insights



The rest of the article is divided into the following sections: first, a brief explanation of nowcasting is given, highlighting the benefits over forecasting. Secondly, a description on how nowcasting allows our company to generate a digital twin of the oil supply chain, expanding on the use of cargo tracking data to measure flows in real-time and geospatial imagery to measure stock changes. Finally, a conclusion is given on how nowcasting will continue to find its way in the energy markets.

What is Nowcasting?

Nowcasting is the prediction of the present, the very near future and the very recent past in economics and meteorology. The technique of nowcasting has been used in meteorology for a long-time. The term itself is a contraction of "now" and "forecasting" and refers to the utilization of readily available data sets to infer the current state of a variable. It is about predicting the present, the recent past and the near future. One can use this technique to estimate the global oil supply and demand in near real-time. Nowcasting models use unstructured data sets to make:

- *Direct measurements*: the target variable is directly observed (e.g., remote sensing via satellites of oil inventories or the digital twinning of the oil supply chain)

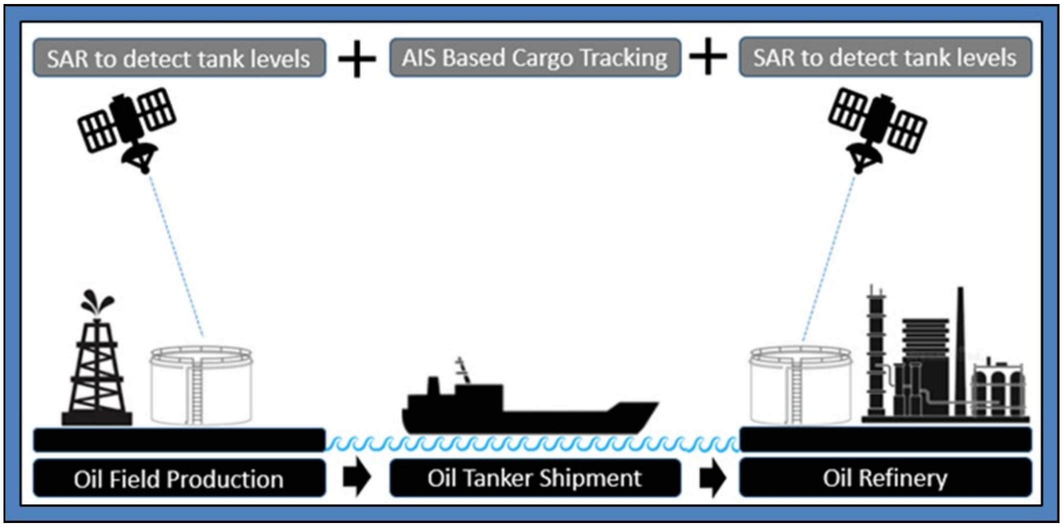
- *Short range predictions*: the target variable is not directly observed (e.g., Apple Mobility Data to infer U.S. gasoline demand)

As López de Prado and Lipton (2020) note, the advantages relative to forecasts are the following: direct measurements always hold true as they do not rely on a statistical lead/lag relationship. Short-range predictions are far more stable than long-range predictions.

A Digital Twin of the Oil Supply Chain

In aggregate the oil market functions like a giant bathtub: supply comes into the market from the faucet and exits through the drain, the demand. Too much supply relative to demand and the bathtub fills up; too little supply relative to demand and the bathtub drains. This flow sets the price. To go into a bit more detail, oil is produced and moved to some type of storage tank. Ultimately, the oil is moved to a user. The mode of transportation could be by truck, rail, water, or by pipeline. The oil is generally transported to a refinery that converts crude oil into a more valuable product such as gasoline. This is happening at a global scale. Figure 2 on the next page illustrates the flow of oil, including its tracking, from production through shipment to storage at a refinery.

Figure 2



Note: SAR stands for Synthetic Aperture Radar; and AIS stands for Automated Identification System.

Because of these continuous transit and storage phases, market participants with large assets through the supply chain, physical oil traders, have historically held an advantage in estimating if the bathtub is filling up or draining. However, in recent years this advantage has waned as new technologies are democratizing access to the otherwise rare data, allowing more players to understand the physical state of the oil market. Coupling these new data sources with other historical data sets through sophisticated machine learning algorithms can overcome the challenges of scale and allow a company to replicate digitally the global crude supply chain with nearly real-time observations.

At our company, there are two main alternative data sets that work as direct measurements, which allow us to come up with short-range predictions of the current status of the global crude markets: cargo tracking and geospatial imagery.

Cargo Tracking

The base data set involved in any effort to track the movement of oil by tanker is the Automated Identification System (AIS). AIS is a platform by which vessels communicate their location and other critical information such as current course and speed. In a way it could be compared to the Global Positioning System (GPS) system used in phones whenever we use a navigation application. AIS identification is required for many ships by the International Maritime Organization as well as other organizations such as the U.S. Coast Guard. While there are certainly exceptions and some vessels do not comply with this rule, AIS provides a massive amount of data on the movement of the world's vessels – many of which are transporting crude oil or refined products. This data is collected by receivers located around ports, but given that the range of an AIS signal is only about 50 nautical miles, satellite constellations are also used to collect AIS signals from vessels outside of the range of a terrestrial transponder. We leverage AIS data from both terrestrial and satellite sources and together with the maritime technology partner, Signal Ocean, we track over 3,200 vessels on a daily basis.

As mentioned above, although AIS provides a significant amount of information, the picture provided by AIS data is often incomplete. For instance, some vessels may not have an active transponder, either intentionally or caused by a malfunction. Moreover, AIS is not an entirely automated system, and some data such as the depth of a vessel in the water (draft) and destination are updated manually and sometimes prone to inaccuracies or input mistakes.

This inherent imperfection in the data causes challenges for those tracking the vessel's cargo. Therefore, just as crude oil needs to be refined to be consumed, in order to leverage this data it is necessary to translate a series of vessel locations into a history of standard actions that may be understandable by a computer algorithm.

Our methodology to purify this data is the following: firstly, we map every vessel's location to a large layer of infrastructure allowing us to generate a history of potential loadings and discharges. Next, we compare this with other vessels in order to identify possible ship-to-ship transfers, something that is especially relevant to understand U.S. crude exports.

At this point, new challenges arise from the complexity and granularity in the movement of cargoes, specifically from docks that load multiple types of cargo such as those that load refined products. To sort out these intricacies we combine additional data sets such as import manifests and Signal Ocean's deep database of shipping chartering details and fixtures. These data sets provide critical context for the AIS data and can tell which products a vessel was chartered to carry, the dates of that charter, the involved parties, and the origin and destination of the vessel.

By combining these different layers of data, we can accurately understand active cargo movements as well as make inferences about future movements based on historical actions. Additionally, we can predict which crude grades load from which docks and infer possible destinations.

To sort out these intricacies we seek to add additional context. For this, we rely on U.S. import manifests reported daily, port reports and Signal's fixture database, which contains multiple sources of fixture data. By assigning the origin, destination, quantity, and grade to each vessel movement we are then able to provide a real-time view of how much oil has been exported by a specific port. From a port level, we can roll up to a country level and understand flows between countries or regions. We then compare our estimates to national statistics to test and fine-tune our model. Finally, on top of all this, an additional layer of data is added: country specific customs data provided on a lagged monthly basis. By doing this regularly we are able to validate our results and also ensure that we are reacting and adjusting for changes in infrastructure.

Oil Inventories

The second alternative data set that has become widely used in the oil market is geospatial imagery. Satellite imagery was once only available to the government or large corporations, but this data is becoming increasingly available and on a more frequent basis. The eye in the sky is most useful for tracking oil in storage. Examples of satellite imagery for oil in storage are provided in the next two pages in Figures 3 through 5.

Figure 3
Tank Terminal: High-Resolution, Low Frequency Optical Image on the Left and Low-Resolution, High-Frequency Image on the Right

Since a large percentage of crude oil is stored in tanks with floating roofs, we can use the depth of the tank's roof to estimate the amount of oil being stored in the tanks. For estimates of inventory in floating roof tanks, two types of satellite imagery are generally used: optical and SAR (Synthetic Aperture Radar) images.

Figure 4
Tank Terminal: Optical Image on the Left and SAR Image on the Right

Optical satellite imagery is similar to traditional pictures, only taken from space. However, standard optical cameras cannot penetrate dark skies or dense clouds. Therefore, the use of SAR technology becomes essential. Unlike optical images, SAR signals are not weather nor light dependent.

We leverage the imagery provided by the Sentinel constellation of the European Space Agency (ESA) whose satellites complete a scan of Earth every six days. Given the vast number of tank farms and the dispersion of their location, machine learning algorithms are needed to accurately translate both images into an estimated level of storage.

Figure 5
Cushing, Oklahoma Tank Storage: Automated Optical Tank Detection

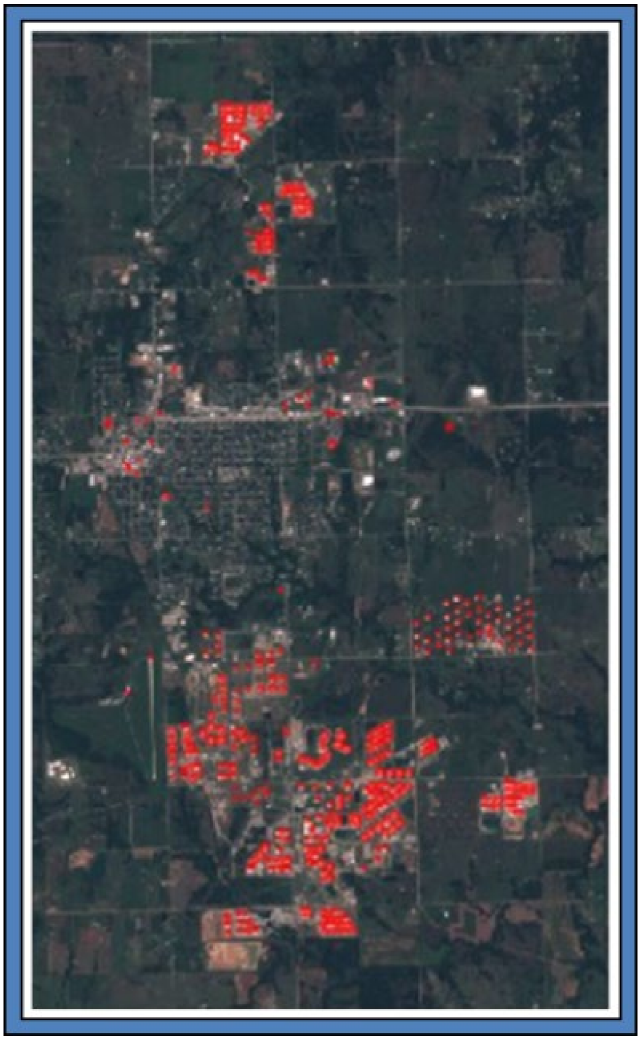
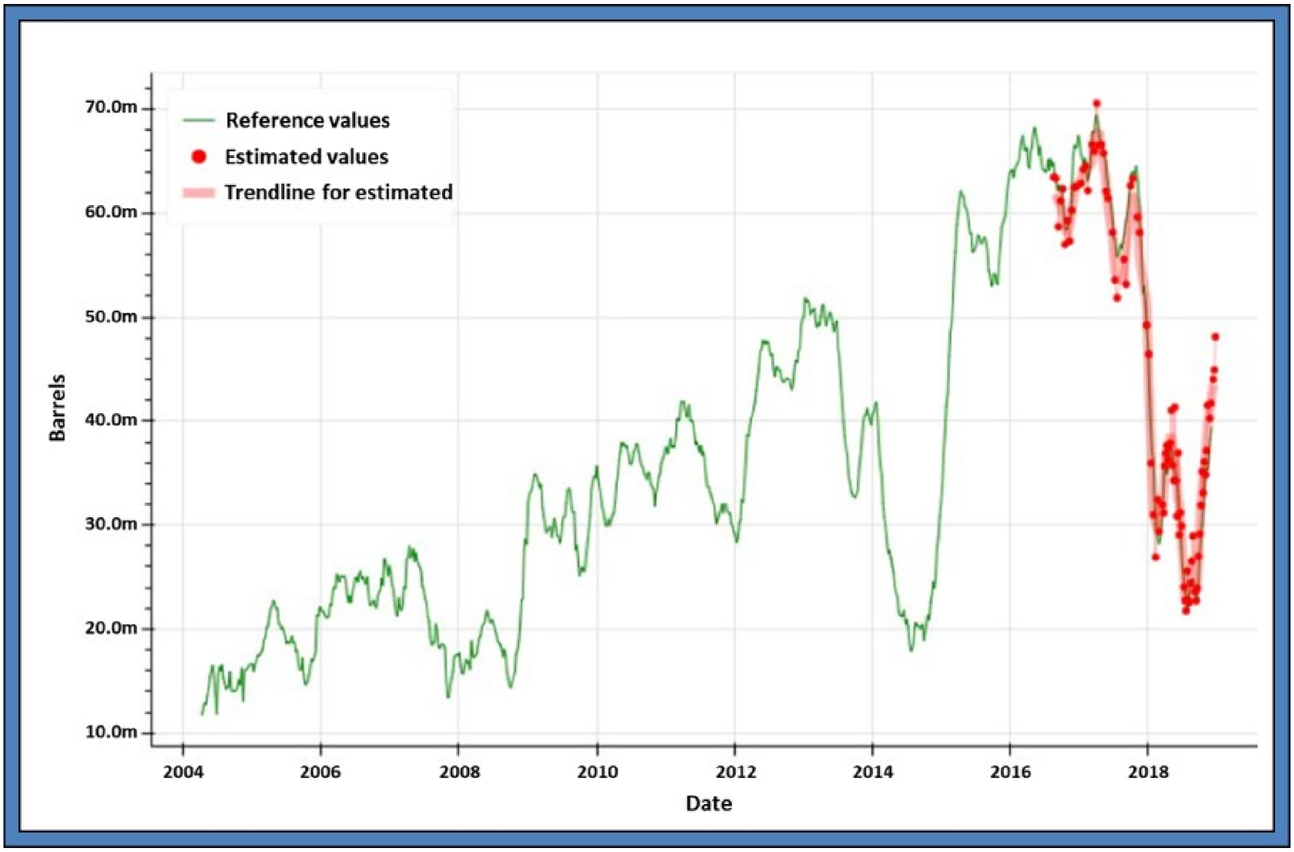


Figure 6
Cushing Inventories: Time Series Modeling vs. EIA Data



Note: The U.S. Energy Information Administration (EIA) data is represented by the green line while the estimated values from our algorithms are depicted with the red dots and solid pink line.

Our machine learning algorithms identify the position of a tank's roof relative to the rest of the tank effectively allowing us to estimate the amount of oil stored inside every tank. Figure 6 above provides an example of our algorithms' estimated values for Cushing, Oklahoma storage relative to U.S. Energy Information Administration data.

Field expertise is crucial in order to point the algorithm to the right tank farms. Our oil experts have access to a global network of oil logistics experts to assist with model calibrations. For instance, some tank farms in the Middle East are partially buried into the ground for extra security and additional calibrations are needed to enhance the accuracy of the algorithm. Furthermore, in densely urbanized areas, some industrial tanks holding other liquids can be mistakenly classified as crude tanks causing incorrect readings.

Where Do We Go From Here?

Oil cargoes and oil inventories are just two examples of how oil market participants are leveraging the vast amount of data now being generated to create a digital view of the world. By employing a "nowcasting" methodology in conjunction with this data, we are able to achieve a far better and accurate view of what the current state of the market is. This provides an opportunity for efficiency gains across the industry.

Finally, we are continuously looking for new and different sources of data to further our understanding and provide insights into areas that previously relied on traditional forecasting. As we build out our understanding of different pieces of the oil market, we can gain a better understanding of what is happening in the whole. We can create a picture of the market, and this allows us to understand aspects for which data might not exist.

Endnote

1 Established in 2018, OilX combines the latest in advanced data science frameworks with extensive oil analytics knowledge to create the first real-time supply-demand balance tool. Headquartered in London, OilX has more than 15 years of oil analytics experience across oil majors, investment banks and hedge funds at the highest level. For more information, please visit www.oilx.co.

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Mr. Juan Carlos Rodriguez was the Head of the FX & Commodities Desk at the Central Bank of Mexico where besides investing the reserves portfolio worth over $175 billion, he led the execution of the world's biggest oil hedging program. He now works as an Oil Economist at OilX where his focus is on generating market research and combining fundamental and systematic trading strategies.

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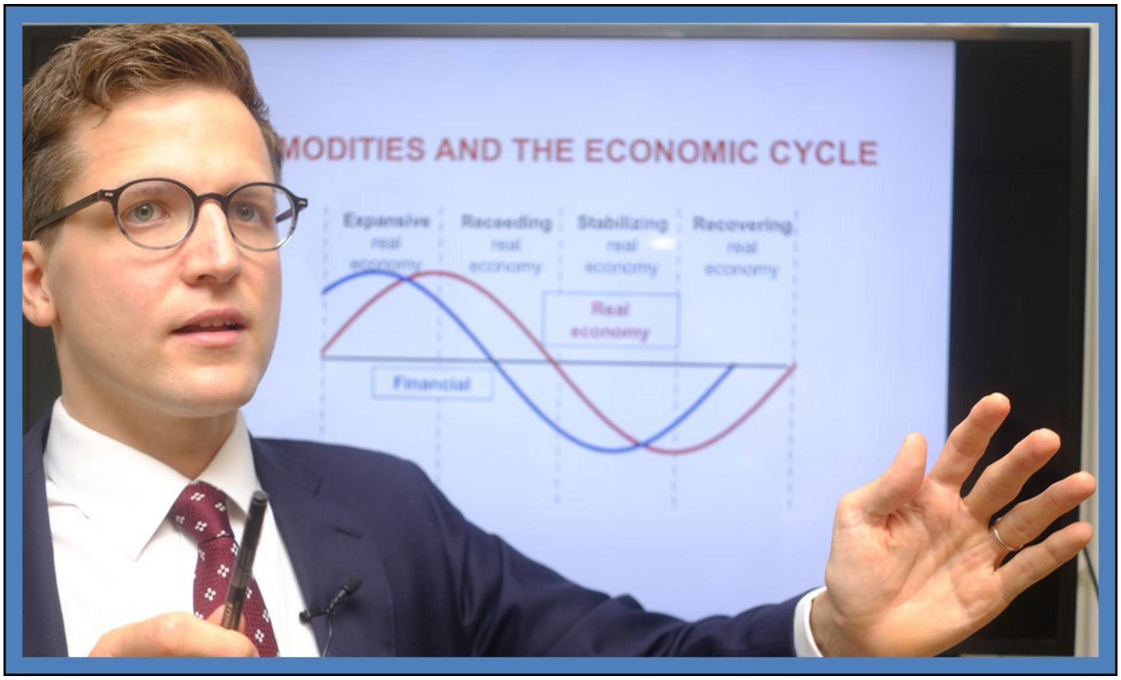
Mr. Bert Gilbert was the Americas Oil Market Specialist at Bloomberg for five years and later ran the oil focused research for Bloomberg New Energy Finance. Prior to these roles, he held a business development role selling Bloomberg licenses to oil market participants in Calgary and Houston. Prior to joining OilX, he most recently worked on developing a vessel tracking platform for Enverus.

Can a Responsible Investor Invest in Commodity Futures?

Gillis Björk Danielsen
Senior Portfolio Manager, APG Asset Management, The Netherlands



Mr. Gillis Björk Danielsen, Senior Portfolio Manager, APG Asset Management, presenting on commodities and the economic cycle in an introduction to commodities.

Problem Statement

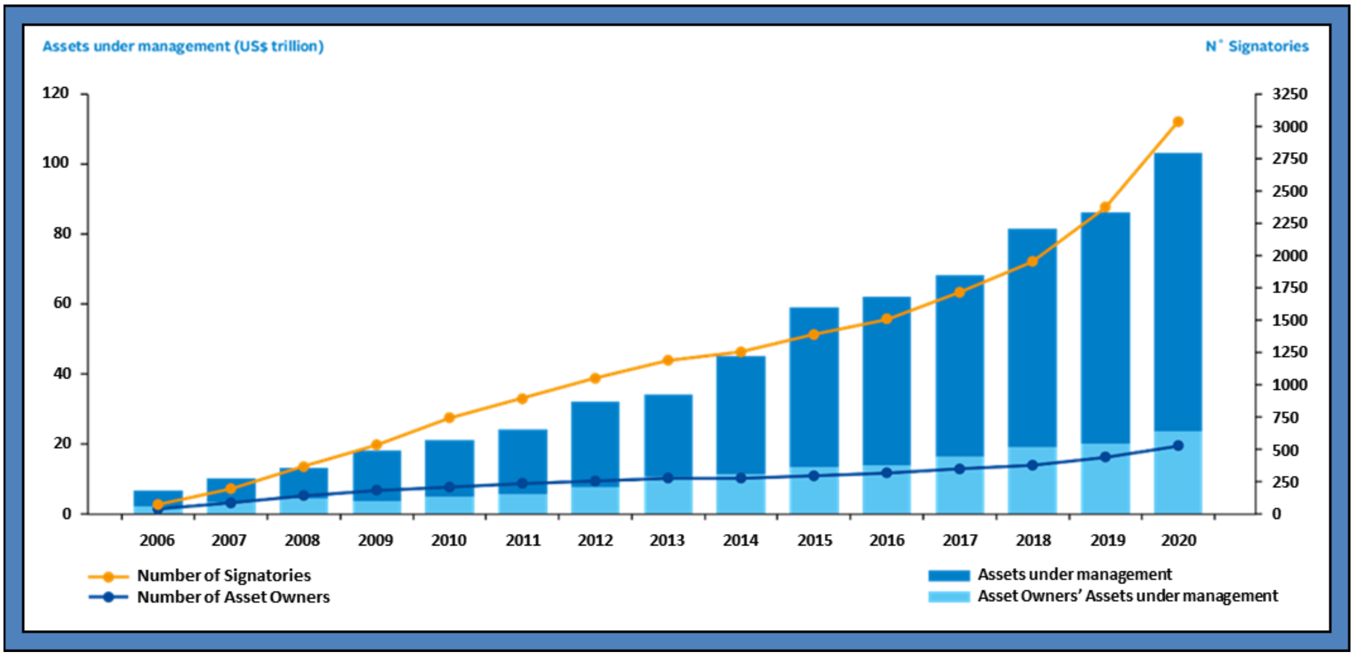
Efficient institutional investment portfolios include commodity derivatives. This may be through long-only allocation to commodity beta-risk, or through long and short positions taken by macro hedge fund mandates or alternative risk premia strategies. Simultaneously, a growing number of investors perceive the importance of responsible investment both from a moral and risk standpoint. The total number of institutional asset managers striving towards responsible investment portfolios is constantly growing (see Figure 1 on the next page).

While there is a solid understanding today about the many ways responsible investment can be integrated into equity and bond investments, reasonable and complete guidelines and industry consensus for what responsible investment entails for commodity derivatives is still missing.

This article attempts to summarize and discuss the various perceived Environmental, Social, and Corporate Governance (ESG) issues with regards to allocating capital to commodity futures. I also discuss how already available policies and guidelines could reasonably be applied to answer these questions. Lastly, I propose two actions available to investors.

Throughout this article, I will only discuss purely financial investment use of commodity futures. That is, futures positions that are rolled forward well ahead of contract expiration and are not hedges for any physical good. Furthermore, for brevity, I will limit the discussion to commodity futures although my arguments can also be extended to other types of commodity derivatives.

Figure 1
Signatories to the U.N. Principles of Responsible Investment and Their Combined Total Assets Under Management by Type



Source: United Nations' Principles for Responsible Investment website.

Applicable Guidance and Terminology

Throughout this article, I attempt to discuss responsible investment using the terminology, and the spirit, of the two available key instruments for responsible investment: the Organization for Economic Co-operation and Development (OECD) guidance and the U.N. Principles for Responsible Investment (UNPRI). Regrettably, neither at this point in time provide comprehensive guidance specifically related to commodity futures.

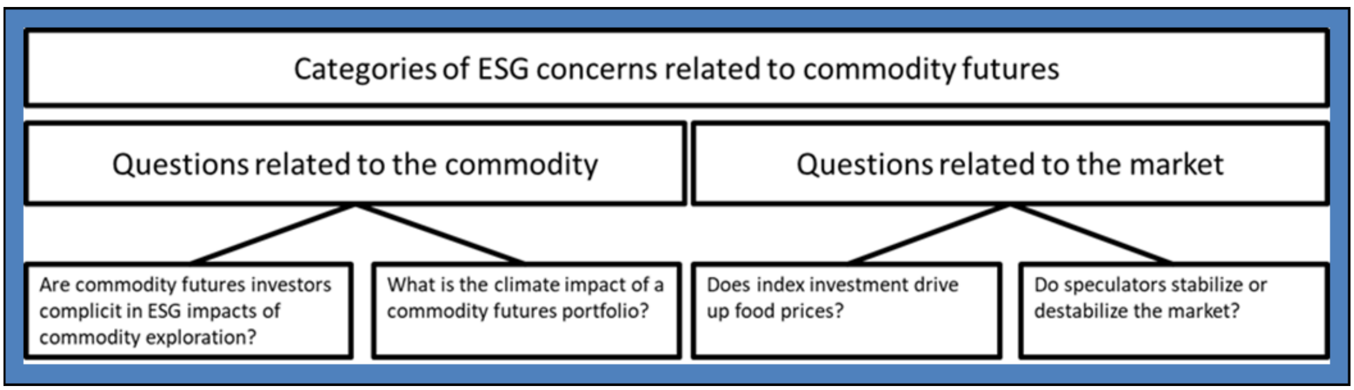
The UNPRI is a corporate responsibility instrument developed by the financial sector under the auspices of the United Nations. The PRI defines responsible investment as a strategy and practice to incorporate ESG factors in investment decisions and active ownership by adhering to six core principles.[1] *Active ownership* involves *engagement* with investments, that is, challenging investment counterparties to improve how they manage or disclose on ESG issues. If initial engagement efforts are unsuccessful, the PRI recommends collaborative engagement with other investors, reducing exposure or, as a last resort, divesting.

The *OECD Guidelines* for Multinational Enterprises (MNEs) is a comprehensive responsibility instrument addressed by governments to investors (OECD, 2017). The *OECD Guidelines* set out principles and steps that investors are expected to take to avoid and address their investment from causing *adverse impacts* across a range of societal concerns. Investors or their service providers are expected to carry out *due diligence* to avoid and address involvement with adverse impacts.

Taxonomy of ESG Questions

I argue that for commodity futures, perceived ESG issues fall broadly into one out of two categories visualized in Figure 2: Issues related to the exploration of the commodity underlying the futures contract, and issues related to the societal impact of the futures market. Within these categories, I will study two common questions, each in more detail.

Figure 2
ESG Issues



Issues Relating to the Commodity

The first fundamental question in this category is: what is the role of commodity futures investors along the value chain? Is the investor a stakeholder in activities involved in extracting or processing the commodity?

When it comes to equities and bonds of corporations involved in the exploration, processing and refining of commodities, this link is clear; the investor provides capital, which the corporation uses in order to produce more of a particular commodity in a given way. The corporation undertakes these activities with the intent of making a profit, allowing it to return the investor his investment plus interest. As the investor finances these activities through the purchase of equities or bonds, the investor also gains tangible leverage to influence particular corporations' actions. In the parlance of OECD guidelines, *business relationships* entailing certain responsibilities are present (OECD, 2017, pp. 12-13).

The same relation does not exist when it comes to financial participation in commodity futures markets. Even though futures contracts have physical commodities underlying the contracts, they do not, before expiry, give their holders any rights beyond receipt of price returns. In fact, before the delivery period, the investor's futures contract is not linked to any particular source, production method or seller beyond what is required by the contract specifications.

Throughout the investment, the investor never owns a particular commodity, and therefore the investor cannot perform due diligence on its source, nor can the investor favor more sustainable alternatives among the range of grades and qualities available for delivery. It would be unreasonable to argue that the investor holds accountability of all possible commodities that might have been delivered, had the futures contract been held to expiration.

Various ESG issues undeniably exist along commodity value chains. OECD guidelines do encourage responsible investors to take part in industry initiatives that aim to increase overall industry responsibility (OECD, 2017, p. 14). With such an initiative, commodity futures investors can petition exchanges to increase minimum requirements on deliverables where desirable, a complex topic in itself, discussed later in this article.

The second fundamental difference to an equity investment is that as futures contracts do not finance exploration, such positions also do not create or destroy any additional supply of the commodity. Because no commodity is created or consumed, popular ESG metrics familiar to equity investors, such as the investment's carbon footprint, lose their meaning for futures. Nevertheless, financial service providers have, in the name of ESG, taken to marketing modified commodity indices with constituents that are less energy intensive to extract (Ghia *et al*., 2020). When considering the investment case for switching to such an index, an investor ought to accept that even though the new index may have other merits, it cannot reasonably be claimed to reduce portfolio GHG emissions.

Issues Relating to the Market

Commodity futures markets are global high frequency marketplaces transacting billions of dollars per day in financial centers. The settlement prices reached at these exchanges impact the immediate livelihoods of billions of people around the planet. It is a legitimate question to ask, does this "financialization" of commodities bear adverse impacts on society – and do investors unwittingly contribute to these adverse effects?

Futures markets help the global economy manage risk. Futures contracts allow energy companies today to mitigate short-term price volatility so they can invest into future energy sources, while also letting farmers grow their crops at a price secured in advance, without having to worry about global trade disruptions that could drive them into ruin.

Futures markets have been the extension of the spot market and the intersection between producers, consumers and financial participants for centuries. In some markets, futures have been introduced late to liquid cash market; in others, popular futures markets have existed but later were removed for regulatory reasons. The economic historian David Jacks analyzed 18 markets from these two categories over the last 150 years, concluding that there is strong evidence to show the existence of futures markets has lowered the volatility of the traded commodities (Jacks, 2007).

It may be countered that recent financial innovation such as high frequency trading and modern asset allocation techniques have skewed such results, making them irrelevant in reflecting the dynamics of today's financial market. However, there is very little empirical evidence to support this position. The U.S. Commodity Futures Trading Commission releases weekly statistics detailing what kind of investors hold which positions in the market. These statistics have changed remarkably little over the last decades, even as financial technology has simultaneously evolved significantly (see Bhardwaj *et al*., 2016; Kang *et al*., 2019). Also today, commercial hedgers remain on aggregate short while speculators are on aggregate long. Both parties hold similar overall stakes of open interest.

This leads us to the second common question; given that commodity speculators are biased to the long side, can they be the cause for too high global food prices? This discussion was particularly active around the year 2008, as many staple food commodities had risen to all-time highs concurrently with capital inflow into commodity futures index funds. In studies of the possible causality, the question is typically called "The Masters hypothesis," according to investor Michael W. Masters, who testified in front of the U.S. Congress that it was his belief that commodity index funds had caused the record market prices seen at the time.

The Masters hypothesis has been quite actively debated in academic publications over the decade following that hearing. In their 2015 review article, Will *et al*. (2016) conclude:

> "All articles that successfully passed academic peer review, as well as the vast majority of the empirical contributions to gray literature, unanimously arrive at the conclusion that financial speculation does not have an adverse effect on the functioning of the agricultural commodities markets."

To be clear, commodity markets can, as can all financial markets, be temporarily squeezed or manipulated. However, such manipulation tends to be related to criminal actions. Cornering a market almost certainly requires the investor to breach position limits set by regulatory agencies at levels intended to prevent investors acting in good faith from causing undue disruptions to the market.

What Can an Investor Do?

Various Environmental-, Social- and Governance issues are known to exist along commodity value chains. As this article has argued, commodity futures investments are not directly linked to particular exploration practices, which also means futures offer their investors limited leverage for active investment. Nevertheless, I want to highlight two actions available to investors.

Engage the Exchange

Both exchanges and financial industry organizations have voiced their willingness to engage with stakeholders to find financial solutions for a more sustainable future.[2] Responsible investors need to answer the call and take the industry up on its word.

The futures investors cannot know what product will eventually be delivered against a futures contract beyond the minimum requirements set out in the contract specifications. Commodity exchanges define these contract specifications, and they have historically been based almost solely on physical or chemical properties alone.

Fundamentally, both the exchange's and its investors' incentives are in setting the contract specification in ways that maximize participation at the exchange, maximizing market liquidity and minimizing transaction costs. Setting contract specifications is a complicated multi-stakeholder process, which when hurried or ill-conceived can go wrong with disastrous consequences for the market as a whole. A textbook example of a one-sided change gone wrong was when the Kansas City Wheat contract abruptly lost 2/3 of its open interest in 1953 as the contract was made less useful to millers, by including a seller's option to also deliver soft red wheat (Till, 2016).

The World Federation of Exchanges released a working paper highlighting many further challenges exchanges face in incorporating sustainability standards in contract specifications (WFE, 2019). Firstly, should the new standards be enforced on current contracts, or be launched as parallel contracts? Secondly, how can standards be made simultaneously loose enough not to disrupt small but responsible producers while tight enough not to become meaningless or unenforceable?

Responsible futures investors can make their voices heard to the exchanges, and they can support and encourage exchanges to investigate or undertake responsible sourcing initiatives. Nevertheless, the investor must remain cognizant that it is unlikely futures contracts can both fulfill their societal role as the global facilitators of trade while simultaneously strictly confining contracts to only the very best sourcing practices.

The Portfolio-Holistic Approach

For a diversified asset allocator, it is important not to lose sight of the goal of responsible investment: to invest in a way that mitigates or even addresses adverse effects on environment and society. An investor who wants to impact the issues prevalent in the exploration and refining of commodities should not miss the direct possibilities the rest of their portfolio gives for that. Global equity and bond indices cover many of the integrated corporations involved in exploration, processing and consumption. Therefore, it makes sense that ESG views are implemented in a holistic way where leverage is applied where it is most available to the investor.

As a simple case study, I illustrate this point by studying five industrial metals. Primary production of metals is a sector known for many ESG risks while simultaneously being an essential sector to grow for accomplishing the global energy transformation. Our analysis shows that owning popular benchmark equity indices entails holding business relationships with 30-91% of the world production of each of these five metals (see Figure 3 on the next page). Engagement with investments, be it through proxy voting or direct management outreach, gives the investor an efficient form of leverage to favor responsible practices.

Figure 3
Share of World Metals Production in Benchmark Equity Indices

	World production 2018	Produced by companies in MSCI World/EM indices	Share
Copper	20 851 kT	9 543 kT	46%
Platinum	5 200 koz	4 724 koz	91%
Aluminium	64 338 kT	29 783 kT	46%
Iron ore	1 854 MT	1 184 MT	64%
Zinc	13 848 kT	4 202 kT	30%

Based on the constituents of the MSCI World and MSCI Emerging Markets equity indices as of August 2020. Companies are included in the tally if they, or their current subsidiaries, were among the largest producers of a particular metal in 2018. Metals production means primary mined production.

Source of Data: APG-AM, Morgan Stanley Research, FactSet, Company filings.

Conclusions

I have discussed the key questions and concerns a responsible commodity futures investor must be able to address. Firstly, the indirect relation between the commodity futures investor and the physical commodity market: a commodity futures investment is not tied to any particular source or production method. Secondly, I have discussed how commodity futures investments do not create or consume the underlying commodity.

These two facts can appear paradoxical at first, and it will likely remain a challenge for the investor to explain them to his stakeholders. However, it is important that investors have these conversations instead of opting for "easy fixes" such as reweighting benchmarks or excluding futures altogether. Both are likely to lead to less efficient portfolios without *de facto* improved ESG performance.

In the second part of the article, I discussed commodity futures markets, and the societal role they play as the place to transact risk between producers, consumers and financial speculators. I find the weight of current evidence strongly favors the view that financial speculation into commodity futures does not destabilize nor skew prices away from fundamentals in either the futures or the cash market. While it is empirically difficult to completely rule out any causal link between speculation in commodity futures and any sort of short-term adverse price effect, investors can, in the light of current evidence, conclude that the net effect of futures market speculation remains positive for society.

Lastly, I have suggested two tangible actions that responsible commodity futures investors should consider: engagement with exchanges and a portfolio-holistic commodities ESG integration.

Endnotes

I am grateful to Professor Geert Rouwenhorst of Yale University, as well as Ralph Sandelowsky of Achmea Asset Management, for insightful discussion and feedback when writing this article. I would also like to thank Susan Bates of Morgan Stanley for providing the company filings data underlying the case study.

1 See "What are the Principles for Responsible Investment": https://www.unpri.org/pri/what-are-the-principles-for-responsible-investment.

2 For papers on finding financial solutions for a more sustainable future, see WFE (2018), FIA (2020) and LME (2020).

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Mean Reversion, Markets, and the McRib:
The Observations and Lessons from Seasoned Commodity Traders

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Ashmead Pringle
President, GreenHaven Group, LLC

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Founder, C&C Ag Consulting, LLC

Introduction

This article chronologically discusses the lessons learned from our diverse experiences in the commodity markets. Typically, one can only gain expertise in commodity trading if one has worked in niche commodity-processor companies, in banks that specialize in hedging project risk for natural-resource companies, or at highly successful proprietary trading companies. In contrast, this article provides the reader with practical lessons regarding the commodity markets without having to undertake these professional experiences.

Commodity-Index Exchange-Traded Fund

In 2008, our firm was involved in launching a long-only commodity-index Exchange-Traded Fund (ETF). This ETF index fund followed the strategy of the original Commodity Research Bureau (CRB) equally-weighted commodity index. This ETF was early-to-market in 2008 to meet the demand of what at the time was a Wall Street wide allocation of investor and institutional capital to long-only commodity indices for inflation hedging. This effort led to our appreciation of the potential returns from a "rebalancing bonus" in a diverse portfolio of commodity futures contracts.

Agricultural Business Ventures

But since 2008 our team has evolved: we ventured into the production of agricultural products, i.e., farming, as well as the risk management of livestock, feed inputs, and energy inputs. We have also actively traded our own accounts to take advantage of opportunistic, seasonally-oriented trades.

Our team learned further lessons from our agricultural business ventures: regardless of whether one is building a long-only commodity index fund, managing a hedge on physical commodities, managing a "tail hedge" on the interest cost of a physical hedge, taking a speculative spread, option or directional position, or simply working within the sector of a commodity space, a keen understanding of seasonal and calendar events is as important as understanding supply and demand.

Without this understanding, a price move in a commodity may be mistaken as a counter-seasonal move when in actuality it may be the result of index funds rolling from front months to back months as they do every roll period. Or observing a futures contract converging with cash in the delivery period may send the wrong signal to someone not informed on these seasonal or calendar events.

This paper will provide three examples of the effect that seasonal events can have on the price action of commodity futures and cash commodities. Each commodity is different, but all are affected by the calendar constraints of the traders in the commodities. Month end, quarter end, holiday schedules, delivery schedules, spring, summer, winter, and fall all have profound impacts on price.

Trading System Design

This paper concludes with a brief discussion of how a trading system based on mean reversion can potentially be improved upon by incorporating seasonal and calendar events in its algorithm. The principles underlying such a system are based on our experiences noted above, namely managing a daily-rebalanced commodity index and running a physical commodity hedging business.

Mean Reversion

As touched upon in the introduction, our commodity team launched a commodity-index fund, which was based on the original CRB and whose methodology is based on the daily rebalancing of futures positions in order to maintain equal weights across commodities. Because of this unique index methodology, we became students of William Bernstein's (and Robert Arnott's) research, as it relates to their work on mean reversion and rebalancing returns. Our index fund's commodity basket, which is comprised of 17 commodities from all sectors, became an interesting data set which our team of traders also have examined to see if one could potentially isolate and optimize a long-short mean-reversion strategy.

Our team at GreenHaven sold the ETF business in 2016, and to be clear, the absolute performance of all long-only commodity indexes and funds that track those indexes, including the fund we managed, has not been good in terms of absolute returns since 2013. This seven-year period can be described as a deep deflationary commodity bear market. Nevertheless, the data we observed showed a strong relative outperformance of a daily rebalanced fund versus its peers that had quarterly or annual rebalancing.

Bernstein (1996) provides insights into the potential benefits of rebalancing. He instructs that the "expected return of a rebalanced portfolio is not accurately represented by a simple arithmetic weighting of individual asset returns." Bernstein also states that "[i]t may be possible to sort assets for a rebalancing return by looking to pair assets with a high standard deviation and low or negative correlation." Furthermore, Bernstein's 1996 paper provides a formula to predict the rebalancing benefit and contemplates using such a formula to predict optimal rebalancing frequency.

Based on Bernstein's work and our own projections and observations, we believe that the historical return profile of several long-only commodity-index ETF's have displayed the following performance characteristics. For the period from 2008 through the present, a fund that bought the commodity futures that have declined in price while selling the commodity futures that have increased in price, rebalancing daily to maintain an equal-weight portfolio, provided an annualized outperformance or "rebalancing bonus" of approximately 0.8% to 1% net of fees, slippage, and commissions. Compounded over a decade, this has led to an outperformance of 10% to 15% versus longer rebalancing periods. We will return to the mean reversion/rebalancing theme later in the article after discussing further insights that we garnered from our physical commodity business.

Market Seasonality and the McRib Effect

As our team moved away from focusing on the commodity ETF business, we focused our attention on our core competency, which is risk management services for customers in the U.S. grains, lean hogs, live cattle, and feeder cattle sectors. This renewed focus led to learning further lessons on idiosyncratic commodity characteristics, namely the importance of seasonal effects, which will be discussed in this section of the paper.

One aspect of our risk-management business is managing the "crush" margins for hog and cattle producers. A "crush" in U.S. livestock business vernacular is a cash-flow hedge of the inputs and outputs of the business. We hedged corn and soymeal as feed inputs and sold forward lean hog futures and live cattle and/or feeder cattle futures against forward purchases and sales. This allowed customers to lock in a margin of the cost of production and expected revenue per unit of commodity sold.

Based on our experience with hedging livestock margins, we learned that calendar and specific seasonal events within the agricultural industry were in many ways of equal or greater importance than the understanding of fundamental supply and demand. Interestingly, this observation is not referring to random events such as a cold winter or a drought-stricken summer that can affect supply and demand beyond expectations. More specifically, we found if one researches each commodity and its sector, there are repetitive seasonal events impacting supply and demand of the commodity or the commodity futures contract that the market may not necessarily price efficiently in the forward market, but which the experienced commodity expert is well aware of. It may be a subtle fact such as a key holiday falling on a weekday or weekend, which if it falls on a Friday or Monday may materially change the number of manufacturing or processing days in a month by 10 to 15%. Short-term supply is certainly impacted by holiday schedules. What if the Easter holiday is in early March versus early April? What happens if Christmas and New Year's Day are on a Friday and processing plants cancel Saturday processing for two consecutive weeks?

The data-driven quantitative analyst and the physical commodity trader alike observe that specific markets tend to trend and mean revert strongly within one-year periods, which is correlated with specific calendar dates that can create extreme tops and bottoms. For the casual or uninformed professional, the market may seem irrational and out of touch with supply and demand numbers. For the informed professional it becomes an expected seasonal move.

If we have any advice for a student or new professional to the world of commodities or a specific commodity sector, it would be to understand the direct and indirect seasonal factors that impact prices and/or the demand for futures. We provide specific examples in the next section of this article.

The McRib

In 1981, McDonald's released the McRib Sandwich, a processed pork barbeque sandwich trademarked and sold by McDonald's. Since the late 1990s the McRib is only offered seasonally, becoming a cult classic, whereas food bloggers and connoisseurs of the sandwich would speculate on whether McDonald's would bring back the McRib again. (See Kleincast (2016), ABC Channel 7 Chicago (2017), McRib Locator (2018), and McDonald's Corporation (2019).)

By paying attention to marketing campaigns, one could see that businesses would act rationally according to the seasons. The annual fall release of the McRib coincides with the lower price of pork that is due to the biological fact that pigs breed more piglets in the spring that hit the markets in the fall and have less success breeding piglets in the fall that are marketed in the summer. In addition to recognizing the McRib's annual release within weeks of the typical fall low for pork prices, one can also observe that October is National Pork month, which presumably is meant to encourage demand during this seasonal period.

The McRib Cycle

Based on data from the Moore Research Center, one can observe that from 1990 through the present, prices in the hog cash market have fallen into the fall in 27 out of 30 years with the cash price falling as much as 40%+ from the summer high. There are exceptions such as supply disruptions due to disease such as in 2014 with the PED virus and in the fall of 2020 with supply impacted by euthanized piglets due to COVID-19. Notably, the futures contracts have generally priced in relatively modest changes in cash prices as compared to the actual cash changes that have been realized.

"McCorn Cycle"

One can observe other seasonal patterns, which while not always the case, merit attention in commodity trading. Drawing again from Moore Research Center data, corn typically rallies in the cash market from the fall low, peaking on average in late June over the last 30 years. The futures curve is generally upward sloping from the fall into the summer, but the actual spot move can be several standard deviations greater than the implied seasonal move calculated from the futures curve during the fall.

"McBeef Cycle"

An additional example can be found in the Boxed Beef market, again based on Moore Research Center data. This market has rallied in 32 of the last 33 years from the fall low to the spring high, peaking on average in late March. The price of Choice Steers has been closely correlated to this typical seasonal rally. Analogous to the previous two examples, the futures contracts for live cattle have historically priced in only a fraction of this move, as of the fall contracts.

Caveats on Seasonal Cycles

The reader should not take our position that the same trade or hedge or procurement decision works every year. But what we have observed is that the senior managers at the top of their respective commodity fields have risen to the top because they have maximized the probability of beating the market and are thus recognized for their above average achievements. To beat the market, one has to take the opposite position of the market and be correct in one's position, even if only for brief timeframes. These relative outperformers know to push their positions and risk in the seasonal periods which have the highest odds of success, long or short, and they understand how to read the calendar as much as the supply and demand or the technical analysis charts.

"McMean Reversion Cycle"

This section will briefly discuss how one can *potentially* combine insights from managing an equally-weighted, daily rebalanced commodity fund with the seasonal lessons garnered from managing physical commodity hedging programs, resulting in a hybrid trading system. That said, we fully understand that one must be cautious about how much one can extrapolate historical results into the future.

In considering the design of a new trading system, we drew from our knowledge that rebalancing asset pairs with high standard deviations and low correlations could provide a "rebalancing bonus." Our particular data set used the following futures contracts: corn, wheat, soybeans, bean oil, crude oil, natural gas, heating oil, gold, platinum, silver, copper, coffee, sugar, cocoa, cotton, live cattle, lean hogs, and since 2018, bitcoin. As a next step, we modeled the optimization of a rebalancing or mean-reverting trade strategy by examining the change in standard deviations and correlations amongst our study's asset pairs, followed by sorting the asset pairs with the highest standard deviations and low correlations. Utilizing this simple sorting methodology for mean-reversion long-short trades, we found that such a system would have provided respectable gross annual returns from January 2014 through June 2020, but with extreme volatility.

Interestingly, when we used a version of the optimization formula to pick the perfect rebalancing period, including weekly or monthly, we did not find any significant improvement to risk-adjusted returns. But once we integrated the seasonal lessons learned in the physical commodity world, the results notably improved.

Instead of trying to optimize mean-reversion trades in a linear fashion (i.e., rebalance every day, every week, every month, or say every second Friday), we adjusted the formulas to do the opposite of mean reversion in seasonal periods of extreme volatility. Arguably, like McDonald's we were attempting to gain an edge based on typically repeatable calendar events. Adding this fundamental insight to a trading system based on mean reversion produced promising risk-adjusted returns, which aligned with our experiences in the two business ventures that we discussed in this article.

Conclusion

By trading, modeling, and hedging commodities, we learned that commodities are materially impacted by calendar events and seasonality that may not be fully priced into the commodity futures markets until these events approach the maturity of a commodity's futures contract. As a result, the seasoned commodity expert in a specific sector or commodity must consider these events as catalysts for short and intermediate commodity price moves, which allow for an increased probability of mean reversion in certain time periods and an increased probability of counter-seasonal price trends in other periods. In addition, based on our historical research, we believe that these observations are useful in improving upon the design of a systematic futures trading system based on mean reversion.

Endnote

For more information on GreenHavens' perspective on seasonal commodities and mean reversion, please visit: http://www.greenhavengroup.com/public.html.

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Mr. Thomas Fernandes is responsible for the strategy and daily operations of the farmland and livestock businesses at GreenHaven. In addition, he serves on the Product Development, Land Acquisition and Hedging Committee and has been an employee since April 2020 at GreenHaven Cattle Company, LLC. Previously Mr. Fernandes co-founded and served as Chief Operating Officer of GreenHaven, LLC, holding that position since October of 2006. From May 2005 to October 2006, Mr. Fernandes worked as a commodity derivatives expert at Grain Service Corporation. Prior to joining Grain Service Corporation, Mr. Fernandes worked as an analyst at West Broadway Partners, an investment partnership from March 2002 to April 2005. From March 2000 to March 2002, Mr. Fernandes was employed as a trader at Fleet Bank of Boston and from 1996 to 2000 he was a trader at Speer, Leeds & Kellogg. Mr. Fernandes has an M.B.A. from Fordham University and a B.A. in Political Science from SUNY Geneseo. In addition, he co-authored a chapter with Ashmead Pringle in *Intelligent Commodity Investing* (Risk Books, 2007).

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In addition to serving as the Vice President of Trading and Futures Operations for GreenHaven Group, LLC, Mr. Glasing also serves as the Head Trader for GreenHaven Advisors LLC, the trading advisor of a public commodity ETF and is a developer of commodity trading algorithms. His responsibilities include daily portfolio management, cash flow management, treasury portfolio management, and quantitative analysis of commodities. Additional responsibilities include his membership on the Product Development Committee as well as carrying out futures and financial product research. Mr. Glasing also serves as the Director of Operations for Grain Service Corporation where he helps clients with their hedge accounts. He has over 34 years of futures industry experience, holds a Series 3 license and was first registered with the National Futures Association in 1988. Previously, Mr. Glasing worked with both speculative and hedging clients at several Chicago firms. He studied finance and economics at the University of Illinois at Chicago.

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Mr. Doug Wilson started as a commodity broker in the meat trade in 1992. He traded his own commodity account as member of the Chicago Mercantile Exchange from 1992 to 2004. In 1994 he founded and was head trader for a commodity fund until 1996 when he decided to focus on trading his own capital. Since 2004, Mr. Wilson has invested in the electronic trading of meat and grain commodity futures as well as various farmland development projects. Mr. Wilson studied Administration in Higher Education at Southern Illinois University.

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Mr. Pringle serves as President of GreenHaven Group, LLC. He is responsible for the overall firm strategy and serves on the Product Development Committee. Mr. Pringle co-founded GreenHaven, LLC and has served as its President since October 2006. In 1984 Mr. Pringle founded Grain Service Corporation, a commodity research and trading company where he still serves as President. He has conducted hundreds of seminars on hedging, risk management, and basis trading in energy and agriculture, and is a recognized expert in commodity risk management. He has been quoted in the *Wall Street Journa*l and appeared on CNBC. Mr. Pringle holds a B.S. in Mechanical Engineering from Duke University and an M.B.A. from Harvard Business School. In addition, he co-authored a chapter with Thomas Fernandes in *Intelligent Commodity Investing* (Risk Books, 2007).

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Mr. David Cary has been an executive in the departments of pork procurement and risk management solutions for over 35 years within global corporations such as Cargill and Seaboard Triumph Foods. Mr. Cary has developed relationships with the decision makers at the large protein companies as well as having daily direct relationships with pork producers in Nebraska, Minnesota, Iowa, Indiana, Illinois, Ohio, and North Carolina. Since 2018, Mr. Cary has been working as a commodity risk management advisor for swine and grain producers at C&C Ag Consulting, a company that he founded.

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All investments carry a certain degree of risk and there is no assurance that an investment will provide positive performance over any period of time. Commodity Trading Involves Substantial Risk of Loss.

Is Oil-Indexation Still Relevant for Pricing Natural Gas?

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Hilary Till
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The oil and gas markets have functioned over the years through megacycles that are driven by the balance between demand and supply. The trajectory of these oscillations is determined by the magnitude and the nature of the price shocks driven primarily from either the demand or the supply side. However, the COVID-19 pandemic has created a new paradigm that combines both unprecedented demand destruction and a simultaneous supply shockwave that has reverberated throughout the fabric of the energy ecosystem.

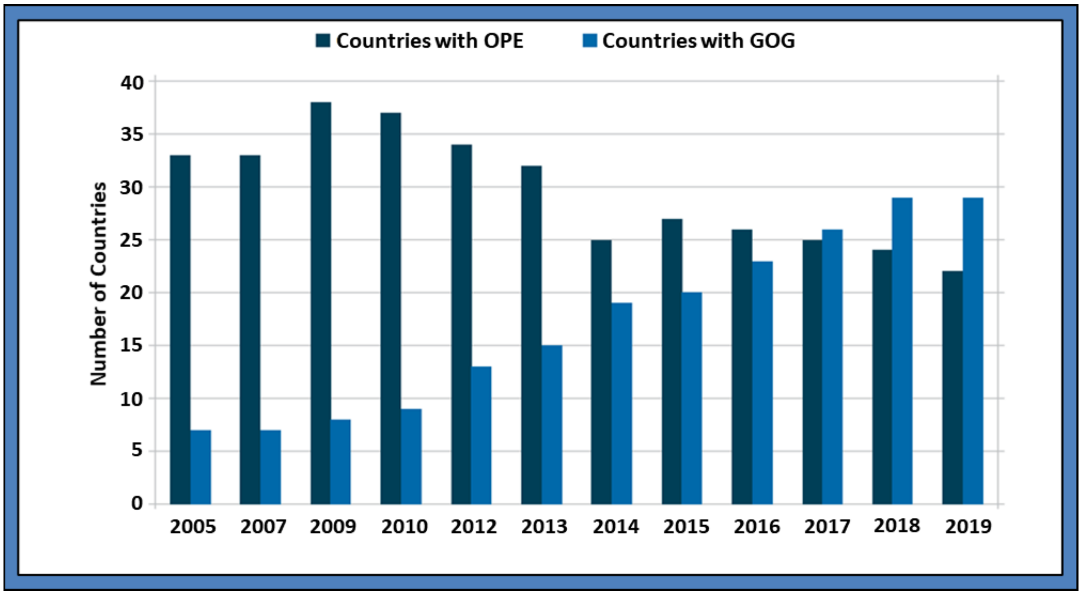
Without a doubt, this global health crisis is having a profound impact on the economy as a whole and more specifically on the oil and gas markets. It is reasonable to anticipate that these developments may create new trends while accelerating some existing ones. It is also natural to be curious about the impact of these developments on oil-linked natural gas contracts that have already been losing their luster even before the pandemic. What are the structural challenges of oil indexation? Will it survive in the long run?

Broadly speaking, there are three main regimes for pricing natural gas, whether delivered by pipeline or via Liquefied Natural Gas (LNG) transport: (1) Hub pricing also known as gas-on-gas competition ("GOG") or market-based pricing, which represents the framework by which natural gas is competitively priced based purely on the interplay between gas demand and supply; (2) oil-indexation, sometimes referred to as oil price escalation ("OPE"), which means contractually pricing natural gas using oil or other refined fuels prices; and (3) regulated prices set by governments.

Over the years, the gas industry has used oil-indexed long-term contracts that have usually been 20 to 25 years in most parts of the world. But oil-indexation is increasingly losing its economic attractiveness. Particularly with a gas glut, new arrangements that are more favorable to buyers are ever more in evidence (Grigas, 2018).

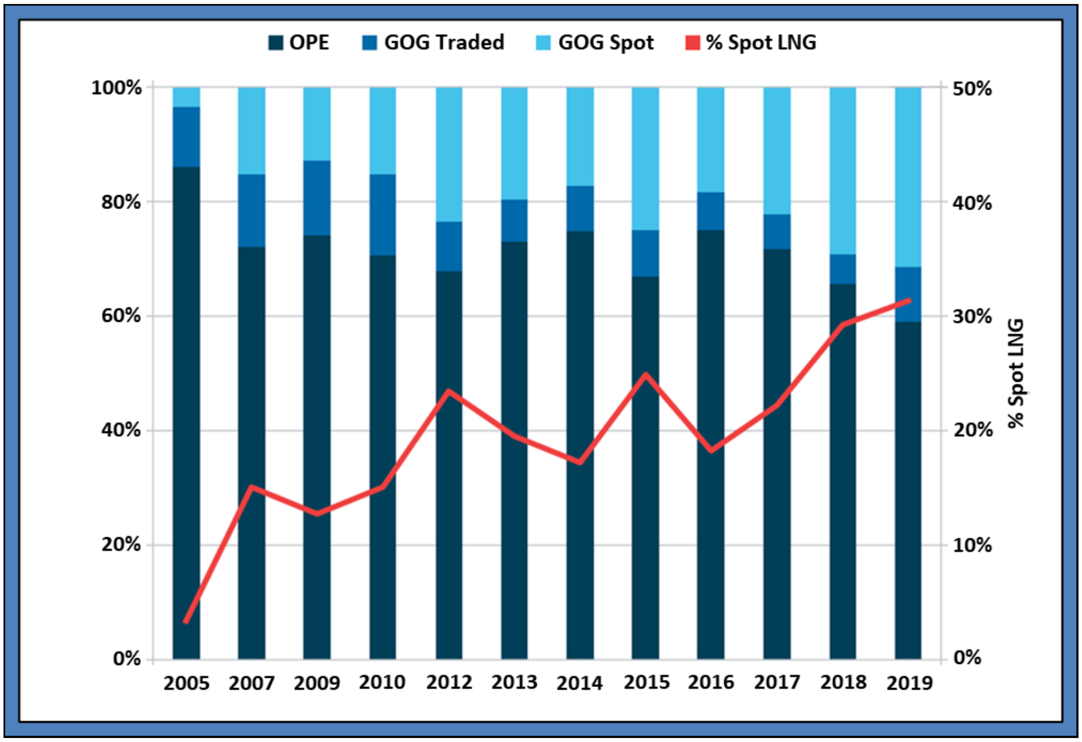
Figures 1 and 2 illustrate how more countries are straying away from OPE as a pricing mechanism and adopting GOG instead. This explains the significant rise of the market share of GOG in LNG imports from 2005 to the most recent published data of 2019 while the share of OPE continues to decrease.

Figure 1
Number of Countries by Price Formation



Source: International Gas Union (IGU) Wholesale Price Survey 2020

Figure 2
World Price Formation - LNG Imports



Source: IGU Wholesale Price Survey 2020

Regional Differences

The linkage of gas and oil prices is not uniform across the global market and should be analyzed in a regional context because natural gas is priced differently in North America, Europe, and East Asia. Each regional market has historically followed a different evolutionary path and developed independently from the others due to various considerations including regulatory environment, contractual structuring, and economic conditions. Subsequently each regional market has gained its own distinctive attributes and idiosyncrasies. That said, these regional markets are becoming increasingly interconnected (Grigas, 2018).

The natural gas market in North America relies on a purely hub-based pricing or GOG mechanism whilst at the other end of the spectrum, the East Asian gas market is still heavily indexed to oil. Corbeau (2017) noted that "[c]reating a transparent and liquid hub … [can] take a decade." The American experience is the most successful representation of the hub-based market structure. In essence, the U.S. has become home for the most mature, highly competitive, and fully liberalized gas market in the world after going through major milestones of deregulation and market liberalization, which in turn took 15 years of gradual policy changes (Till, 2018). The U.S. gas market is anchored around Henry Hub natural gas futures, which serve as a benchmark to all locations in the form of a differential or basis to account for regional market conditions, transportation costs, and available transmission capacity between locations.

The picture in Europe can be thought of as a mosaic since the level of transition from oil indexation to hub pricing varies across subregions. For example, Northwest Europe has the most advanced hubs followed by Central Europe. Southern Europe, in turn, is at an embryonic stage in hub pricing.

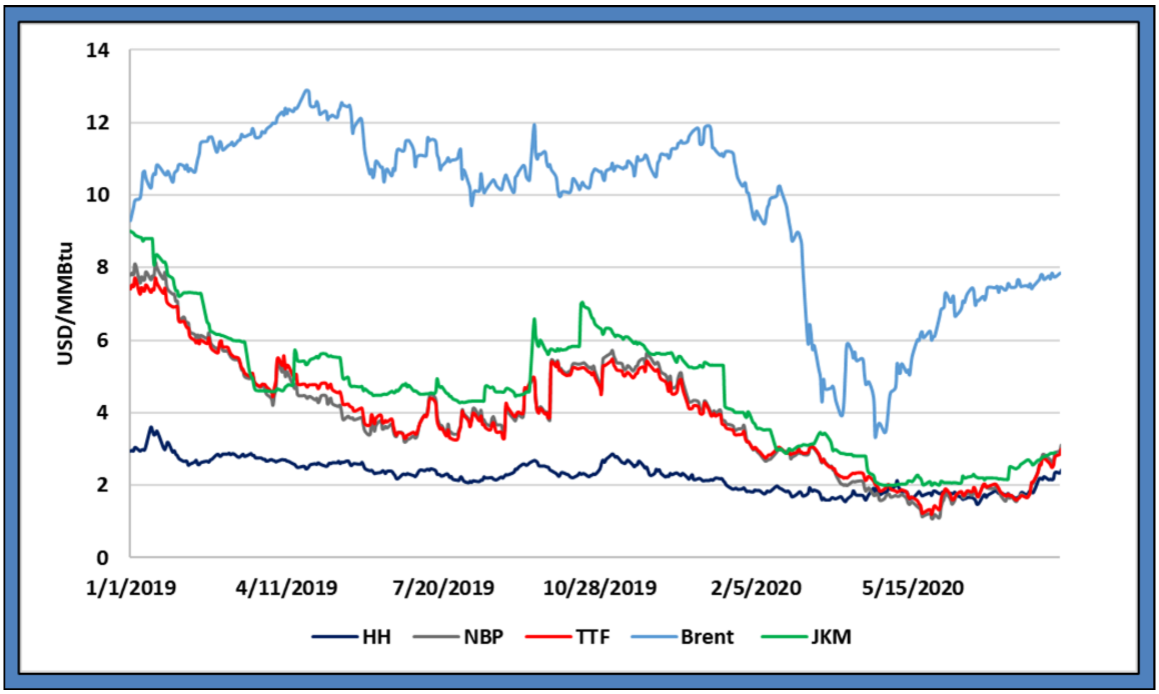
Contractual Linkage Versus Economic Linkage

It is important to differentiate between economic linkage versus contractual linkage with natural gas and oil. Oil indexation is a contractual linkage that is explicitly embedded in the contract while economic linkage refers to the direct relationship between the two fuels based on supply and demand factors. For instance, U.S. gas prices are established by the balance of gas demand and supply without any explicit reference to oil although natural gas and oil prices have moved in tandem in the long run due to their linkage through a substitution effect and resource competition (Mchich, 2018). This price relationship reached an inflection point after 2008, and they have since decoupled as the crude oil production surplus from the shale plays has redefined the relative supply structure of the two fuels.

Oil & Gas Are No Longer Competing Fuels

In Asia, the genesis of linking gas prices to those of oil related products goes back to the 1960s when Japan enacted environmental regulations and started to offer financial assistance to power generation companies to incentivize them to switch to LNG/gas instead of burning crude oil and coal. In addition, Continental Europe independently adopted a similar strategy to promote switching from oil products to gas. This contractual linkage was founded on the hypothesis that oil and gas are close fuel substitutes in energy generation and industrial plants. Essentially, this makes their relative value to be equivalent to the difference in intrinsic heat contents in addition to any costs associated with transportation and production. Their relative value had historically kept both fuel prices from deviating significantly from each other. However, this hypothesis no longer holds as oil is becoming less a generation fuel and more of a transportation fuel that is still heavily influenced by geopolitical events. Regarding the latter factor, Putnam and Norland (2020) covered the plausible disruption scenarios unique to crude oil before the global health crisis hit this past spring. In comparison to crude oil, gas is now the *de facto* fuel of the stationary sectors, which includes the commercial, industrial, residential, and power generation sectors.

Figure 3
Global Fuel Prices



Source: CME Group

Notes: HH stands for Henry Hub; TTF: Title Transfer Facility (in the Netherlands); NBP: National Balancing Point (in the U.K.); and JKM: Platt's Japan/Korea Marker. MmBtu stands for one million British Thermal Units.

LNG has traditionally relied on oil indexed long-term contracts to secure supply and finance capital intensive projects. Added Corbeau (2017): "Long-term commitments from buyers [were] … regarded as … [critical] for projects to move ahead, notably because banks [had] regard[ed] these elements as an essential part of project financing." In the Asian markets, imported LNG has historically been priced based on the average of a basket of crude oil imports into Japan known as the Japanese Customs-cleared Crude (JCC) price. The JCC price usually has a one-month lag from the Brent oil price. The duration of the lag varies depending on the negotiated contract terms. Some contracts can be priced based on averaging JCC prices from one year to 5 years. This type of pricing is usually supplemented by spot transactions to balance the positions of importers in those markets. The spot transactions are usually priced using gas-on-gas competition-based markers such JKM or Henry Hub. The rationale behind averaging the Brent price is to smooth out any spikes or price shocks that are inherent to the oil market.

Oil indexation has been subject to criticism due to its structural flaws, which have prohibited a full-commoditization of LNG. Recently the COVID-19 pandemic and its drastic impact on energy prices seems to have exacerbated those flaws and magnified market inefficiencies.

This pricing system can create an economic disparity between the current market price when the gas is delivered (via cargo or pipeline) and the contracted price. The effect of the embedded lagged oil price is significantly amplified in an extreme volatile environment. As illustrated in Figure 3, oil prices suffered a severe price shock in March 2020 due to fundamentals that are intrinsic to the oil market. Yet, residuals of this shock will be carried and rolled several months forward to price gas that will be delivered at a future date under very different market conditions.

Pirrong (2017) provided an apt historical analogy in understanding how problematic the oil-indexation approach has become:

> "[I]t would arguably be only slightly less efficient to put LNG on the gold standard than the oil standard. From 2009 to 2015, the correlation between the spot price of LNG, delivered to Japan and South Korea … and the price of Brent crude oil was -1.4%. During the same period, the correlation between the JKM LNG price and the price of gold was -2.4%. Thus, *pace* Keynes, oil benchmarking of LNG has become a 'barbarous relic' because oil-linked prices do not reflect the value of gas to purchasers, or the cost of producing it."

The economic misalignment caused by oil indexation represents a major risk that can potentially erode the profitability of a commercial deal for either the buyer or the seller side depending on the direction of the price shock. The industry has traditionally relied on contractual provisions called "Price Review Clauses" or "Price Openers," which allow the parties to make price adjustments if the market conditions change and the contract price does not adequately reflect current supply and demand dynamics. Since there is no standard language for those clauses, parties may find themselves in a situation where they have to negotiate and come to an agreement about the elements and circumstances that can trigger such stipulations. According to Christie and Ogut (2017), enforcing a Price Review provision is not an easy exercise because parties tend to have different interpretations of the terms which can subsequently become a fertile ground for debate that can often end up in arbitration or litigation.

Conclusion

Arguably, oil-indexation contracts have lost their relevance as oil and gas prices continue to decouple. The impact of the pandemic has provided further evidence of how this pricing framework has become ever more obsolete and an impediment to market competition and efficiency.

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Ms. Till's additional academic affiliations include her membership in the North American Advisory Board of the London School of Economics (LSE) and her position as a Research Associate at the EDHEC-Risk Institute in Nice, France. She has been a panel member at the U.S. Energy Information Administration's (EIA's) workshops on financial and physical energy market linkages, including the EIA's workshop on the dynamics of oil, natural gas, and LNG markets. She has a B.A. with General Honors in Statistics from the University of Chicago and an M.Sc. degree in Statistics from the LSE where she studied at the LSE under a private fellowship administered by the Fulbright Commission.

Interview with Mark Keenan

Head of Research and Strategy at Engelhart Commodity Trading Partners; and Editorial Advisory Board Member, *Global Commodities Applied Research Digest*

In this issue of the *GCARD*, we have the pleasure of interviewing Mark Keenan. Mr. Keenan is Head of Research and Strategy at Engelhart Commodity Trading Partners (ECTP) and an Editorial Advisory Board Member of the *Global Commodities Applied Research Digest*. He has over 20 years of experience in commodity quantitative analysis, research and strategy across all the major energy, metal, agriculture and soft commodities markets. He is also the author of two books: *Positioning Analysis in Commodities Markets – Bridging Fundamental and Technical Analysis* and most recently *Advanced Positioning, Flow and Sentiment Analysis in Commodity Markets*. In this interview, Mr. Keenan discusses his experience in the commodity markets and how he got started in commodities. He also provides insight on commodity strategies that are in vogue right now. In addition, he provides an overview of his recently published books on positioning analysis on commodity markets. Finally, he provides advice to students and young professionals as well as his thoughts on the value of an academic commodity center like the JPMCC.

Interview

With over 20 years of experience in the commodity markets, how did you get involved in commodities, and how has your role evolved?

I studied Biochemistry at university, and I was set on a career in pharmaceutical analysis and research. I also realized quite quickly that it might perhaps be sensible to first get a job in something like finance to settle a few bills and buy somewhere to live. At the time, starting salaries in scientific research in the U.K. were not great – something that might change as we now see how important research into virology for example can be. I convinced myself that that I would only stay in finance for a few years, before returning to scientific research.

Part of my degree was involved in mapping the human genome and in the search for new genes. It was a hugely exciting area of research at the time, involving significant amounts of computing power and the collaboration of numerous teams around the world. After three months of searching, I found my first gene and was (and still am) immensely proud of myself. To put it in context however, humans have about 30,000 useful genes, so I also learnt the importance of teamwork on being able to eventually get it finished! Everything was entirely quantitative and based on techniques in pattern recognition and statistics. Interestingly, these areas now serve as the foundation of nearly everything I do in commodity research and analysis.

After finding a few more genes, I graduated and began working at Morgan Stanley in London. I was immediately drawn towards the more quantitative areas and specifically into the futures markets where a lot of quantitatively driven trading strategies seemed to be developing. After moving to a small derivatives house in London, I focused exclusively on commodities. Working in commodities also made me feel a little less guilty, as there were many areas where their fundamentals overlapped with what I had studied in chemistry. Commodities were also real, somewhat logical in their behavior and I also found a huge number of linkages between what I had learnt in pattern recognition and statistics and how prices evolved.

I always stayed in the world of commodities, working in a range of different areas of the market including broking, trading for the Saudis, building commodity investment products at UBS and commodity asset management in London and then Singapore. Each time exploring new quantitative trading styles and strategies. More recently, I have decided to focus entirely on commodity research and strategy and in the trading of very specific types of commodity strategies called risk premia. I do this currently at Englehart Commodity Trading Partners (ECTP) in Stamford, Connecticut.

As I look back on my career, it could seem well thought out and logical – but, I simply moved from area to area as my interests shifted and markets evolved. The important thing was that I stayed in commodities and always within the more quantitative areas of the market. If I had to divide it up, there were three very clear periods. Initially, I focused almost entirely on commodity price analysis in all its forms. I was extremely interested in the developing world of technical analysis and quantitatively driven CTA and hedge fund trading strategies. After about 10 years of exhaustive analysis, I began to realize that I was unlikely to find the perfect trend or quant algorithm – commodity markets were simply not the human genome that could be decoded, and I should perhaps start to look at other areas of the market.

For the next five years I focused on what are now referred to as "quantamental" strategies. The idea was to apply the same disciplined framework I had used to analyze price and apply it to fundamental data. I had always thought that fundamental analysis was messy and unstructured and that this was a good solution. This was a rapidly developing area of research and trading as vast new sets of data became widely accessible at the time. These included data like satellite imagery, various types of transport data and high frequency weather data.

Finally, as I learnt that one approach was not necessarily better than the other and that it was always sensible to embrace a variety of different tools and techniques, I noticed that whilst fundamentals ultimately prevailed, prices could decouple from them for extended periods of time. Moreover, this trend seemed to be increasing as new types of investment flows started to develop in many commodities and the analysis of positioning, flow, sentiment, and many of the "fuzzier" aspects of commodity price dynamics have been very helpful in understanding this better. It seems that now, what I do is the most like searching for patterns and relationships in DNA – now I search for patterns and relationships in commodity data.

The reason I now work at ECTP, a very fundamentally driven trading firm, is that the analysis of positioning, sentiment and flow are critical components in position sizing, timing and risk management and in being able to successfully monetize fundamental trading strategies. I see these linkages only becoming stronger.

What are some of the commodity investments and strategies that are currently in demand?

I think that one of the most interesting and fastest growing areas of demand and innovation in the commodity investment world has been in risk premia strategies. In a similar way to the growth and proliferation of commodity indices like the Goldman Sachs Commodity Index (GSCI) and the Bloomberg

Commodity Index (BCOM) in the early to mid-2000s, the growth in commodity risk premia, over the last few years in particular, has been phenomenal.

By way of a little background, commodity indices are diversified baskets of commodity futures, often weighted in proportion to their significance in the global economy, that investors buy as an index in the same way they can buy an S&P 500 index tracker. These products are widely used by pension funds and asset managers to diversify portfolios, as a way of taking a broad investment on the commodity market and as a hedge against inflation.

Risk premia strategies are similar. They are also based on indices, but instead of having a directional view, they are typically characterized by a market neutral approach. They are also used by pension funds and asset managers to diversify portfolios by capturing specific factors in commodity markets like "carry." Carry is typically captured by establishing short positions at the front of the curve, by going short a benchmark index like the Bloomberg Commodity Index (BCOM), and establishing long positions further down the curve, by going long a deferred version of the BCOM. These strategies capture instances of convexity in the curve. Other types of risk premia endeavor to capture factors like "value," by identifying cheap and expensive commodities in similar sectors, "congestion" by taking specific types of spread exposure ahead of index and ETF roll periods, "momentum" and "seasonality" through a variety of different methodologies and differences in implied and realized volatility. Some of the very latest trends in risk premia innovation include machine learning strategies.

Commodity risk premia strategies compete with some of the most complex and successful hedge fund strategies in the market in terms of both innovation and performance. For some strategies, their size in the market is starting to reshape commodity flow patterns and open interest profiles down the curve.

Can you describe how Positioning Analysis is applied in the commodity markets?

In my latest book, I try to define "Positioning Analysis" as a blend of positioning, flow, and sentiment analytics to better understand how they collectively interact and how they can help explain price behavior. This is an area that I find particularly fascinating – mostly in the context of the current market regime, where changing flow patterns due in part to the growth in risk premia and other quantitative trading strategies have become disproportionally important in helping to identify both risks and opportunities.

Positioning Analysis bridges aspects of both fundamental and technical analysis by looking at how certain types of positioning and flow patterns, both within the data and in the context of changes in variables like price, curve structure, seasonality, exchange rates, fundamentals such as inventory, changes in the broader macroeconomic environment and the levels of risk and uncertainty in the market can be used to develop trading models, indicators and analyses.

The book focuses on Positioning Analysis. It is based on new material, but also updates and builds significantly on some of the work in my previous book. New material includes analytics based on the analysis of flow, the decomposition of trading flows, trading activity in the Chinese commodity markets, the inclusion of newsflow into Positioning Analysis and how machine learning can provide insight into trading relationships.

What advice could you give to students and young professionals interested in the commodity markets?

It is especially important to stick to it – both in terms of commitment to the market, but also to the same firm until you have developed a demonstrable skill. Too many young professionals move between asset classes, under the illusion they are learning more and too many keep switching firms for the wrong reasons.

Commodities are one of the only areas in finance where knowledge and experience are almost always accretive. This is a combination of the asset class being relatively small in many ways, yet also vast in terms of the depth you can reach within it. Put more simply: to become an expert in tech stocks is very challenging and spending years understanding one or two areas of the sector runs the risk of redundancy as technologies and trends shift. Becoming an expert in the metals market is more realistic and spending years understanding the nuances of the copper market for example can create continuous value throughout a career. In short, we are unlikely to stop using copper any time soon, but a technology company can disappear very quickly.

Learning how to code or at the very least what coding can do is also especially important. Python, for example, can be helpful in nearly every area of the commodity market. This is true whether you work on the development of trading and risk management strategies, in research and data analytics, in the development of models and analytics or in nearly all areas related to the more operational areas of the market.

How do you think a broad-based commodity center like the JPMCC can be most valuable to industry?

I think the JPMCC is and has been a hugely valuable resource in the industry. There is simply nothing like it in terms of its accessibility and the depth and range of relevant research material it has available both in the *GCARD* publication and available on the website. The breadth and relevance of the courses and classes offered are also fantastic.

Overall, the JPMCC provides an indispensable resource in helping students and young professionals understand the industry and see what is available to help them make good decisions in finding the right career.

Thank you, Mark, for serving on the GCARD's Editorial Advisory Board and for this opportunity to interview you!

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Notes

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GLOBAL COMMODITIES
APPLIED RESEARCH DIGEST

SPECIAL REPORT: ECONOMIST'S EDGE

Thoughts on the Twists and Turns of the Virus' Impact on Commodities

By Bluford Putnam, Ph.D.
Chief Economist, CME Group

Supported by funding from CME Group

Business School
UNIVERSITY OF COLORADO DENVER

Thoughts on the Twists and Turns of the Virus' Impact on Commodities

Bluford Putnam, Ph.D.
Chief Economist, CME Group; and Member of the J.P. Morgan Center for Commodities' (JPMCC's) Research Council at the University of Colorado Denver Business School

Dr. Bluford Putnam, Ph.D., the Chief Economist of the CME Group, answers a question during a commodity industry panel at the JPMCC's 3rd Annual International Commodities Symposium. The panel session was moderated by Ms. Hilary Till, the *GCARD*'s Contributing Editor. Joining Dr. Putnam during the panel discussion were (from left-to-right) Mr. Lance Titus, Managing Director, Uniper Global Commodities and Ms. Julie Lerner, Chief Executive Officer, PanXchange.

Introduction

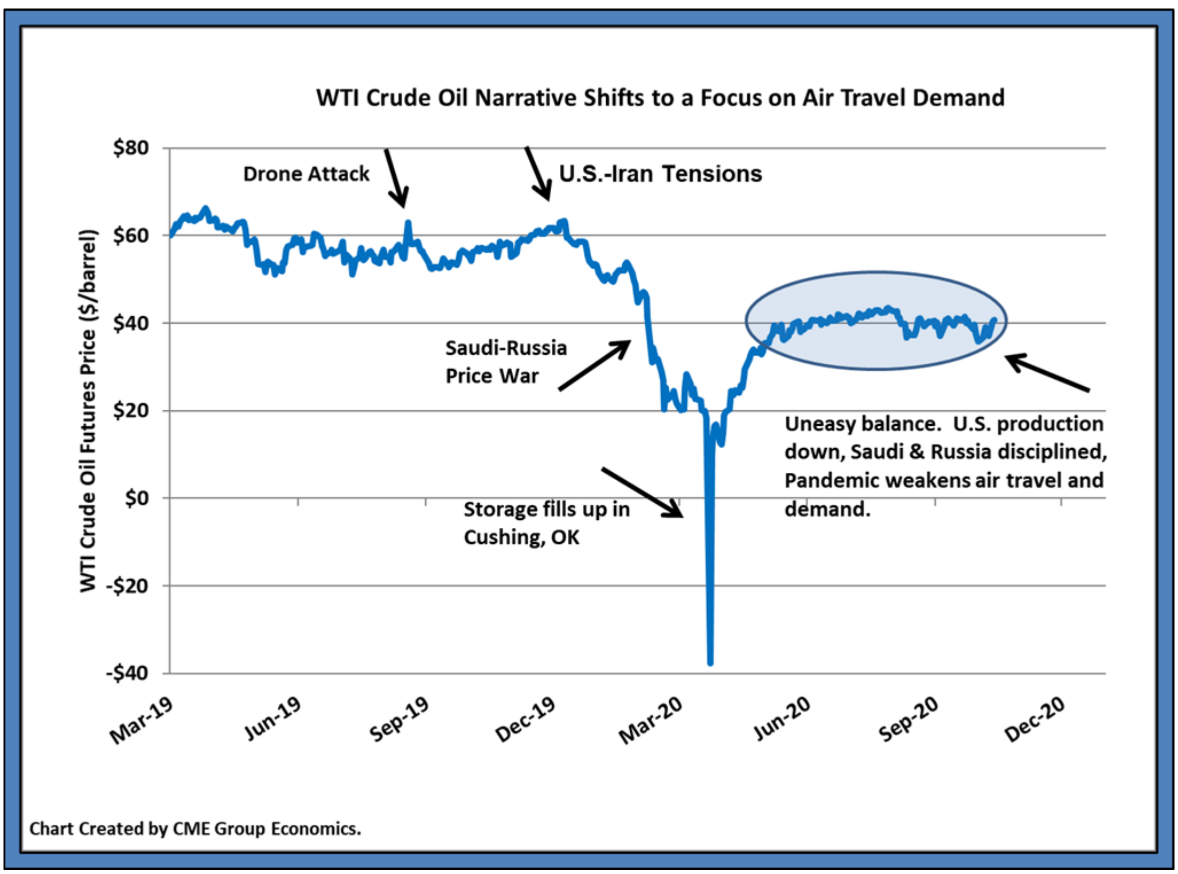
The pandemic of 2020 had a major influence on almost every facet of life as the COVID-19 virus wound its way around the world. Commodity markets were impacted as well, yet not in any unifying pattern. Every commodity was influenced differently. In this research, we look back at how four selected commodities performed – oil, copper, soybeans, and gold – in 2020, and try to detangle the influence of the virus from everything else that was happening. It is a conflicted picture, which illustrates the many feedback loops and dynamic aspects of complex systems.

Oil

When the coronavirus started to spread in China, at the very beginning of the year 2020 the commodity market with the first reaction was oil. China is the world's largest importer of crude oil. As China shut down the province of Hubei with its capital city, Wuhan, and then restricted air travel domestically and internationally, oil prices declined sharply as market participants realized the implications for the demand for oil from a Chinese economy in recession and partly shutdown.

The twists and turns of feedback loops became apparent in February and March as Saudi Arabia and Russia reacted to falling oil prices. Initially, instead of cutting production, Saudi Arabia decided to put pressure on other producing regions, especially U.S. shale and Russia by keeping production elevated. U.S. shale responded to the downward price pressures quickly, and the drilling of new wells dropped precipitously. Russia, however, took the production challenge, and there was a short-lived price war, driving the price of oil lower and lower. Coupled with storage constraints in Cushing, Oklahoma, the spot oil price actually went negative for a few hours at the end of the trading day in late April 2020. After that, crude oil prices climbed steadily back to the $40/barrel territory. The oil maturity curve, which had been in backwardation (i.e., spot prices higher than long-dated prices) before the pandemic, flipped to contango (i.e., spot prices lower than long-dated prices) during the Saudi-Russia price war, and then the curve moved to a relatively flat shape in the second half of 2020 as an uneasy balance returned to the market.

Figure 1
WTI Crude Oil Futures



Source: CME DataMine, Market Sentiment Meter (CLCO) powered by 1QBIT.

In the fall of 2020, the dynamics of the virus hit the oil market again. As the virus had another surge in Europe and then the U.S., the focus turned to air travel. There had been hopes in the summer of 2020 that air travel was on the road to recovery. This expectation of a recovery in air travel became critical for the oil market on the margin. This is because jet fuel is an important part of the end-use of crude oil.

The expectation of a recovery in air travel met two obstacles in the fall of 2020. First, many corporations began to realize that the work from home culture of office workers and the explosion of virtual meetings during the pandemic was working reasonably well. That meant that even after the pandemic subsides and workers return to their office towers, businesses could slash travel budgets and permanently rely, at least to some extent, on virtual meetings instead of business travel. That is, the realization hit market participants and airlines, that business travel demand might never return to pre-pandemic levels.

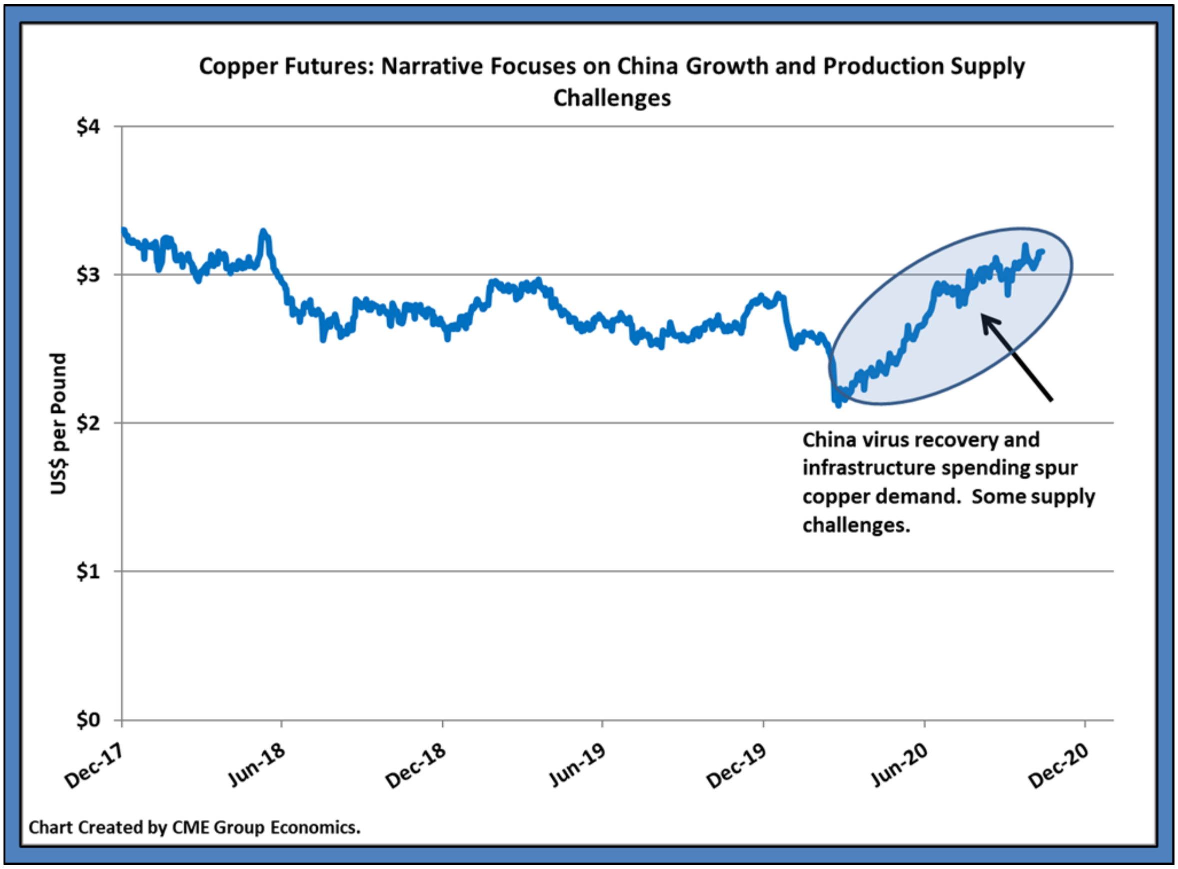
At the same time, another surge of the virus hit Europe and then North America, further dampening domestic air travel and extending the restrictions on international travel. Oil prices were pushed back below $40/barrel. The only outlier to this narrative was China. China's economy had started a strong recovery in the second quarter of 2020, continuing into the third quarter. With China, domestic air travel had recovered to some 90% of pre-pandemic levels, even if international air travel was still largely restricted.

At year's end, the potential for the arrival of an effective vaccine for the virus coming in 2021, served to elevate expectations of an economic recovery around the world, and the possibility of increased air travel and oil demand.

Copper

Copper is a shorter story, with very much a China focus. As with oil, China is the largest buyer of copper in the world. When the virus hit China at the beginning of the year, copper prices fell. When the Chinese economy mounted a solid recovery, copper prices rebounded. There was much less complexity to the copper narrative than for oil. With oil, the market had to cope with the changing production policies of Saudi Arabia and Russia. And while there were some extraction disruptions in 2020, copper prices largely followed the decline and then recovery of the Chinese economy.

Figure 2
Copper Futures

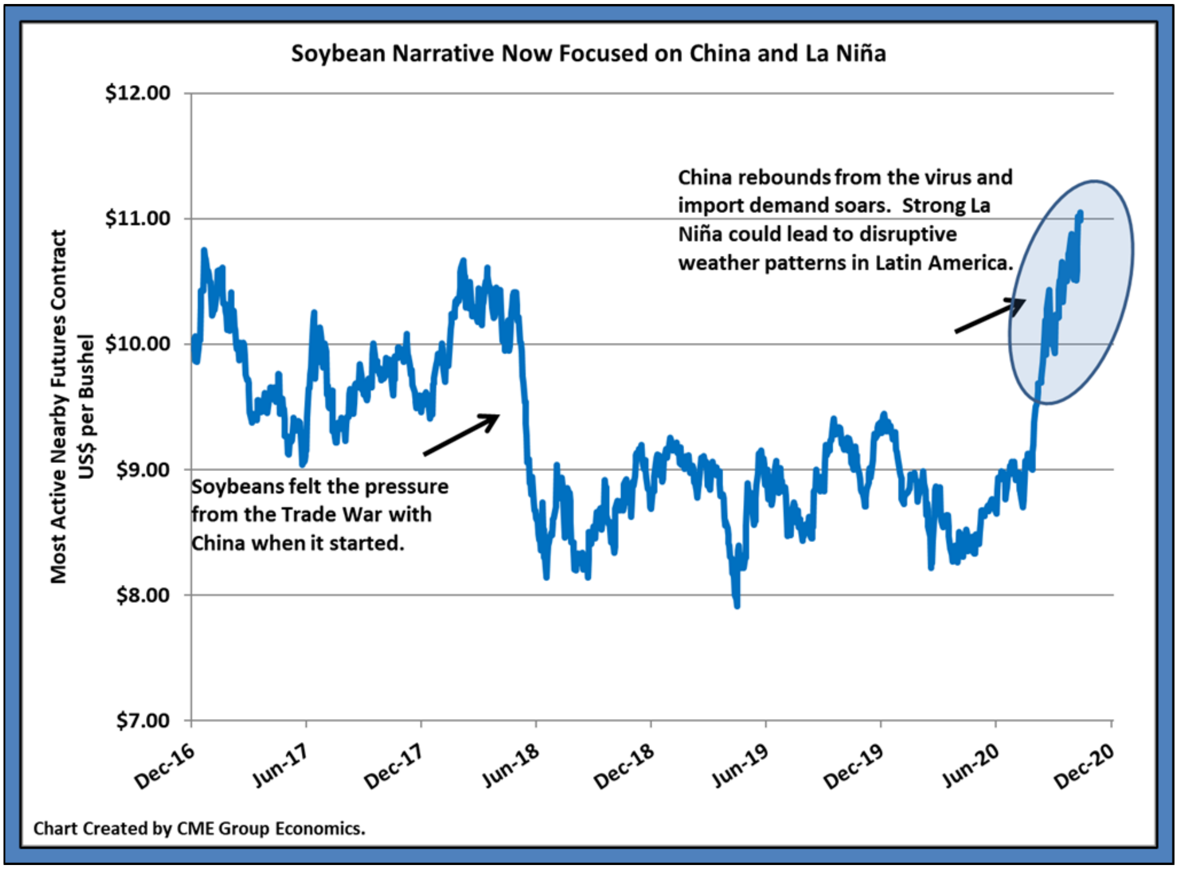


Source: Bloomberg Professional (HG).

Soybeans

The global soybean market dealt with two unrelated narratives in 2020. The first was the virus, and again, the attention was on China. Soybeans prices were not much impacted when the virus initially hit in early 2020. It was when China mounted its robust economic recovery that soybean prices rose. A strengthening Chinese economy allowed the country to expand dramatically its import demand for grains, not just soybeans, but corn as well. China was also successfully working to rebuild its hog herd from the bout with African swine fever. The Chinese appetite for chicken and pork is huge. Chickens mostly just eat soybean meal, while hogs have a slightly more diversified diet – soybeans for protein, corn for energy, and some wheat and sorghum to fill out the feed mix. In any case, second half 2020 Chinese demand for soybeans soared in both North and South America, pushing the U.S. price from around $8/bushel into the $10/territory. In this case, it was China's ability to control the virus and get its economy moving quickly that impacted the price of soybeans.

Figure 3
Soybean Futures



Source: CME DataMine, 1QBIT, Market Sentiment Meter Data.

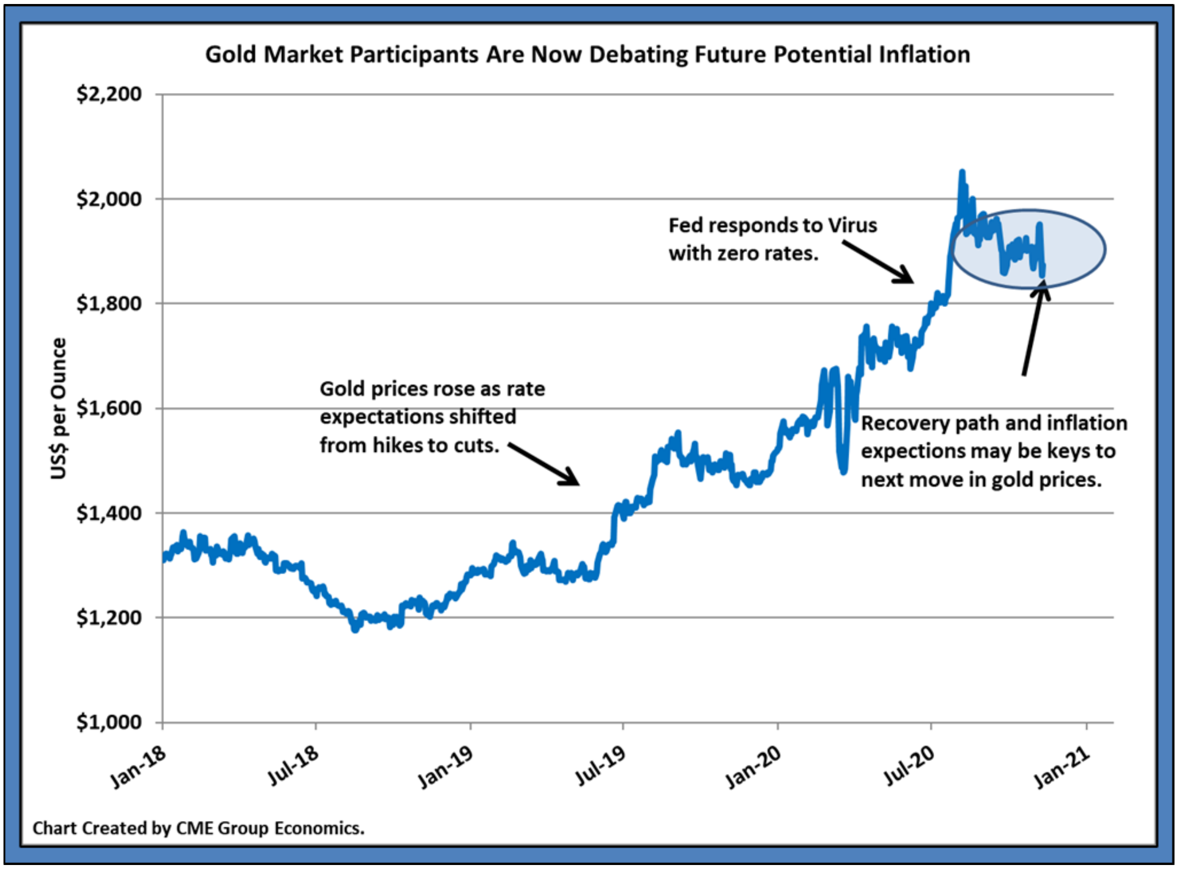
Gold

For oil, copper, and soybeans, the impact of the virus wove its wave through the interconnected dynamics of supply and demand. For gold, the narrative has a few more steps.

Gold is an inflation sensitive commodity. It is held as a store of value and used to diversify financial portfolios. Gold bears no explicit interest rate, so rises in U.S. dollar interest rates tend to work against the gold price, while falling rates support the gold price. So it went in the last few years. When the Federal Reserve (Fed) was raising rates, gold prices were stuck down in the $1200/ounce range. When the Fed announced it would halt its step-by-step rate rise program, gold rallied. When the Fed cut rates, gold rallied some more. When the virus hit in the first half of 2020 and the Fed pushed short-term rates down to near zero, gold surged over $2000/ounce.

In the second half of 2020, though, the story changed. With the U.S. federal funds rate at near zero and the Fed providing guidance that short-term rates would stay there for an extended period time, even if inflation pressures emerged, there was no further push upward on gold prices for any potential Fed rate cuts, and gold settled back into a wide trading range centered around $1900/ounce.

Figure 4
Gold Futures



Source: CME DataMine, 1QBIT, Market Sentiment Meter (GCOG).

The debate in the gold market at the end of 2020 was whether inflation pressures would actually emerge in 2021, 2022, or beyond. The case for inflation reemerging in force, and along with it higher gold prices, was based on the fusion of monetary and fiscal policy brought about by policy responses to the pandemic of 2020. In the U.S., and in Europe and Japan, government budget deficits were expanding dramatically to cushion the impact of the partial shutdowns of economic activity, and central banks were buying large quantities of government debt. This was effectively a back-door entry into the world of Modern Monetary Theory (Putnam, 2020).

One group of analysts argued that once the pandemic was contained and if stimulus was continued for an extended period after the economic rebound was well underway, then the development of serious inflation pressures would be highly likely. Another group of analysts took a different view of the longer-term impacts of the pandemic. These analysts argued that many pandemic-induced behavioral changes were going to be long-lasting, such as more flexible work from home alternatives and less business travel.

This could result in a slower economic recovery, with many years of elevated unemployment likely. With elevated unemployment, this camp could not see the catalyst for serious inflation pressures emerging. Time will tell how this debate turns out, and for certain, gold market participants will be watching with intense interest.

Bottom Line

What is clear is that the path of the virus, with its various twists and turns, moving from region to region, surging and then receding, emerged as a key factor in commodity market analysis for 2020. The main influence of the virus worked its way through its influence on the demand side of the price equation. Although with oil, there were feedback loops impacting supply as production policies shifted in Saudi Arabia and Russia. Gold presented the most complex narrative about the virus, because the story first focused on Federal Reserve rate cuts and then shifted to debating to the possibilities of a re-emergence of inflation down the road, once the virus was contained.

Endnote

The research views expressed herein are those of the author and do not necessarily represent the views of CME Group or its affiliates. All examples in this presentation are hypothetical interpretations of situations and are used for explanation purposes only. This report and the information herein should not be considered investment advice or the results of actual market experience.

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Author Biography

BLUFORD PUTNAM, Ph.D.
Chief Economist, CME Group

Dr. Bluford Putnam is Managing Director and Chief Economist of CME Group. As Chief Economist, Dr. Putnam is responsible for leading the economic analysis on global financial markets by identifying emerging trends, evaluating economic factors and forecasting their impact on CME Group and the company's business strategy. He also serves as CME Group's spokesperson on global economic conditions and manages external research initiatives.

Prior to joining CME Group, Dr. Putnam gained experience in the financial services industry with concentrations in central banking, investment research and portfolio management. He also has served as President of CDC Investment Management Corporation and was Managing Director and Chief Investment Officer for Equities and Asset Allocation at the Bankers Trust Company in New York. His background also includes economist positions with Kleinwort Benson, Ltd., Morgan Stanley & Company, Chase Manhattan Bank and the Federal Reserve Bank of New York. Dr. Putnam holds a bachelor's degree from Florida Presbyterian College (later renamed Eckerd College) and a Ph.D. in Economics from Tulane University.

Dr. Putnam has authored five books on international finance, as well as many articles that have been published in academic journals, including the *American Economic Review*, *Journal of Finance*, and *Review of Financial Economics* among others. His newest book, Economics Gone Astray, is now available from World Scientific (WS) Professional.

Dr. Putnam is also a member of the J.P. Morgan Center for Commodities' Research Council.

GLOBAL COMMODITIES
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The *Global Commodities Applied Research Digest (GCARD)* is produced by the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School.

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The *GCARD* is edited by Ms. Hilary Till, the JPMCC's Solich Scholar, jpmcc-gcard.com/hilary-till, whom can be contacted at till@jpmcc-gcard.com.

The Winter 2020 *GCARD* cover image is cropped from the following artwork, whose complete image is above: "Goole Steam Shipping", LMS poster, 1923–1947. London Midland & Scottish Railway poster advertising regular services between Goole and Hamburg, Amsterdam, Rotterdam, Antwerp, Ghent, Dunkerque, Copenhagen. Artwork by JP. Image No. 10173966.

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