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

GLOBAL COMMODITIES

APPLIED RESEARCH DIGEST

WINTER 2017

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Business School
UNIVERSITY OF COLORADO DENVER

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

GLOBAL COMMODITIES
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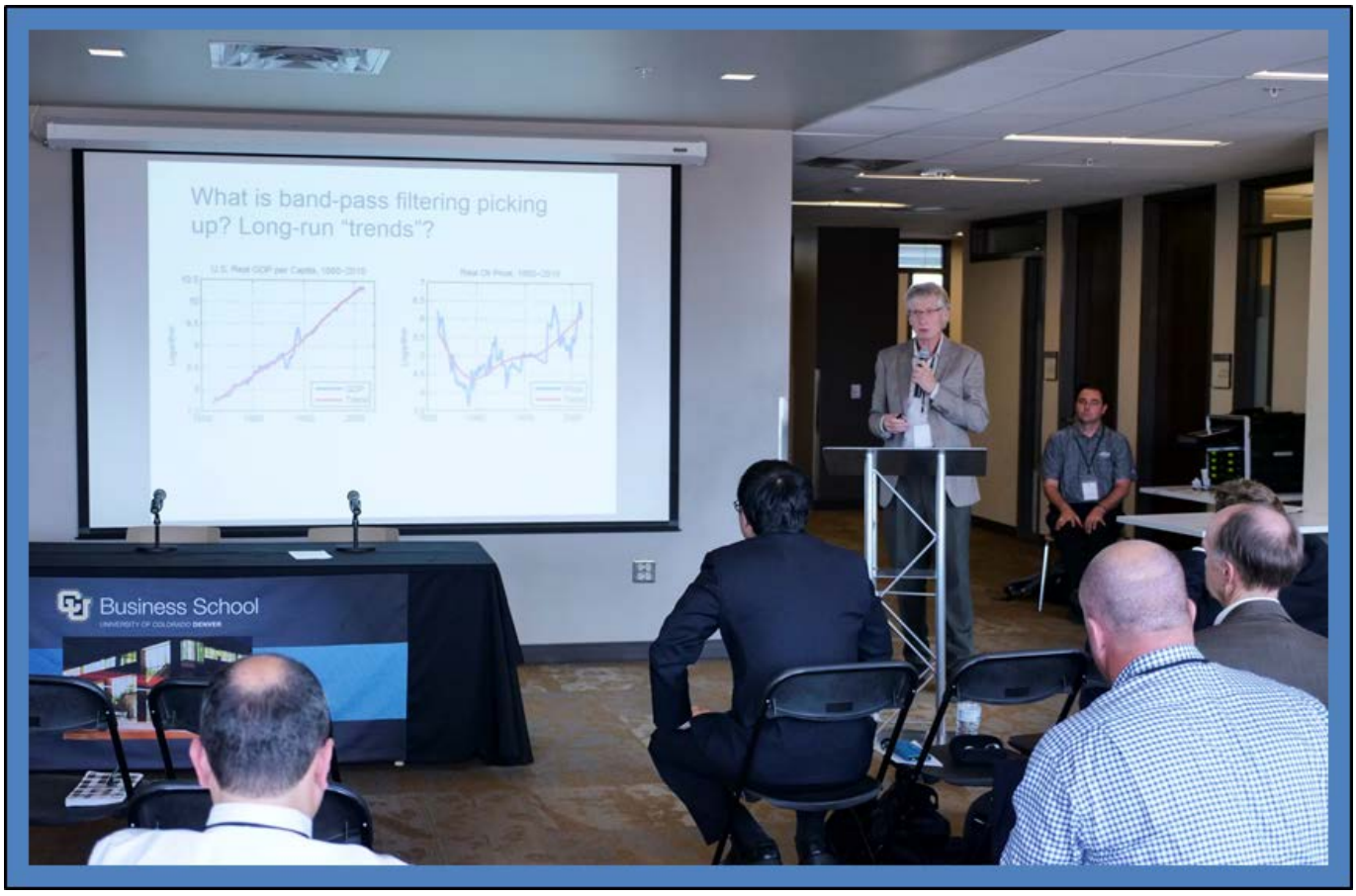
The *Global Commodities Applied Research Digest* (*GCARD*) is produced by the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School. The University of Colorado Denver Business School is led by Dr. Rohan Christie-David, Ph.D., Dean and Professor of Finance. The JPMCC's Research Director is Dr. Jian Yang, Ph.D., CFA, who is also the J.P. Morgan Endowed Research Chair and Professor of Finance. The JPMCC's Program Manager is Mr. Matthew Fleming.



Professor Graham Davis, Ph.D., Colorado School of Mines, discusses an econometrics paper at the J.P. Morgan Center for Commodities' (JPMCC's) international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017. In his capacity as a founding member of the JPMCC's Research Council, Professor Davis co-organized the August commodities conference with Dr. Ajeyo Banerjee, Ph.D., of the University of Colorado Denver Business School. Like the *GCARD*, the August conference's lead sponsor was the CME Group Foundation. The conference also benefitted from sponsorship by the Payne Institute for Earth Resources and the Chartered Alternative Investment Analyst (CAIA) Association. The next issue of the *GCARD* will summarize the conference's academic insights for the digest's practitioner audience.

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

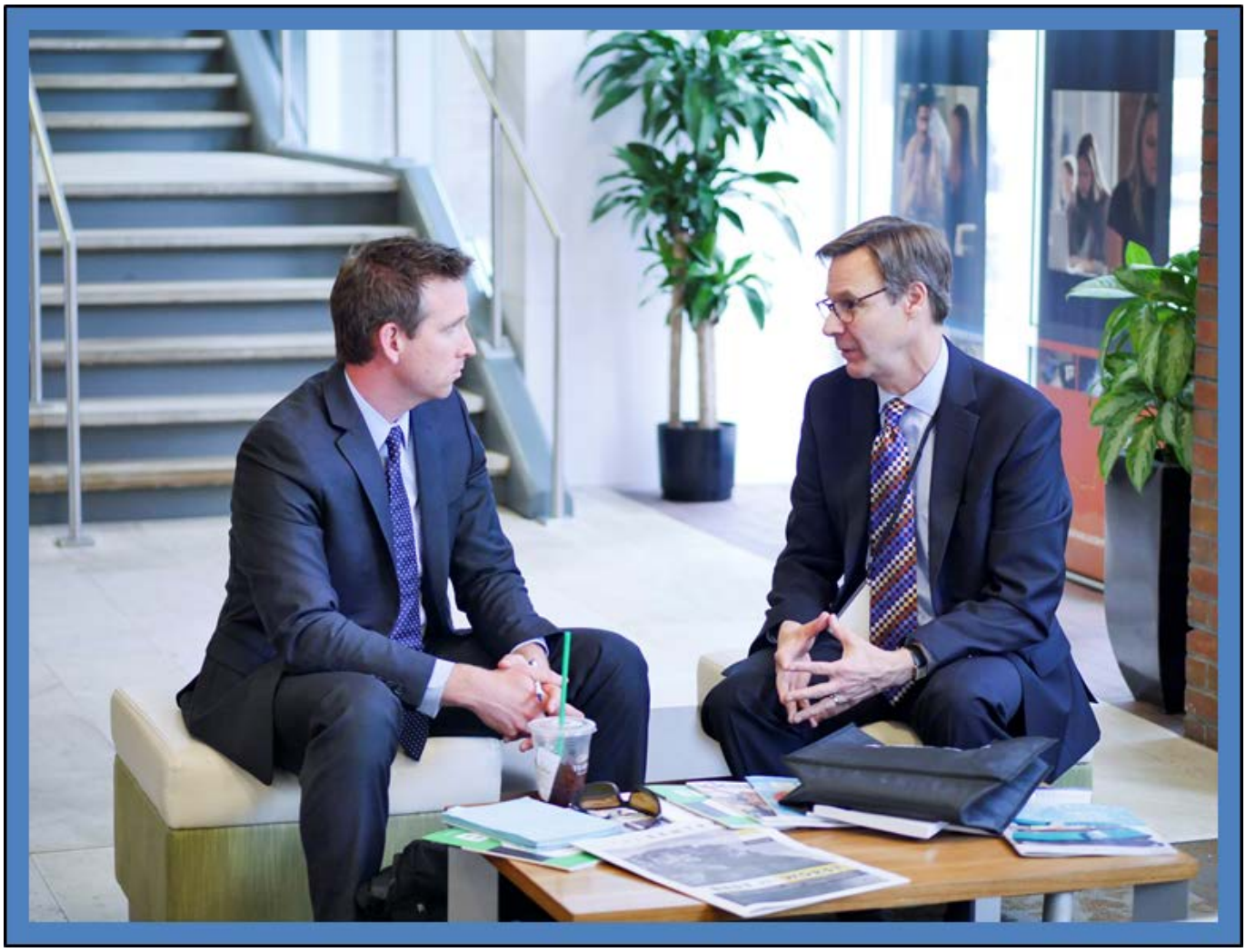
impact public policy in the near future. The digest is published twice per year and has been made possible by a generous grant from the CME Group Foundation.

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. The *GCARD*'s Editorial Assistant is Ms. Katherine Farren, CAIA.

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

J.P. Morgan Center for Commodities (JPMCC) 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. With the support of the Advisory Council, the JPMCC aims to become a global leader in commodities education and applied research. The JPMCC is grateful for the Advisory Council's staunch support of its activities!



Pictured from left-to-right are **Mr. Dan Kowalski** and **Mr. Antony Bahr**, both of whom are executives at **CoBank**, during the JPMCC's international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017. With a dual mission in education and applied research, the JPMCC was launched in 2012 with the generous support of multiple donors, including J.P. Morgan, CoBank, George Solich (of FourPoint Energy, LLC), and major commodity firms.

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J.P. Morgan Endowed Research Chair

Jian Yang, Ph.D., CFA
J.P. Morgan Endowed Research Chair, J.P. Morgan Center for Commodities; and Professor of Finance and Risk Management, University of Colorado Denver Business School

Professor Jian Yang, Ph.D., was the keynote speaker at the 3rd Derivatives Academic Forum, a special event of the 13th China International Derivatives Forum held from December 1 through December 3, 2017 in Shenzhen (China). Professor Yang's presentation was on how international crude oil futures and options markets respond to fundamental information.

The J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School has selected Dr. Jian Yang, Professor of Finance and Risk Management, as the JPMCC's Endowed Research Chair. Dr. Yang will strengthen the JPMCC's global ties, particularly in Asia, and will be responsible for creating coursework and academic conferences that will establish the JPMCC as a leading education and research center in the field of commodities.

Dr. Yang earned a Ph.D. from Texas A&M University and previously held visiting positions at the People's Bank of China, Federal Reserve Bank at St. Louis, and at several leading universities in China. His research on commodities has been cited by the World Bank, the World Trade Organization, and the Organization for Economic Co-operation and Development. He also serves as an editorial board

member of the *Journal of Futures Markets* and as an associate editor of the *Journal of Commodity Markets*.

Dr. Rohan Christie-David, Ph.D., the Dean of the University of Colorado Denver Business School, has noted that Dr. Yang "has strong ties to commodities and a broad understanding of the newest trends in research. He is well prepared not only to drive the … [JPMCC's] research program, but also heighten awareness of the Center's activities."

Future issues of the *Global Commodities Applied Research Digest* will feature Dr. Yang's research work.

J.P. Morgan Center for Commodities (JPMCC) Research Council

The JPMCC is honored to have a distinguished Research Council that provides advice on shaping the research agenda of the Center. For example, the Technical Committee for the JPMCC's August 2017 international commodities symposium, "New Directions in Commodities Research," consisted of members of the Research Council. In addition, the *GCARD* draws from insightful presentations and discussions that occur at the JPMCC's Research Council meetings. The JPMCC's Research Council members are listed on the next page.

Professor Lutz Kilian, Ph.D., University of Michigan at Ann Arbor, and member of the J.P. Morgan Center for Commodities' Research Council, was a keynote speaker at the JPMCC's international commodities symposium, "New Directions in Commodity Research," which was held at the University of Colorado Denver Business School on August 10 through August 11, 2017. Professor Kilian's keynote address was entitled, "Lower Oil Prices and the U.S. Economy: Is This Time Different?"

J.P. Morgan Center for Commodities Research Council Members

Jian YANG, Ph.D., CFA, J.P. Morgan Endowed Chair & JPMCC Research Director
University of Colorado Denver Business School

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Benjamin LEE, Ph.D. *National Renewable Energy Laboratory*	**Wei XIONG, Ph.D.** *Princeton University*

EDITORIAL ADVISORY BOARD
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Research Council Report

At the JPMCC's September 2016 Research Council meeting, Mr. John Schmitter, President, KEP LLC, discussed rail capacity challenges. This digest article summarizes Mr. Schmitter's presentation, in which he explained 1) how railroads fit in the commodity supply chain, 2) North American railroad industry characteristics, 3) rail capital investment and capacity, and 4) rail availability risk.

Research Digest Articles

This digest article summarizes a co-authored research paper by Charoula Daskalaki, Ph.D., Department of Economics, University of Crete, Greece; and George Skiadopoulos, Ph.D., Department of Banking and Financial Management, University of Piraeus, Greece. Their paper assesses the effect of margin changes on prices, the risk-sharing between speculators and hedgers, and the price stability of 20 commodity futures markets. The paper provides evidence that margin increases decrease the rate at which prices change, yet they impair the risk-sharing function and decrease market liquidity in certain markets.

This digest article summarizes a research paper by the following three co-authors: Steven Jordan, Ph.D., Alfaisal University, Saudi Arabia; Andrew Vivian, Ph.D., Loughborough University, United Kingdom; and Mark Wohar, Ph.D., University of Nebraska-Omaha. Their article documents empirically that precious metals contain economically valuable predictive information content for stock returns.

This digest article summarizes a research paper by the following four co-authors: Adrian Fernandez-Perez, Ph.D., Auckland University of Technology, New Zealand; Bart Frijns, Ph.D., Auckland University of Technology, New Zealand; Ana-Maria Fuertes, Ph.D., Cass Business School, City, University of London, U.K.; and Joëlle Miffre, Ph.D., Audencia Business School, Nantes, France. Their article investigates the link between the skewness of the distribution of commodity futures returns and subsequent price changes. A trading strategy that goes long futures contracts with the most negative skew and shorts futures contracts with the most positive skew has historically generated significant alpha.

Contributing Editor's Collection

Editorial Advisory Board Commentaries

Editorial Advisory Board Commentaries (Continued)

This article is the first in a two-part series. The series will provide insights into the complex dynamics of oil price formation from 2014 onwards. Part 1 focuses on the events influencing the oil markets from 2014 through 2015 while Part 2, which will appear in the next issue of the *GCARD*, will cover the oil-market-moving events from 2016 through the present. The author previewed some of the work featured in this digest article during his Knowledge Exchange lecture at the JPMCC in April 2016.

This paper discusses inferring crude-oil-market fundamentals through price-relationship data, largely through the perspective of a commodity futures trader. In doing so, the paper briefly covers (1) the promise of big data; (2) the reality of data "black holes"; (3) the wealth of futures price data; (4) what futures prices potentially reveal about petroleum-complex fundamentals; and (5) caveats on the use of price data.

Industry Commentaries

This article provides an update on the fortunes of the U.S. Haynesville shale region, which is amongst the top four natural gas production areas in the U.S. Technological improvements have led to a rebound in shale gas production to the highest levels for the region since the end of 2013.

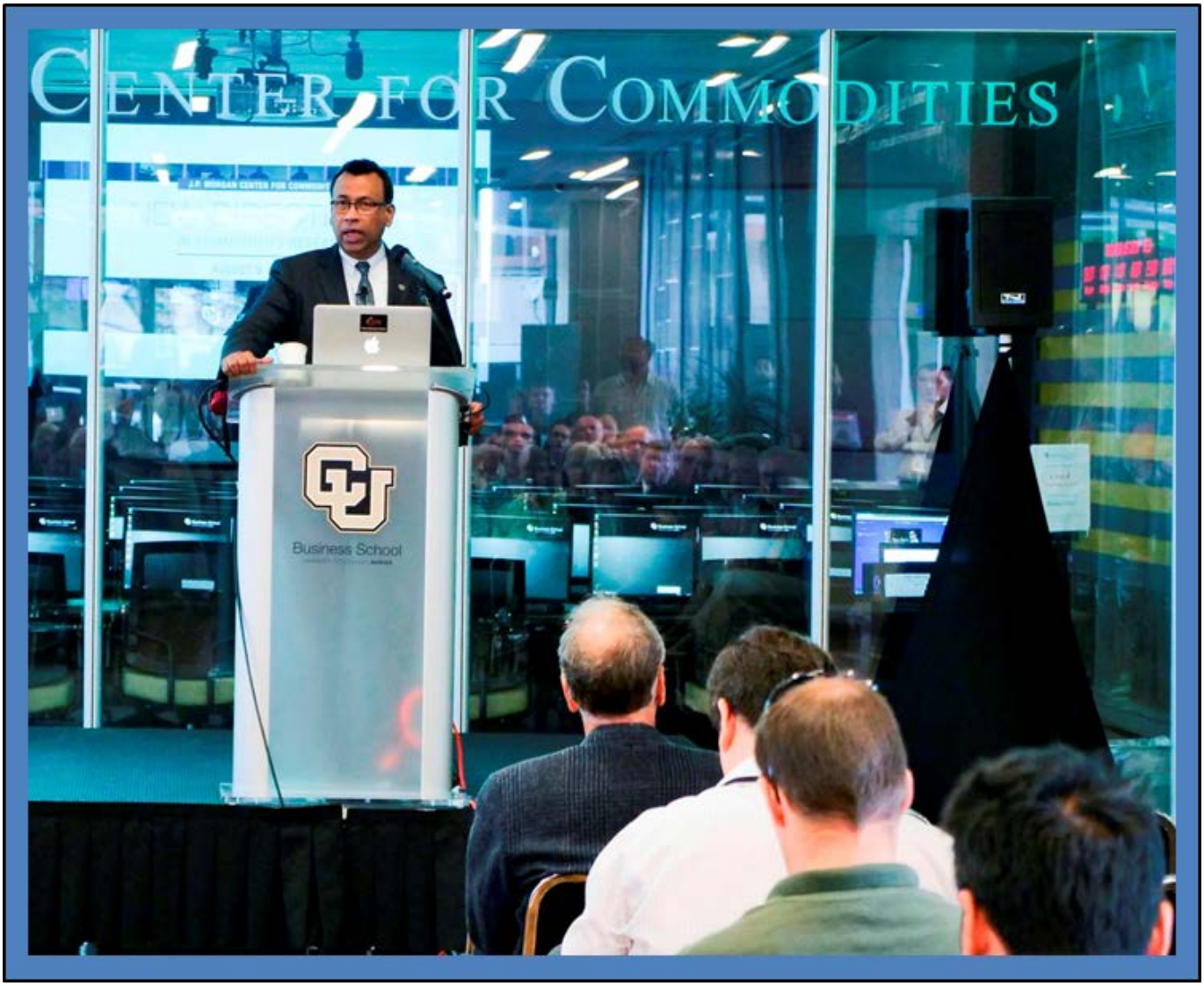
Following a brief overview of the current global supply and demand situation for liquefied natural gas (LNG), this article examines to what degree non-market forces have contributed to a narrowing of inter-regional price differentials. Against an overlay of rapid technological change that has facilitated new sources of supply, the situation in North America is contrasted with the very different forces impacting LNG prices in Europe. Finally, the article surveys the largest and most rapidly changing global market, Asia, briefly evaluating each of the most important non-supply-demand factors to have reshaped LNG trade in recent years and their impact on price movement.

Interview

In the Winter 2017 issue of the *GCARD*, we are honored to interview Mr. Robert Greer, Scholar-in-Residence at the JPMCC. Mr. Greer explains how he became involved in the commodity markets and what led him to writing the first published article on an investable commodity index. He also touches on some of the major changes in the commodity industry, concluding with a description of the value that the JPMCC can potentially bring to the commodity industry.

Welcome Letter

Rohan Christie-David, Ph.D.
Dean and Professor of Finance, University of Colorado Denver Business School



Rohan Christie-David, Ph.D., Dean of the University of Colorado Denver Business School and Professor of Finance, welcomes participants to the J.P. Morgan Center for Commodities' international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017.

Dear Reader,

I am very pleased to welcome you to the Winter 2017 issue of the J.P. Morgan Center for Commodities' *Global Commodities Applied Research Digest (GCARD)*. I would also like to thank the CME Group Foundation for its continuing sponsorship of this important publication. I believe the *GCARD* adds great value to the global commodities' community; I expect it to grow and mature over the next several years,

which would not be possible without the support of the CME Group Foundation.

I would also like to recognize Hilary Till, the *GCARD's* Contributing Editor, as well as the *GCARD's* Editorial Advisory Board. Without Hilary's work and dedication, and the invaluable contributions of the *GCARD's* Editorial Advisory Board, this publication would be far short of the high quality that it has delivered in its short life so far. Finally, I would like to recognize the Center's Advisory Council for their guidance and support, and Dr. Ajeyo Banerjee for his leadership in getting the Center, its many activities, and this publication, up and running over the last five years.

One of the most prominent of these activities has been the international "New Directions in Commodities Research" symposium, held from August 10 through August 11, 2017, at the University of Colorado Denver Business School. The Center's distinguished Research Council played a key role in the organization of this conference, for which I am grateful and would like to recognize. The symposium was highly successful, attracting prominent presenters, discussants, and participants from around the world.

As it moves into its sixth year, the J.P. Morgan Center for Commodities (JPMCC) is undergoing strategic change to consolidate its past and face the next phase of its development. Our core mission is to develop research and education programs that foster practical understanding of the end-to-end financial and physical processes by which food, minerals, energy, and other raw materials move from their source to their destination. We're all very excited about the prospects for the future as we execute on this mission, and we believe that the JPMCC is in a unique position in the world to do so.

I want to emphasize the importance of this publication – the *GCARD* – to our overall strategy and to the extended global commodities community. To reiterate, the essence of the JPMCC mission is to foster the practical application of the latest innovations developed either in academia or in industry. This is of course the *raison d'être* for the *GCARD*, and we will be working hard to continue its development and grow its audience as a primary resource to bring interest and participation to the Center as we expand its global scope and reach.

So, again, welcome to this fourth issue of the *GCARD*. I hope you will find it both useful and engaging.

Sincerely,

Rohan Christie-David, Ph.D.

Contributing Editor's Letter

By Hilary Till
Solich Scholar, J.P. Morgan Center for Commodities (JPMCC), University of Colorado Denver Business School; and Contributing Editor, *Global Commodities Applied Research Digest (GCARD)*

Ms. Hilary Till (standing), the Contributing Editor of the *GCARD*, was the moderator for the panel on Chinese commodity demand during the JPMCC's international commodities symposium, which took place from August 10, 2017 through August 11, 2017. The session's panelists (seated) from left-to-right in the photo were Dr. Keith Black, Ph.D., CFA, CAIA, Managing Director, Chartered Alternative Investment Analyst (CAIA) Association; Ms. Jodie Gunzberg, CFA, Managing Director, Head of U.S. Equities, S&P Dow Jones Indices; and Dr. Kevin (Kaifeng) Chen, Ph.D., Chief Strategist, Hywin Capital Management. The panelists are each members of the *GCARD*'s Editorial Advisory Board.

Dear Reader,

Welcome to the fourth issue of the *Global Commodities Applied Research Digest*! We are grateful that members of both the JPMCC's Research Council and the *GCARD*'s Editorial Advisory Board have lent their expertise to the Winter 2017 issue of the *GCARD*. This issue features articles from across the commodity complex, including on the energy, metals, and agricultural sectors. This edition also includes articles relevant to commodity supply chains, commodity futures regulation, and to fiduciary due diligence.

This issue of the *GCARD* is divided into the following seven sections: (1) the Research Council Corner; (2) the Research Council Report; (3) the Research Digest Articles; (4) the Contributing Editor's Collection; (5) the Editorial Advisory Board Commentaries; (6) Industry Commentaries; and (7) an Interview with a Thought Leader in Commodities.

In this issue's **Research Council Corner**, our authors separately discuss the factors involved in forecasting the price of oil and also in forecasting global gold mine supply. In the former article, Dr. Bluford Putnam of the CME Group notes that not being able to assume a stable political or technological environment in the oil markets creates major challenges for forecasting. In the latter article, Dr. Thomas Brady of the Newmont Mining Corporation relates how the discovery of major new resources and game-changing technological advancements impact global gold mine supply. Both Dr. Putnam and Dr. Brady are members of the JPMCC's Research Council, and we very much appreciate their contributions to the *GCARD*!

Mr. John Schmitter (left), President of KEP LLC, with Mr. Lance Titus (right), Principal, Continuum Commodities, LLC, during the JPMCC's September 30, 2016 Research Council meeting. Mr. Schmitter's presentation at this meeting is covered in the Research Council Report section. Mr. Titus, in turn, is a member of both the JPMCC's Advisory Council and its Research Council. In addition, Mr. Titus will be joining the *GCARD*'s Editorial Advisory Board in 2018.

The **Research Council Report** section provides a transcription of a presentation on rail transportation capacity, an otherwise opaque topic, which Mr. John Schmitter, President of KEP LLC, generously gave to the assembled members of the JPMCC's Research Council on September 30, 2016. This report completes the coverage of the morning panel of the fall 2016 meeting, which also included presentations on dry-bulk shipping capacity and on industrial consumer supply-chain risks. The latter two topics were covered in the Spring 2017 *GCARD*.

In the **Research Digest Articles** section, Professor Ana-Maria Fuertes of Cass Business School, City, University of London (U.K.) summarizes three scholarly papers, touching on research relevant to regulation, precious metals, and the statistical properties of commodities. Professor Fuertes is also an Editorial Advisory Board member and has greatly contributed to the success of the *GCARD* through her accessible digest articles.

The **Contributing Editor's Collection** covers topics that we expect to be of interest to commodity futures traders, including (a) how to avoid common trading mistakes; (b) how the problems at the Futures Commission Merchant / Broker-Dealer, MF Global, could have been anticipated; and (c) how to choose amongst types of wheat futures contracts for implementing bullish views in the agricultural complex. The MF Global article, in turn, was previewed by the Harvard Law School Bankruptcy Roundtable on October 10, 2017.

Ms. Jodie Gunzberg (left), CFA, Managing Director, Head of U.S. Equities, S&P Dow Jones Indices, with Dr. Kevin (Kaifeng) Chen, Ph.D., Chief Strategist, Hywin Capital Management, at the JPMCC's August 2017 international commodities symposium. Ms. Gunzberg contributed the article, "Chinese Economic Growth and Commodity Performance," to this issue of the *GCARD*.

In the **Editorial Advisory Board (EAB) Commentaries**, four EAB members contributed articles on the following topics: (1) the connection of Chinese economic growth to commodity performance across sectors and individual commodities; (2) commodity futures trading opportunities; (3) the history of past oil price surprises; and (4) petroleum-complex fundamentals as deduced from price-relationship data. The following summarizes this issue's articles by *GCARD* EAB members. Ms. Jodie Gunzberg, CFA, Managing Director, Head of U.S. Equities, S&P Dow Jones Indices, draws from her presentation at the JPMCC's August 2017 international commodity symposium and documents how the impact of Chinese economic growth may have been different across the five commodity sectors in the S&P Goldman Sachs Commodity Index. Professor Isabel Figuerola-Ferretti of ICADE, Universidad Pontificia de Comillas (Madrid), in turn, covers fundamentally-oriented trading and also characterizes calendar-spread strategies as a type of convergence trading. Next Mr. Jan-Hein Jesse of JOSCO Energy Finance and Strategy Consultancy (Amsterdam) provides the first article in a two-part series on the complex dynamics of oil price formation from 2014 onwards. Mr. Jesse, who is also an expert for the

International Energy Agency, has contributed to three of the *GCARD*'s four issues, for which we are very grateful at the JPMCC. The concluding article of this section is co-written with an EAB member, Joseph Eagleeye of Premia Research LLC, on what oil-sector price relationships have indicated about petroleum-complex fundamentals.

The **Industry Commentaries** include two articles on natural gas markets, specifically (a) on U.S. shale production and (b) on the global liquefied natural gas (LNG) market. Our two authors bring their wide-ranging, in-depth expertise to the *GCARD* and are respectively, Mr. Faouzi Aloulou, Senior Economist, U.S. Energy Information Administration, and Mr. Colin Waugh, Partner, SCP Africa Investments.

Mr. Robert Greer, Scholar-in-Residence at the JPMCC, presenting at the December 4, 2015 JPMCC Research Council meeting. Mr. Greer is also an Editorial Advisory Board member of the *Global Commodities Applied Research Digest (GCARD)*. Mr. Greer is interviewed in this issue of the *GCARD*.

In this issue's **Interview with a Thought Leader in Commodities**, we interview Mr. Robert Greer, who is a Scholar-in-Residence at the J.P. Morgan Center for Commodities and is also an active member of both the JPMCC's Research Council and its Advisory Council. Mr. Greer is most well-known in his former role as an Executive Vice President and Real Return Product Manager at PIMCO, before his retirement. He has also been referred to as the "Godfather of Commodity Investing" because he originated the idea of an investable commodity index in a pioneering 1978 *Journal of Portfolio Management* article.

In conclusion, we are grateful for the support of the CME Group Foundation for sponsoring the *GCARD*, and we welcome feedback from our readers on what topics would be of most value to commodity-market participants.

Best Regards,

Hilary.Till@ucdenver.edu

Solich Scholar, J.P. Morgan Center for Commodities, University of Colorado Denver Business School

Oil Markets: The Analytical Challenges

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

Bluford Putnam, Ph.D., Chief Economist at the CME Group, presented on commodity risk management at the J.P. Morgan Center for Commodities' international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017.

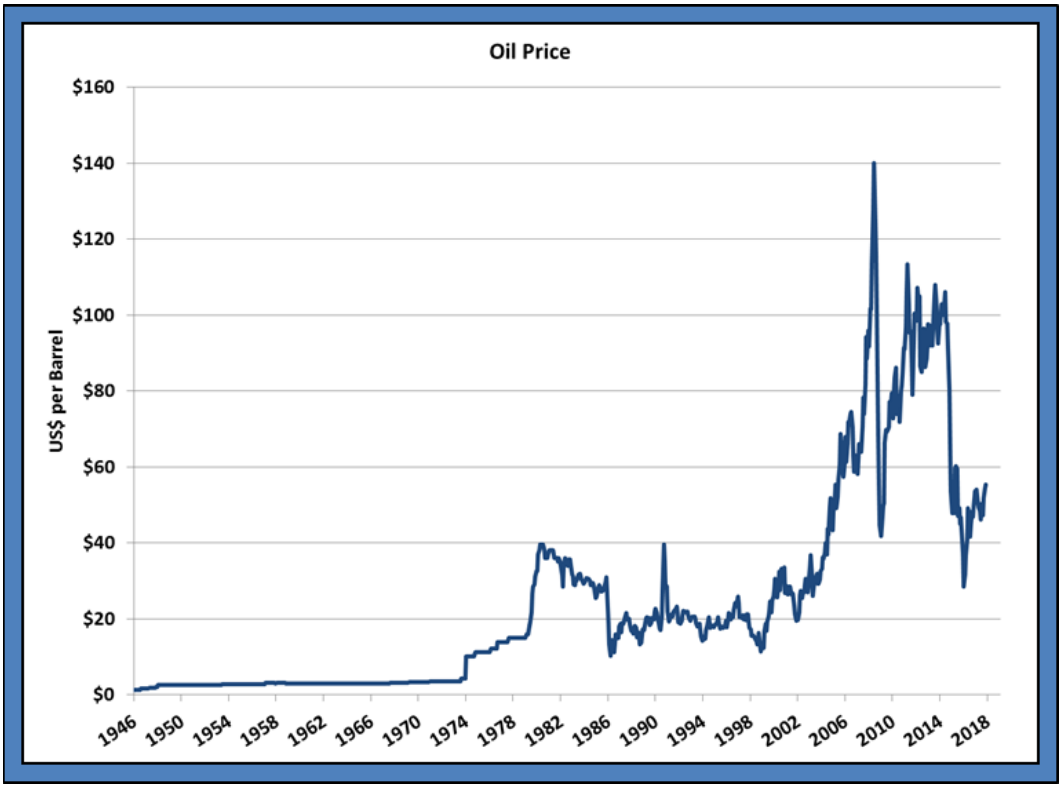
Oil markets were easy to forecast and analyze in the 1950s and 1960s. The U.S. oil price slowly rose from $2.50/barrel in 1950 to roughly $3.50/barrel in early 1973, or roughly the equivalent of $20-$25/barrel at inflation-adjusted prices. Since late 1973, when the Organization of the Petroleum Exporting Countries (OPEC) first flexed its muscles, the oil price has been on a roller coaster ride. One does not just have to analyze the politics and economics of OPEC, there have been major resource discoveries, such as in the North Sea, as well as supply-side technological revolutions with hydraulic fracturing of shale oil, and now we are looking forward to demand-side technological disruption from electric vehicles.

For those data-driven economists stuck in the world of fixed-parameter regression analysis, the inability to assume a stable political or technological environment is a major challenge, since the one thing that seems certain is that the supply-and-demand parameters are time-varying, and the parameter shifts seem to come in jumps and not in a steady pattern. Failure to use statistical techniques allowing for regime shifts can lead to estimates that unintentionally embed the view that the past is a useful predictor of oil market prices – which it is decidedly not.

For Wall Street analysts, the magnetic attraction is to extrapolate recent trends to grab media headlines. For example, back on May 21, 2008, *The New York Times* ran an article by Louise Story entitled: "An Oracle of Oil Predicts $200-a-Barrel Crude". Similarly, as oil prices were sliding in 2015 and into early 2016, Anjli Raval and David Sheppard writing in *The Financial Times* on January 11, 2016, reported on the research of some investment bank energy analysts with the title: "Oil prices to slide towards $20 a barrel". As it happened, oil prices peaked in June 2008 at $139/barrel and hit bottom in February 2016 at $27/barrel – both within a month of the sensationalist analysis.

Perhaps, the best analysis of long-term oil markets was provided back in 1984 by Charles Maurice and Charles Smithson in a classic and concise book*, The Doomsday Myth: 10,000 Years of Economic Crises*, published by the Hoover Institution Press. Instead of ignoring technology and politics, Maurice and Smithson focused on the long term and emphasized the ability of markets to create incentives for technological change and to win out over politics – eventually. For analysts and economists, though, the very long and variable time lags and uncertainties over the magnitude of the eventual technology and political responses present a continuing challenge and can make it difficult to resist the temptation to extrapolate the latest trend. Here, we take a concise look at the key long-term and short-term forces that may drive the oil price in 2018, and in the 2020s. We will start with long-term challenges, such as supply-side technology and demand-side technology, and then provide some cautionary comments related to the economic and political environment as of Q4/2017.

Figure 1

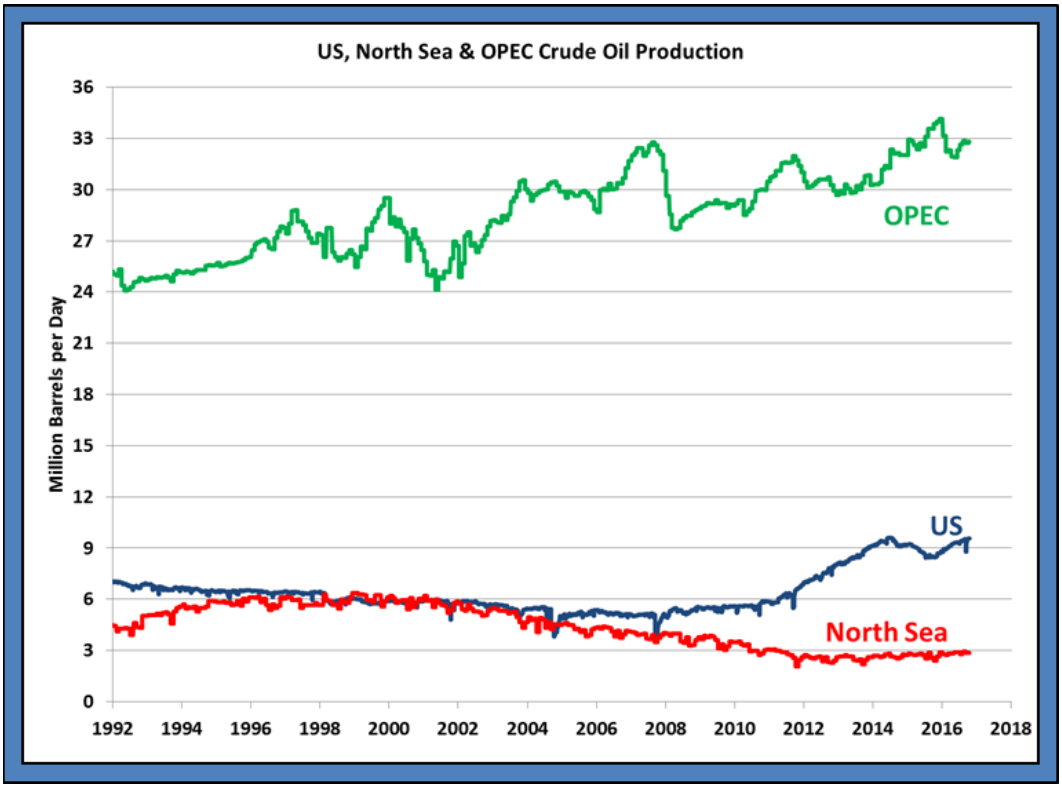


Source: MacroTrends, LLC – US WTI Crude Oil.
(http://www.macrotrends.net/1369/crude-oil-price-history-chart)

Long-Term Supply Technology Themes

The key supply-side technological development is the U.S. shale oil revolution, which commenced before 2010 and has driven U.S. oil production from below 6 million barrels per day (mbd) to over nine million mbd currently, and headed for over 10 mbd in 2018 and beyond. What is often not appreciated is that shale oil technology is not a one-time event. The extraction technology continues to improve every year, driving the marginal cost of the next barrel of oil produced successively lower over time. Also worth noting is that the advances in supply-side oil extraction technology have largely not yet impacted traditional drilling, including in the North Sea. Indeed, the major change in the North Sea oil scene is that in the 2020s, safely decommissioning depleted oil wells will be a much bigger business than drilling new ones. From a production perspective, U.S. oil output is now three times larger than North Sea oil production and that gap is expected to continue expanding through the next decade, weakening Brent's role as even a regional benchmark. We also note that as Brazil liberalizes rules for international companies to drill offshore, there will be some powerful supply increases coming from the more efficient drillers compared to the costly, inefficient and formerly protected domestic oil company, which itself is now in a restructuring phase as it emerges from its scandal-plagued past.

Figure 2

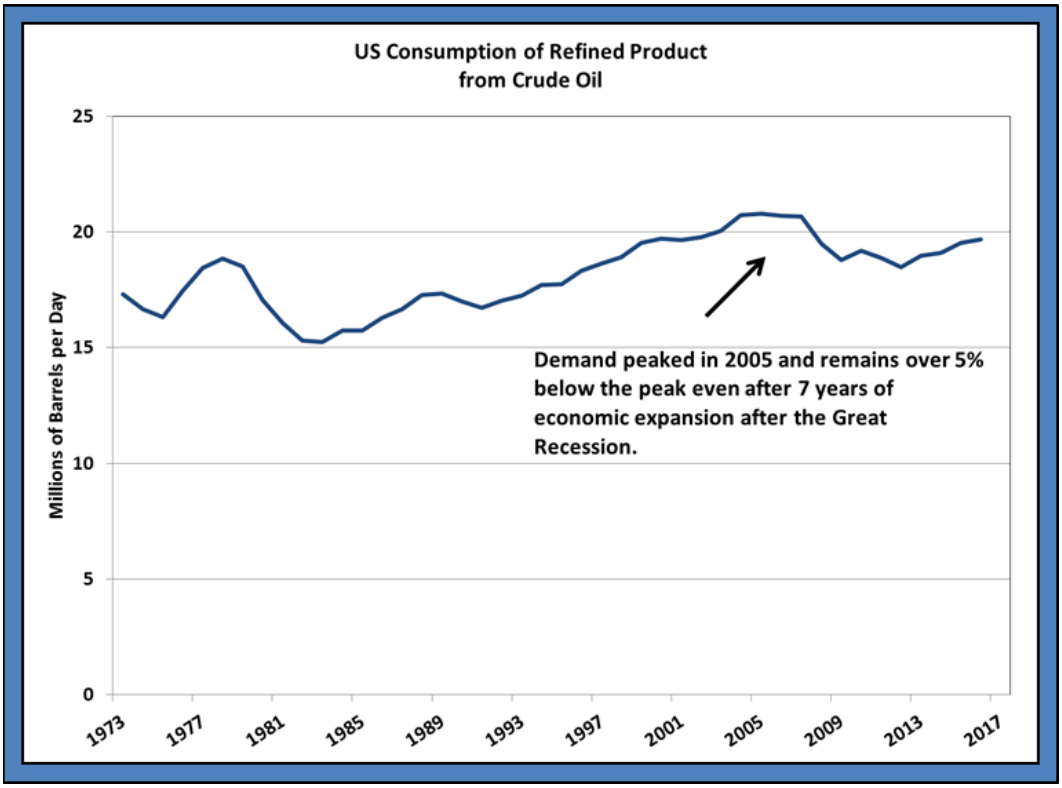


Source: Bloomberg Professional.
(US = DOETCRUD, North Sea = PIWANORT, OPEC = OPCRTOTL)

Long-Term Demand Technology Themes

On the demand side, the key technological development involves the great strides being made in transportation fuel efficiency. In its refined state, the primary job of oil is to power transportation – from automobiles to trucks, to trains to boats and planes. Total petroleum demand in the U.S. peaked back in 2005 and was then driven lower by the Great Recession of 2008-2009. Still, after years of steady, albeit modest, economic expansion, U.S. petroleum demand in 2016 remained more than 5% below its peak of over a decade ago. And, even more importantly, the future of transport efficiency is getting brighter by the day with major new investments in electric-powered vehicles. The truly impressive gains for fuel efficiency in transportation are not likely to emerge until the 2020s, yet when they do, we would be looking at a major source of downward pressure on crude oil prices.

Figure 3



Source: US Energy Information Administration.
(Data Code = MTTUPUS2)

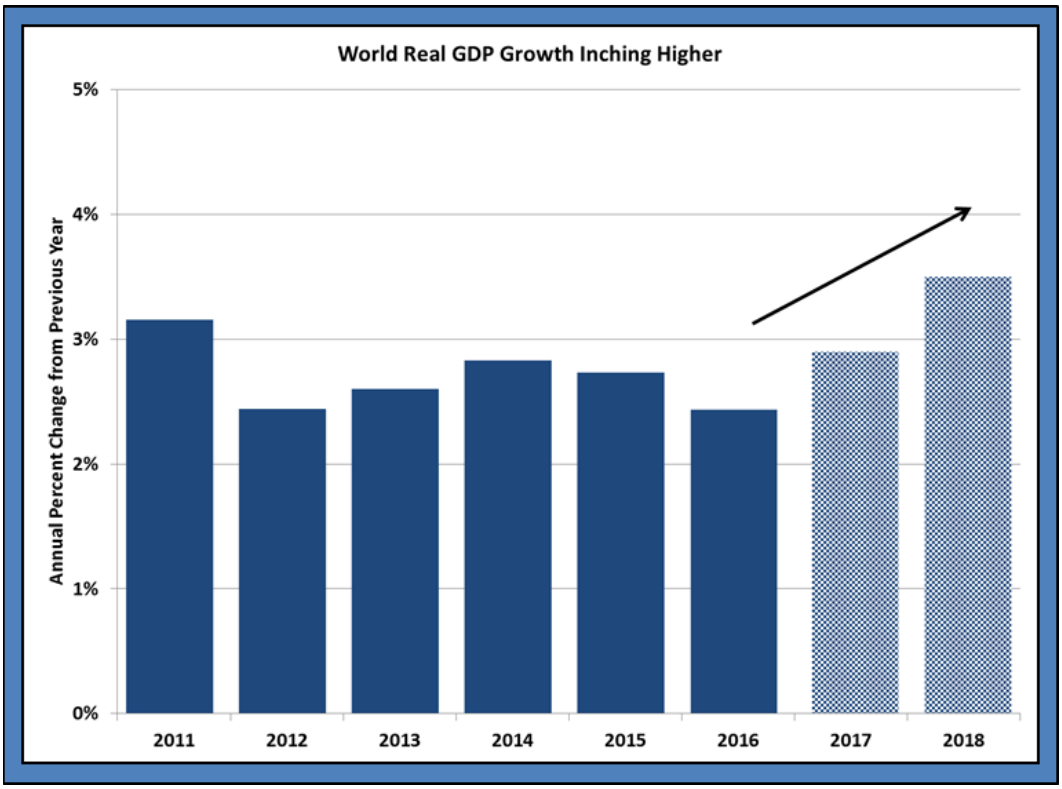
Short-Run Demand-Supply Pressures

There are some key supply disruptions impacting oil prices in the short run. Venezuela's economy has imploded and production has been sharply reduced with no sign of improvement on the horizon. The Kurdish independence vote caused some analysts to worry that Turkey would shut off the pipeline that takes oil from the Kurdish region of Iraq to markets in Europe. Saudi Arabia has a strong incentive to cut production to push oil prices higher in the short term in an effort to boost the Initial Public Offering (IPO) price of state-owned ARAMCO. Indeed, with the U.S. pulling back from a world leadership role, the Saudis are now talking with Russia, and a key theme is about how to keep oil prices above $50/barrel and push them towards $60/barrel and maybe even $70/barrel.

Also a positive for oil prices in late 2017 and into 2018 is the modestly improving tone of global economic activity. According to World Bank calculations, world real GDP growth has not exceeded 3% since 2011; however it now appears that that world economic growth will be close to 3% in 2017 and moving toward 3.5% or higher in 2018. While the U.S., Europe, and Japan are all indicating they can grow a little over 2% in 2018, the important gains driving global growth improvement are coming from the developing world. Indeed, the gains in global economic activity are coming largely from what is no longer happening. China has stabilized and slowed its pace of deceleration. Brazil has exited its deep

recession. Russia is a major beneficiary of oil prices coming off their lows of February 2016 (below $30/barrel) and now edging higher. India has shown solid growth, if not a steady pace of reforms.

Figure 4



Source: Data through 2016 from the World Bank via the Bloomberg Professional (WRGDWRLD); 2017 and 2018 estimates provided by CME Group Economics.

Conclusion: The Tug of War between Long-Run Technological Advances and Short-Term Supply-Demand Factors

While our perspective is that the short-term supply constraints and demand increases will eventually have to confront the longer-term technology disruptions, the lags can be long and variable. The next downdraft in oil prices coming from long-term technology developments may be delayed for years until the transportation efficiencies are more fully realized. Still, when oil prices rise to the top of the trading range, the maturity curve typically displays "backwardation," in which there are higher short-term prices twinned with lower long-term prices. This type of maturity curve suggests that oil markets are, indeed, grappling with the tug of war between (a) upward short-term pressures resulting from geopolitics and global growth and (b) downward long-term price pressures resulting from technological advances on both the demand and supply side of the equation.

Endnotes

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

Author Biography

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

Dr. Bluford Putnam is Managing Director and Chief Economist of CME Group. He manages the Intelligence & Analytics team, which includes both data science and management analytics. 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 most recently served as Managing Partner for Bayesian Edge Technology & Solutions, Ltd., a financial risk management and portfolio advisory service he founded in 2000. 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 in liberal arts 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.

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

Global Gold Mine Supply

Thomas Brady, Ph.D.
Chief Economist, Newmont Mining Corporation; and Member of the J.P. Morgan Center for Commodities' (JPMCC's) Research Council at the University of Colorado Denver Business School

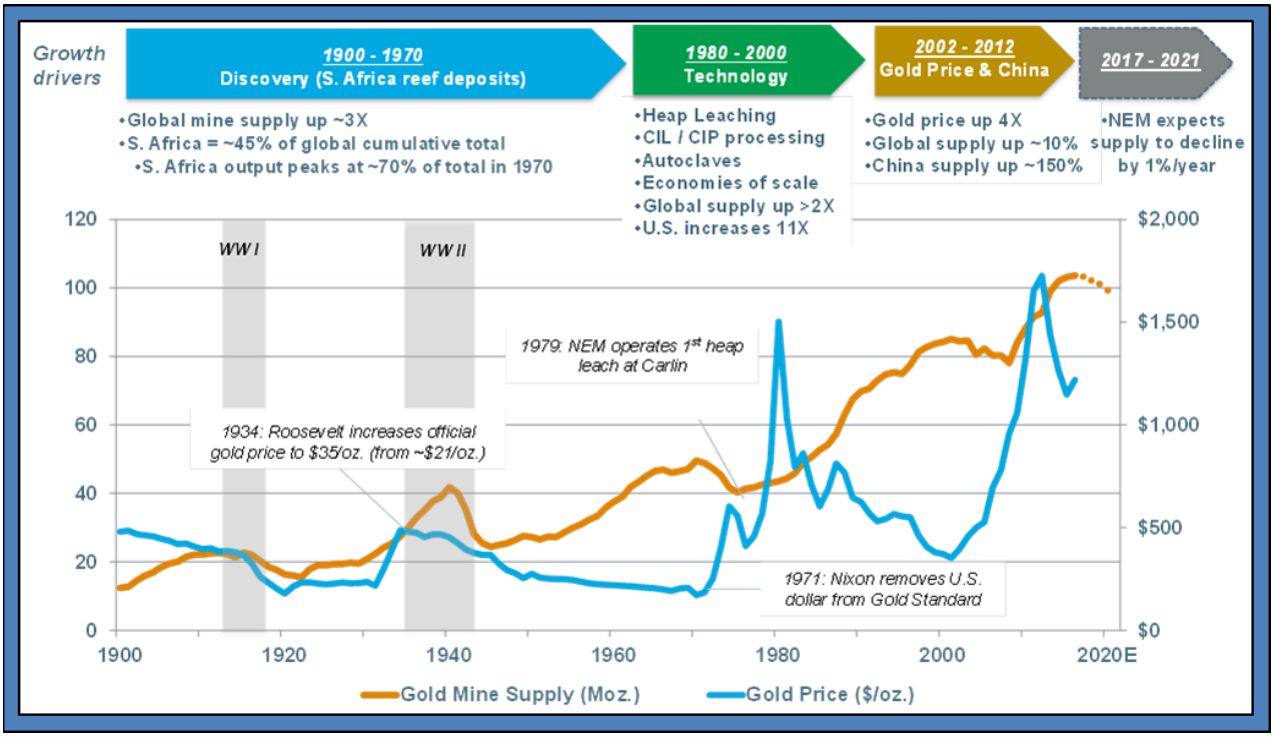
Thomas Brady, Ph.D., Chief Economist at the Newmont Mining Corporation, discusses an academic paper on the copper industry at the J.P. Morgan Center for Commodities' international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017.

As the Chief Economist at Newmont Mining Corporation, my responsibilities include providing forecasts of key commodity prices, foreign exchange and other financial rates. These forecasts are then used in various activities throughout the corporation including mine and business planning, reserve and resource estimates, investment analyses, and in the public reporting of financial statements by our accounting teams. These forecasts are based on a mix of third-party analyst and economist projections, fundamental and econometric analysis of historical data, as well as an assessment of longer-term

fundamental, macroeconomic and demographic trends, including gold mine supply. This article will focus on the latter topic, the trends in gold mine supply. The article will review historical gold mine supply trends, along with their key drivers, and will conclude with my expectations regarding supply over the coming years.

Figure 1 displays global gold mine supply since 1900 (orange line) and the various drivers that buoyed growth trends including exploration success, technological advances and gold prices. Inflation-adjusted (or real) gold prices are also included (blue line).[1] As shown, global gold mine supply totaled approximately 12-million ounces in 1900. Aside from declines during the First and Second World Wars, global supply generally trended upward to nearly 50-million ounces by 1970.[2] A primary driver during this period was the very large and very deep reef deposit discoveries in the Witwatersrand in South Africa, particularly during the 1930s through the 1950s.

Figure 1
Gold Mine Supply (Left-Hand Side in Millions of Ounces) and Real Gold Price (Right-Hand Side in $/ounce) (Since 1900)



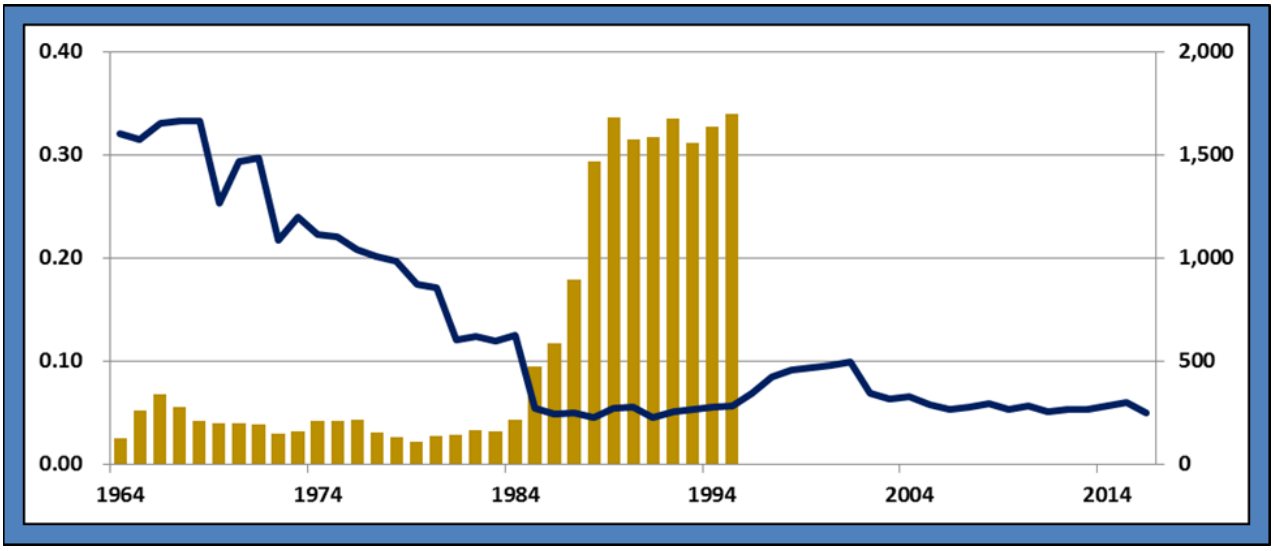
The abbreviations in this figure are as follows. "Moz": millions of ounces; "oz": ounces; NEM: Newmont Mining Corporation; and CIL / CIP processing: Carbon-in-Leach and Carbon-in-Pulp processing.

Cumulatively over this 70-year period, South African mines generated approximately 45 percent of total gold mine supply, climbing to contribute 70 percent of the annual global total in 1970. Through most of the 1970s, gold mine supply declined, driven by a nearly 20 percent drop in South African supply as mining companies encountered lower grades at traditional operations.

The growth in mine supply recommenced during the 1980s as the technological advancements in new processing techniques such as heap leaching, carbon-in-leach, carbon-in-pulp and others became increasingly widespread, allowing mining companies to profitably extract gold from lower-grade and more complex ore types. Specifically in 1979, Newmont began its first heap leaching operation at its Carlin, Nevada operations, which eventually contributed to annual supply from the state of Nevada increasing 10-fold over the following decade. Accompanying the implementation of new technologies during the 1980s and 1990s, supply growth was also driven by large scale gains in economies of scale with mining and other equipment. For example, Caterpillar haul truck capacities climbed from approximately 150 tons with the CAT 785 in 1984 to over 360 tons in 1998.[3] From 1980, global mine supply more than doubled to 85-million ounces in 2001.

Figure 2 provides an example of how technological advancements and larger equipment have impacted operations at Newmont's Carlin area mines in Nevada, which have been in production since the mid-1960s. In 1965, Carlin produced approximately 130-thousand gold ounces with reserve grades of well over 0.3 ounces per ton. As shown in the figure, grades declined at the operation through the early 1980s to well below 0.1 ounces per ton. With the completion of Newmont's first heap-leaching operation in 1979, mining of large low-grade deposits (such as at the Gold Quarry Pit near Carlin), combined with larger equipment allowed production to climb slightly over 130-thousand ounces to over 1.5-million ounces by the end of the 1980s. By the early 1990s, Gold Quarry became the first mine to produce over 1-million gold ounces in a single year.

Figure 2
Reserve Ore Grades (Left-Hand Side in ounces/ton) and Production (Right-Hand Side in '000 ounces) at Newmont's Carlin, Nevada Mines



Source: Newmont's historical annual reports, production, reserve and resource reporting; and Newmont's reserve gold grade data for Carlin open pits and underground.

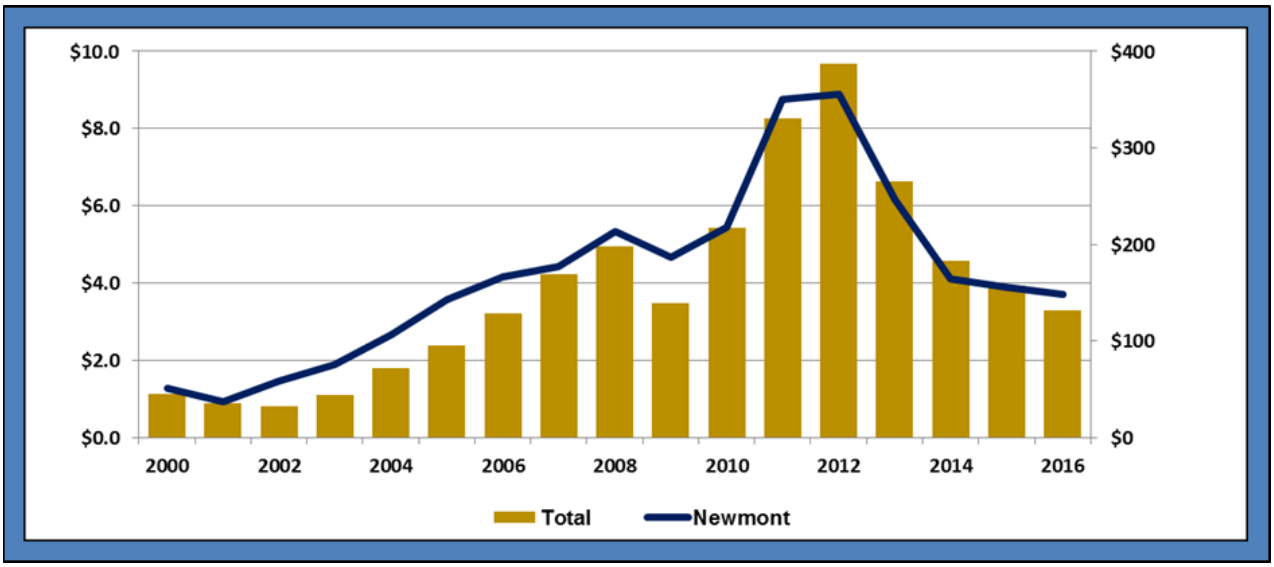
Following the acquisition of Santa Fe Gold in 1998, Newmont initiated reporting on operational results for all of Nevada; thus gold production is only shown through 1997 on this figure.

Reverting back to Figure 1, the most recent period of significant growth in mine supply commenced in 2009, resulting from a period of prolonged gold price increases that occurred during the Metals Super Cycle. As shown on Figure 1, gold prices climbed from a low in 2001, averaging slightly over $350 per ounce to well over $1,700 per ounce in 2012 (in real terms), a nearly four-fold increase. This period of sustained gold price gains allowed mining companies to aggressively expand exploration and project development budgets, contributing to global mine supply climbing to nearly 93-million ounces. Additionally, growth in Chinese mine supply was a key driver as output from the country increased from under 6-million ounces in 2002 to over 13-million ounces in 2012.

Exploration Spending is Fairly Responsive to Gold Price Trends

Within a typical mining company, exploration spending tends to be fairly responsive to gold price trends as these activities generally are one of the first areas within the firm that are ramped up (as prices begin to climb) or cut (as prices trend downward). Figure 3 displays exploration spending across the gold mining sector as well as for Newmont. Following an industry low of approximately $80-million in 2002, exploration spending across the sector increased at an annual rate of 25% per year to a peak of nearly $10-billion in 2012.[4] As shown on the figure, global gold exploration spending has since declined by over 65 percent to slightly over $3-billion in 2016.[5] Exploration spending at Newmont has followed very similar trends, from a low of under $40-million in 2001, to a peak of nearly $360-million in 2012, only to retreat to under $150-million last year.

Figure 3
Exploration Spending: Industry Total (Left-Hand Side in $Billions) and Newmont (Right-Hand Side in $Millions)



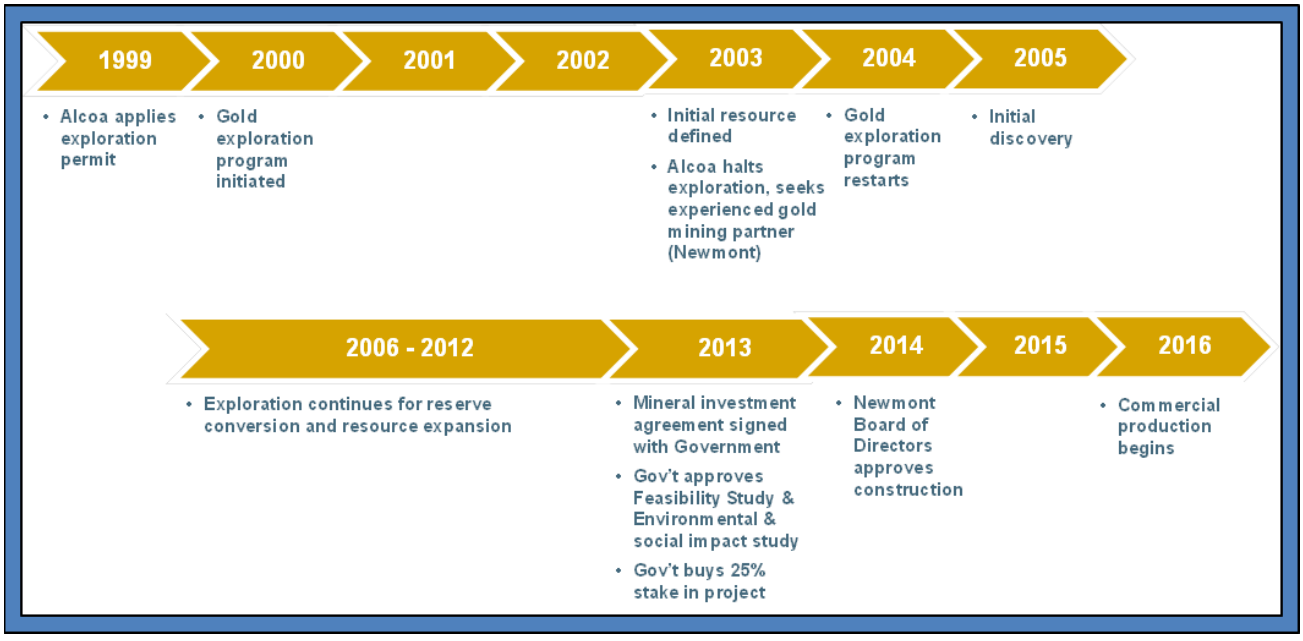
Source: SNL Financial and Newmont public financial statements.

The Inherent Lag with Price and Mine Supply Trends

While exploration spending may be more responsive to gold price trends, it takes multiple years for actual mine supply to react as miners typically continue to complete already-in-progress development projects (even if prices trend lower)[6] and/or begin to relax cost-cutting related programs (as prices initially begin to tick upward). As an example, in the mid-1990s real gold prices peaked in 1996, averaging approximately $550 per ounce at which point, a sustained period of aggressive price declines commenced.[7] By comparison, global mine supply only began to flatten and then trend lower beginning in 2001 (a lag of more than a half decade). A similar multi-year lag subsequently occurred with the aforementioned price uptrend in the early 2000s as mine supply only began to recover in 2009. Further, even as gold prices have retreated from the most recent highs in 2012, global mine supply has continued to climb, reaching nearly 104-million ounces in 2016.

A key contributor to the lag between inflection points in gold price and mine supply trends lies in the time required to advance a prospective property through exploration, feasibility studies, and project approvals to commercial production. Figure 4 provides an example for the Merian gold mine in Suriname, jointly owned by Newmont and the government.[8]

Figure 4
Merian Gold Mine Exploration Through Commercial Production



As shown, the previous owner of Merian (a subsidiary of Alcoa), first applied for an exploration permit in 1999, with drilling activities commencing in 2000. In 2003, an initial resource of approximately 180-thousand ounces was defined. Also during 2003, Alcoa halted this initial exploration program, seeking to partner with an experienced gold-focused company (Newmont). Following the finalization of a joint-venture agreement, exploration recommenced and an initial discovery was declared in 2005. Over the next seven years, exploration continued to expand both reserves and resources. Key investment and

other agreements were approved by the government in 2013, with the project receiving construction approval by Newmont's Board of Directors in 2014. Commercial production at Merian began in 2016 (17 years following the initial exploration program and more than a decade after the initial discovery was declared).

Expectations for Gradually Lower Mine Supply Going Forward

As shown on the dotted-line portion of the gold mine supply curve on Figure 1, my expectations are for global gold mine supply to gradually turn downward over the coming years. This supply downtrend will be driven by the recent trend of lower growth spending across the sector (on exploration and the advancement of development projects) and as the lag between price and supply trends is realized. I anticipate the scale of decline to be gradual, similar to declines in the mid-1990s through early 2000s where industry mine supply dropped by approximately 1 percent annually.

While Newmont has renewed its focus on exploration and business development efforts to expand reserves and resources, the company is not relying upon discovering major new resources, nor is Newmont banking upon game-changing technological advancements (similar to those realized during the 1980s and 1990s). Overall, Newmont remains centered on controlling the aspects of the business that it can: managing costs, continuing productivity improvements and planning for contingencies.

Endnotes

1 Real gold prices are in 2016 U.S. dollar terms.

2 For example, during WWII in the U.S., 8,000 individual gold operations were closed in support of the war effort.

3 Currently, the largest CAT truck is the 797F with approximately 400 tons of hauling capacity.

4 This corresponds to a period when gold prices averaged less than $400 per ounce to well over $1,700 per ounce (in real $2016 U.S. dollar terms).

5 This aggressive change in exploration spending is not unprecedented as similar spending declines occurred in the late 1980s as well as from 1997 through 2002, when cumulative spending dropped by 75%.

6 In addition, aggressive cost-cutting and productivity-improvement programs implemented across mining companies may allow marginal mines to remain active during initial phases of a downtrend.

7 A key driver of this price drop was the lack of an investment thesis for gold as many central banks (primarily in Europe) sold and/or liquidated their gold reserves.

8 Newmont has a 75% interest in Merian, with the remaining 25% owned by Staatsolie, an oil company which is owned by the Suriname government.

Author Biography

THOMAS BRADY, Ph.D.
Chief Economist, Newmont Mining Corporation

Dr. Thomas Brady is currently the Chief Economist at Newmont Mining Corporation and is responsible for generating key commodity price, foreign exchange, and other financial assumptions used throughout the company, as noted in the article's introduction. In this role, Dr. Brady also develops methods to effectively quantify and communicate the economic impact of Newmont's operations to host communities and countries. Previously at Newmont, Dr. Brady led the Strategic Planning function that developed and implemented portfolio modeling analytics and also held positions in Investor Relations, Treasury and Corporate Development.

Previously Dr. Brady was a Senior Manager at Risk Capital Management, a consultancy that advised energy and natural resource companies on financial risk, valuation and commodity hedging.

Dr. Brady has also worked with CQG, Inc. where he developed a suite of automated trading systems for commodity futures contracts using the company's short-term, price and volume charting methods.

He holds a Ph.D. in Mineral Economics with research emphases in commodity markets from the Colorado School of Mines. In addition, Tom holds a Master's degree in Mathematics, also from the Colorado School of Mines.

Dr. Brady is a member of the J.P. Morgan Center for Commodities' Research Council as well as its Advisory Council. In addition, he serves as a member of the *Global Commodities Applied Research Digest*'s Editorial Advisory Board.

Rail Capacity Dynamics in North America

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

The participants in the morning panel of the JPMCC's September 30, 2016 Research Council meeting are shown above. From left to-right are Professor Nikos Nomikos, Ph.D., Cass Business School, City, University of London (U.K.), **Mr. John Schmitter** (speaking)**,** KEP LLC; Mr. Steffen Hammer, Robert Bosch GmbH (Germany); and Professor Colin Carter, Ph.D., University of California, Davis and a Research Council Co-Chair, JPMCC.

Introduction

The September 30, 2016 JPMCC Research Council meeting featured a morning panel on "Emerging Risks and Challenges in Commodity Supply Chains." The panel featured presentations from (1) Professor Nikos Nomikos, Ph.D., Cass Business School, City, University of London (U.K.); (2) Mr. Steffen Hammer, Robert Bosch GmbH (Germany); and from (3) Mr. John Schmitter, KEP LLC. Professor Nomikos discussed global shipping economics and risks; Mr. Hammer, in turn, covered the commodity risk management concerns of a large industrial consumer; and Mr. Schmitter concluded with an explanation of rail capacity dynamics in North America.

The panel was organized by Dr. Ajeyo Banerjee, Ph.D., of the University of Colorado Denver Business School and was chaired by Professor Colin Carter, Ph.D., of the University of California, Davis. Professor Carter is also a Co-Chair for the J.P. Morgan Center for Commodities' Research Council. After very briefly summarizing Dr. Nomikos' and Mr. Hammer's lectures, this digest article will cover Mr. Schmitter's rail capacity presentation.

Global Shipping Economics and Risks

Dr. Nikos Nomikos, Professor of Shipping Risk Management, Faculty of Finance, Cass Business School, City, University of London (U.K.), covered the following topics in his presentation: (1) the economic significance of shipping to the global economy; (2) the growth in seaborne trade since 1996; (3) the overinvestment in shipping during the peak of the market; (4) recent developments in world trade and shipping; (5) how vessel sizes are getting much larger; and (6) emerging trends in shipping. In addition, Professor Nomikos graciously covered his Research Council presentation in a digest article in the Spring 2017 issue of the *GCARD*.

Commodity Risk Management for a Large Industrial Consumer

Mr. Steffen Hammer, the Vice President for Commodity Purchasing at Bosch, also presented during the September 30, 2016 Research Council panel. During his presentation, Mr. Hammer covered, in succession, the following topics: (1) background information on the Bosch Group; (2) an overview of the company's products and commodity risks; (3) the types of commodity risk-management techniques employed by the company; (4) recent examples of commodity risk-management challenges; and (5) a summary of research interests on the part of the Bosch Group. Mr. Hammer's colleague, Sven Streitmayer, elaborated on elements of Mr. Hammer's presentation in a digest article in the Spring 2017 issue of the *GCARD* as well.

North American Rail Economics and Risks

The third and final presentation during the September 30, 2016 morning panel on commodity supply-chain challenges was provided by Mr. John Schmitter, President, KEP LLC. Noted Professor Colin Carter in his introduction, John Schmitter "is a consultant and has a very impressive list of activities and clients. John works on supply chain organization, transportation pricing, and rail-cost analysis."

Mr. John Schmitter, President, KEP LLC, participated in the morning panel on "Emerging Risks and Challenges in Commodity Supply Chains" at the September 30, 2016 JPMCC Research Council Meeting.

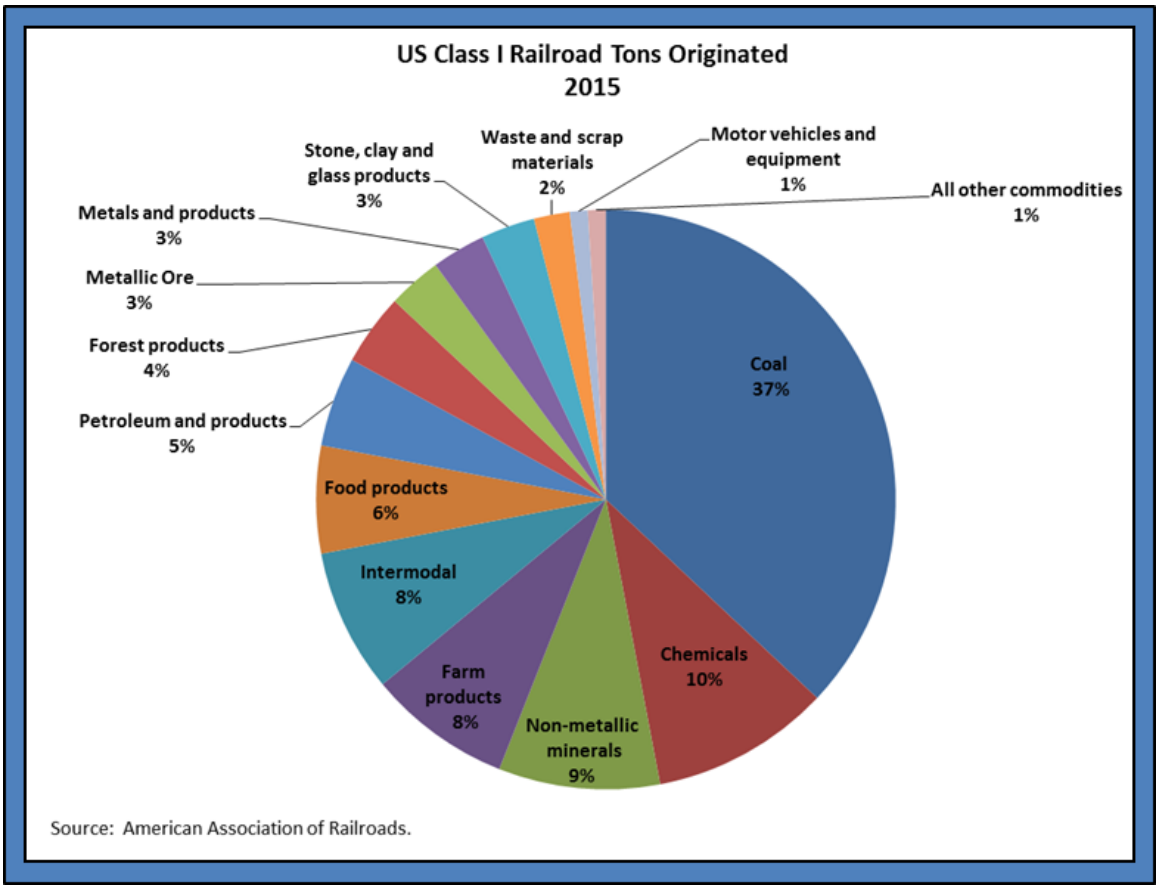
Introductory Explanation

Mr. Schmitter introduced his presentation by explaining that "in the North American railroad industry, it is almost a complete opposite of what Nikos [Nomikos] just described in … ocean shipping ... as regards to container ships. … Rail capacity is available but very much controlled." He stated that his presentation was organized as follows: he would describe [a] "where the railroads fit in the commodity supply chain, … [b] what the industry structure is, which is quite a bit different than it is in most of the rest of the world, ... [c] how railroads look at capacity and capital investment, and [d] some things that practitioners can do to manage … [rail availability] risks."

How Railroads Fit in the Commodity Supply Chain

Stated Mr. Schmitter, "If you look at what railroads handle ... from a tonnage standpoint, it is commodities; it is coal, chemicals, minerals ..., sand, ... grain and other food products as well as the inland portion of intermodal container movements." Please see Figure 1 on the next page.

Figure 1
U.S. Railways Handle Mostly Commodities and Intermodal



Source: Slide 2 of Mr. John Schmitter's September 30, 2016 presentation to the JPMCC Research Council.

For "most of these commodities in the U.S., ... truck and water do play a part in the supply chains … But for the most part, trucks are used for very short hauls or prior or subsequent to water or rail movements. And of course, water is ... limited to where you have access ..."

"So in North America, … commodity supply chains … pretty much [refer to transport via] … railroads."

North American Railroad Industry Characteristics

The North American railroad industry has the following seven characteristics: (1) ownership by shareholders; (2) railroad companies own track, locomotives and other infrastructure; (3) rail customers own or lease about 50% of railcars; (4) labor are railroad employees, and "it is a highly unionized environment;" (5) there is light economic regulation, which is the responsibility of the Surface Transportation Board in the U.S. and the Canadian Transportation Agency in Canada; (6) "companies are very profitable;" and (7) there is little government involvement in infrastructure or operations.

Mr. Schmitter clarified that "as a practical matter, most rail movements in the U.S. are not regulated." In addition, "rail rates and services are really not regulated in Canada at all."

Rail Service Mainly Provided by One Carrier

Mr. Schmitter reviewed that "there are ... two regional duopolies: two large railroads in the West and two large railroads in the East." In the West, the carriers are BNSF and Union Pacific; and in the East, the carriers are CSX and Norfolk Southern. "There is another one that serves the middle of the country, Kansas City Southern; KCS also owns the main railroad in Mexico." While in Canada, "both railroads, the Canadian National and the Canadian Pacific, ... pretty much cover the whole country."

Mr. Schmitter noted that "most rail-served locations are only served by one railroad," which means that "most movements are captive to one railroad at one end or the other." Therefore, the railway industry is one where "private companies … have a lot of market power." He added, "basically [these companies are] ... lightly regulated, capacity constrained monopolies. From a business standpoint, it doesn't get any better than that."

Rail Capital Investment and Capacity

Mr. Schmitter next covered rail capacity investment decision-making. "So how do … [railroad companies] look at capital investment? Whereas Nikos [Nomikos] described … the shipping industry … [as one where when] things look good, everyone is scrambling for market share [and] scrambling for capacity …", it is different for railroads. With the "market power of the railroads, … the companies look at … [capital investing] differently. It is a very capital-intensive industry. I think probably electric utilities are the only more capital intensive industry in the U.S., and the capital has a lot of risk" compared to other large-scale industrial decisions. "If somebody builds a big chemical plant, and … they decide not to use it, they can always sell it to somebody and maybe it could have some other use." In contrast, "rail track is … a 100-year asset. It's pretty much only good for running trains." So one's investment horizon is over a very long timeframe. "Even things like locomotives and rail cars are 40 – 50- year assets." Therefore, "a lot of thought has to go into … [capacity expansion] before … spending money on those things," explained Mr. Schmitter.

"In its early days, … the railroad industry in North America was very much like [how] Nikos [Nomikos] described the shipping industry today: … there were a lot of competitors; there was a real scramble for market share; people were building track like crazy and there was much more capacity than was justified by the volume that was being shipped. … [Heavy regulation followed with constraints on pricing and limited flexibility to adjust capacity to market demand. By the 1970s the railroads in the Northeast U.S. were bankrupt, and most railroads were struggling financially. In 1980, the U.S. Congress passed the Staggers Rail Act and in 1995 the ICC Termination Act which together, substantially reduced regulation, allowing more pricing flexibility along with the ability to abandon or sell lightly used lines. The reduced regulation also made it easier for carriers to merge, and there have been several rounds of mergers resulting in an industry that is more consolidated with seven Class I railroads. Similar changes in regulation occurred in Canada.] It's a very profitable industry now. All these 7 companies are very profitable. They are all public companies. BNSF is a wholly-owned subsidiary of Berkshire Hathaway.

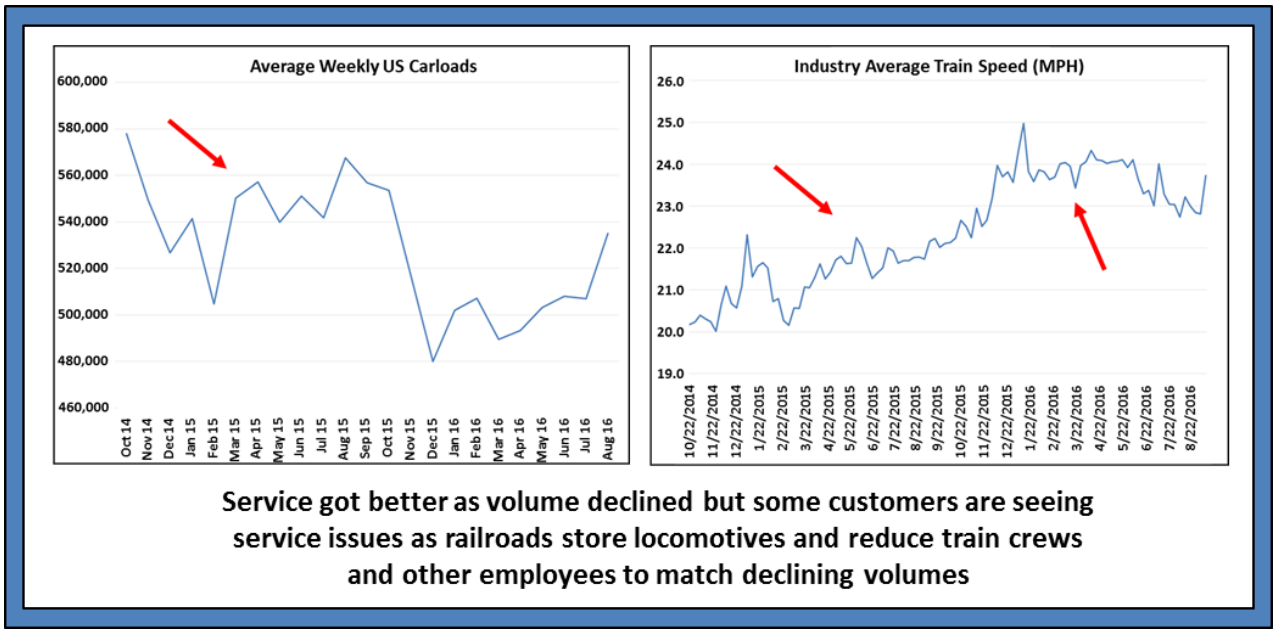
But Berkshire Hathaway itself is a public company so they have shareholders to answer to, and most of the capital requirements for these companies, just for them to stay in business [and] to keep pace with the way it is right now, is a few billion dollars a year, every year. So they consume a huge amount of capital. … [One] can see [that] they've got to generate the operating cash flow in order to … [cover their capital requirements.] The good news is they have it, and they do [make these expenditures.] [For the railroad companies,] it's really a choice … about [a] how much capacity [to aim for], [b] how much to invest in Cap Ex that would encourage both growth and sustainability of the current infrastructure, and [c] how much do … [they] want to return to shareholders in the form of share buybacks and dividends," stated Mr. Schmitter.

"If … one listens to the [company] conference calls with [equity] analysts, the questions the analysts ask are always about … three things. One is … [if] there will be overinvestment in capacity and the companies will start competing with each other again instead of acting like real good economic duopolists. [Investors] … are … [anxious] about business declines that … will create excess capacity and again encourage these companies to start competing with each other. … The third [concern] … is [about] additional regulation that might constrain their pricing power," continued Mr. Schmitter.

Rail Availability Risk

Given these tensions, railroad companies "want to manage the capacity or make sure their capital investment fits their projection of traffic growth, [which is] the volume that they [will] have to handle …, [and] all that is based on projections. [But] sometimes those projections are wrong. … If you look at just the recent past, … there was … congestion [and] … service issues. When volume … declined with the economy … [one] can see [in] the graph [on the next page in Figure 2] on the left [that] … service generally got better, the system got less congested, [and] more fluid. … Volume is still relatively low compared to what it was in 2014. But … [one] can see from the [graph on the right in Figure 2] … that the service level has started to drop off. Why is that? The system is more fluid and there's less traffic moving over the track, but as they start to pare down operations and capital investments -- locomotives are being stored -- train and engine crews and other services are being laid off [too]. When … [the railroads] lay off a train crew that usually means that a local train going every day is now going only three days a week so service starts to decline and clients are starting to see that all over the place," described Mr. Schmitter.

Figure 2
As Volumes Declined, Service Improved – Temporarily



Source: Slide 7 of Mr. John Schmitter's September 30, 2016 presentation to the JPMCC Research Council.

"There's … no government requirement like in utilities where the railroads have to have the capacity or maintain capacity to deal with service. … There's no … big backlog of standby assets that can respond to a short-term uptick in volume. The customers won't pay for it; the regulators don't require it; and the investors won't stand for it. So capacity is going to be matched to what … [the railroad companies] view as the projected traffic volume. What … [this] ultimately means [is] that … [there] will … [be] periods of good service and periods of bad service. … Citing 3 periods here: 1999-2000, 2005-2006, and most recently in 2013-2014, basically the volume was so high [that] the systems in a lot of places basically ground to a halt. The service became very inconsistent, transit times became longer, … and [there were] a lot of problems for [the] commodity supply chain. [For example, if one] worked for a public utility, [one was faced with] … running out of coal. … In 2013-2014, [the service issues were] blamed on … a really bad winter in Chicago. That was just an excuse. … [The] real reason was demand exceeded the capacity. … At the same time … [we] were still experiencing the growth in crude oil by rail, … [one] had a record grain harvest, which caused more grain to be moved than people expected, and … [one] had an uptick in the price of natural gas and that caused utilities to dispatch more coal generation, so [there was] demand for more coal," recounted Mr. Schmitter.

Expanding rail capacity is "not such an easy thing. Capital investment in track is years to plan and construct. … The lead time for locomotives is a year. If [one is] … short now, [then it will be] a year before … [one] can get another one. Even the hiring of train and engine service crews [is time consuming;] … to get somebody capable and up-to-speed is a six-month process. There are crews laid off now; … when volume picks up … [railroads] are going to want to hire those people back. Maybe they

are available; [but] maybe they have other jobs now. ... It can take a year before the train and engine service crew" can get to "ultimate productivity," warned Mr. Schmitter.

"The bottom line is that it is very difficult for the railroads to cope with rapid and unexpected increases in demand. … [A] 5-6% increase … [in] the current volume is really all it would take to bring a lot of portions of the system back to pretty much their … capacity" limit, explained Mr. Schmitter.

"The good news is that there are things … [that can be done.] The industry is in pretty good shape. They do have the operating cash flow to make those investments in capacity. They make good margins on the coal business that will support the capital investment. They will adjust the capacity to meet their projected demand. To the extent they are wrong, [one is] going to have those periods of relatively good service and periods of unexpected capacity shortages," predicted Mr. Schmitter.

"They will increase the rates as market conditions change. … [When companies] … are going to make an investment in a line or [a] locomotive, that investment has to be supported by the least profitable business. … An alternative to making additional Cap Ex is to raise prices on that least profitable business …," noted Mr. Schmitter.

Mr. John Schmitter (left), KEP LLC, in discussion with Professor James Hamilton, Ph.D. (right), University of California, San Diego, whom in turn is also a Co-Chair of the JPMCC Research Council, during the September 30, 2016 JPMCC Research Council meeting.

Conclusion

"The message here for practitioners is ... [one] can't just assume the service. … [One has] to realize that capacity may not be available at the moment … [that one] need[s] it. So if … [one is making decisions at] a utility … and you are taking 5 or 6 coal trains a week, [and then] gas prices get low, [and] now you are only taking 2 for the next two years, and [later] we have an uptick in the gas prices, and you want 5-6 trains a week [or] next month, that is probably not going to happen. … The result of that is you need to focus on more flexibility in supply, use other railroads, [and] other modes [of transportation.] … You may want to be holding more inventory than you would otherwise [have] wanted," recommended Mr. Schmitter.

He also recommended that companies that rely on rail should "[a] manage the railroad relationships carefully; [b] make … capital investments [themselves and] …, [c] make sure that … [one's] location is as efficient as possible for the [railroad] companies to serve."

Author Biography

JOHN SCHMITTER
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Mr. John Schmitter is the founder and president of KEP LLC. KEP LLC was developed to provide strategic, management and economic consulting services to industrial companies, energy producers, retailers and transportation companies. Mr. Schmitter is an expert in transportation issues. His specialties include transportation markets, pricing, yield management and competitive analysis, railroad operations, railcar fleet planning and management, transportation procurement strategies, education and expert witness testimony. Mr. Schmitter has worked with clients in many industries. He has made numerous speeches and presentations before various conferences and seminars and his comments have appeared in various trade publications. He has a Bachelor of Science degree in Business Administration from Northeastern University and an MBA from Pennsylvania State University.

The Effects of Margin Changes on Commodity Futures Markets

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Published in: *Journal of Financial Stability,* 2016, Vol. 22, February, pp. 129–152.

In light of the 2010 Dodd–Frank Act, this paper assesses the effect of margin changes on prices, the risk-sharing between speculators and hedgers, and the price stability of 20 commodity futures markets. It provides evidence that margin increases decrease the rate at which prices change, yet they impair the risk-sharing function and they decrease market liquidity in certain markets. The regulator should set margins by taking the heterogeneity of commodity futures markets into account. Certain effects of margin changes diffuse across related markets though. The effect of margin changes is more pronounced in commodity futures markets than in major equity and interest rate futures markets.

Introduction

Traditionally, futures exchanges use margins as a risk management tool; they are a payment that serves as a collateral deposit to eliminate credit risk. Until recently, futures exchanges had the discretion to set and change margin rules. However, the 2003-2008 commodity boom revived a long-standing debate on whether margin requirements should be regulated so that they can also be used as a policy tool to restrict speculation and drive commodity prices down. The 2010 *Dodd–Frank Wall Street Reform and Consumer Protection Act* gave authority to the U.S. Commodity Futures Trading Commission (CFTC) to establish margin requirements so as to protect the financial integrity of futures markets. So far, the CFTC has not exercised this authority. This paper comprehensively investigates the effect of margin changes on (1) commodity futures prices/returns, (2) the sharing of risk between speculators and hedgers, (3) commodity futures price stability, and on (4) the interaction between various commodity market characteristics.

Why the Paper's Research Question is Important

The study of the effect of margin changes on the above features of commodity markets is of interest to academics, investors and regulators for at least three reasons. First, it stands in the core of the historically ongoing debate about whether margins should be regulated. Second, it tests the predictions of the theoretical literature on the effect of funding constraints on financial markets (see e.g. Gromb and Vayanos, 2002; Brunnermeier and Pedersen, 2009; Gârleanu and Pedersen, 2011; Acharya *et al*., 2013). In the case where investors face funding constraints, margin increases make these constraints tighter, forcing investors to close their positions. Hence, margin changes may affect market liquidity and in turn

This digest article was written by Ana-Maria Fuertes, Ph.D., Professor in Finance and Econometrics at Cass Business School, City, University of London (U.K.).

influence price, volatility and risk-sharing. Third, the commodity futures market is a natural setting to explore the effects of margin changes because historical data on margins are available.

Charoula Daskalaki, Ph.D., Assistant Professor, Department of Economics, University of Crete, Greece, presenting at the J.P. Morgan Center for Commodities' international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017. She presented her jointly written paper, "Diversification Benefits of Commodities: A Stochastic Dominance Efficiency Approach," which was also a CME Group Foundation Research Fellowship winner. Dr. Daskalaki is the co-author of another commodities research paper that is summarized here by Professor Ana-Maria Fuertes, Ph.D., of Cass Business School (U.K.)

Data Description

The authors collect data on maintenance margins for twenty individual commodity futures contracts, two equity futures contracts and two interest rate futures contracts. The employed commodity contracts span the five main commodity categories (energy, metals, grains, softs, and livestock). They consider the S&P 500 and the Nasdaq futures contracts for the case of equity futures market and the 5-year and the 10-year U.S. Treasury Notes for the case of the interest rate futures market. The choice of these contracts is based on their popularity and the availability of a sufficient number of margin changes to conduct their analysis. They obtain data on margins from the Chicago Mercantile Exchange (CME) Group and the Intercontinental Exchange (ICE) where the relevant futures contracts trade. The sample is unbalanced, namely, the starting date and the number of margin changes vary across commodities.

The sample period incorporates bull and bear regimes in commodity prices as well as the 2003-2008 commodity boom period and the 2007-2009 financial crisis. The authors also obtain data on the daily open interest and volume as well as data on the daily ask, bid, closing, opening, high, and low futures prices for individual futures contracts from Bloomberg. Finally, they use the data on the reportable (large) traders' positions reported by the CFTC on a weekly basis.

Description of Investigation

To assess the impact of margin changes on the variables of interest, the authors apply the event study methodology. They isolate the days where a margin change for each individual futures contract has occurred and examine the impact on a number of features of the commodity futures market around these days. They consider a short and a long pre-event and post-event period. They examine the variables of interest over a pre-event period comprising the last five (or twenty) trading days immediately before the margin change and a post-event period comprising the five (or twenty) trading days immediately after the margin change. Note that margin changes may be announced by futures exchanges 24 hours in advance of the actual margin change. Hence, the event study is not subject to an early announcement effect on the considered variables because the pre-event window spans a longer interval of time. Finally, the authors investigate the impact of margin changes, both on individual commodity futures contracts as well as on distinct groups including contracts that belong in the same sector.

Results

First, the authors find that margin increases do not decrease commodity prices as commonly believed but they do act as a 'brake' on the rate at which prices increase. Second, they find that while regulation of margins will likely constrain excessive speculation, such measures may also impair significantly market liquidity and the risk-sharing function by forcing hedgers out of the market. Third, their findings suggest that if a regulator is to introduce controls on margins, then the individual characteristics and features of each market sector must be considered. For instance, the effect of margin changes on the risk-sharing mechanism of the energy market differs from that in the agricultural or metal markets. Finally, margin increases may have irreversible consequences that may also differ across commodity markets. Once margins are increased, a margin decrease of the same magnitude will not restore the market to its previous state. In addition, they find that margin changes for futures on a specific type of commodity (say energy) will also affect the features of futures on other commodity categories (say metals). This can be attributed to the fact that commodity traders take simultaneous positions in various commodity markets. Hence, when they liquidate positions in one commodity market, this impacts their positioning in other commodity markets.

Conclusions

This study provides empirical evidence to argue that the regulation of commodity futures margins has pros and cons. Policymakers should take into account the fact that the effect of margin changes varies across commodity groups, and they should be very cautious before implementing any margin changes because the consequences may be irreversible. Their findings are in line with the contention of Alan

Greenspan (1996), former Chairman of the U.S. Federal Reserve: *"I guarantee you that if you want to get rid of the bubble, whatever it is, that [raising margin requirements] will do it. My concern is that I am not sure what else it will do."*

Endnotes

This commodity research paper is also included in the J.P. Morgan Center for Commodities' *Global Commodity Issues eJournal*. The author of this digest article is a member of the Editorial Advisory Board (EAB) of the *Global Commodities Applied Research Digest (GCARD)*. The *GCARD*'s EAB membership is listed here: http://jpmcc-gcard.com/editorial-advisory-board/.

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Keywords

Commodity futures, margin.

Stock Return Forecasting with Metals: Sentiment versus Fundamentals

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Accepted for publication in: *European Journal of Finance* (forthcoming).

This article documents empirically that precious metals contain economically valuable predictive information for stock returns. The authors show for each of the G7 countries that the stock return forecasts based on precious metals information enable certainty equivalent gains through a market-timing strategy. These gains remain after considering reasonable transaction costs, and are large enough to potentially make active portfolio management attractive, even for individual investors.

Introduction

This paper studies the fundamental question of whether future stock returns can be accurately forecasted using metal returns. It extends the prior literature which focuses on in-sample predictability in this context (Jacobsen *et al.*, 2015; Jahan-Parvar *et al.*, 2012). In contrast, this paper studies the out-of-sample (OOS) predictability of stock market returns employing equity indices for each of the G7 countries. The authors examine the predictive content of precious metals (gold or silver) versus industrial metals (aluminum, copper, nickel and platinum) and combinations thereof.

The paper provides fresh evidence on whether the economic value of forecasts is robust to trading costs. For this purpose, the methodology employed does not just consider a specific trading cost level but accommodates a wide range of trading costs. The findings indicate that economic gains from active management are potentially available to a wide range of investors, including small investors.

Why the Paper's Research Question is Important

Firstly, prior OOS studies generally do not consider commodities in general, or metals specifically, as return predictors; this applies both to U.S. studies and international studies. The focus has been on macro variables and fundamental variables based on dividends and earnings; this literature generally finds that OOS predictability does not lead to large economic gains. However, commodities could be a strong forecaster, which has thus far been overlooked. An exception is Fernandez-Perez *et al.* (2017) who demonstrate that commodity portfolios that capture the backwardation-contango phases exhibit OOS predictive power for the first two moments of long-horizon aggregate equity market returns.

This digest article was written by Ana-Maria Fuertes, Ph.D., Professor in Finance and Econometrics at Cass Business School, City, University of London (U.K.).

Secondly, the channel through which stock returns are predictable is important since it sheds light on what drives equity markets. If precious metals forecast stock returns then this suggests an important role for investor sentiment. If, in contrast, industrial metals better forecast stock returns then this suggests that economic fundamentals are a stronger driver of the primary financial markets.

Thirdly, there is much debate over the extent to which investors can benefit from implementing trading strategies. In particular, for many strategies such as those exploiting the day-of-the-week anomaly, trading profits would be completely wiped out by the transaction costs incurred. Hence, it is important to examine the level of trading costs over which a strategy remains profitable. This paper provides evidence on this issue by plotting the economic gains generated across a wide range of trading costs.

Information Channels from Metals to Equities

Metal returns can broadly impact stock returns via two channels. First, they could impact industry costs if an industrial metal (such as aluminum or copper) is used as an input. For example, metal commodity price movements could be timely indicators of global supply and demand for raw materials or production activity. A second potential impact mechanism for metals is that precious metal commodity price movements could contain information about time-variation in investor risk preferences (or sentiment). That is, metals, such as gold or silver, are an important asset class for investors; therefore commodity returns could reflect changes in investor preferences. It has been theoretically demonstrated that metal prices signal the strength of the global economy. With the growth in exchange traded funds (ETFs), which must purchase and hold the commodities backing traded units, speculative demand and investor preferences could affect price. For example, silver held by ETFs has grown from around 100 tons in 2006 to over 1000 tons by 2011. Recent studies find some evidence of in-sample stock return predictability by using commodity returns; however, little evidence on out-of-sample predictability has been provided.

Empirical Findings

The empirical analysis is based on weekly data from January 1985 until December 2011; the last ten years of data are used as the OOS forecasting (or evaluation) period. First, the authors examine the forecast accuracy of G7 market index returns when metals are included into the information set. Accuracy is assessed relative to an AR(1) model benchmark. In almost all countries, apart from Japan, improvements over the benchmark are possible via precious metals. In contrast, industrial metals perform poorly.

Second, the paper provides evidence from equity trading strategies that are based on incorporating information from commodity markets, such as precious and industrial metal returns, into a forecasting model for equity returns. The analysis is aimed at assessing if equity return forecasts can help improve the asset allocation decision (between the equity market and the risk-free asset). Particularly, the authors estimate the economic value to investors and practitioners by implementing the manipulation proof measure of certainty equivalent gains proposed by Goetzmann *et al.* (2007).

Thirdly, the authors explore how robust forecast gains are to transaction costs. This is especially important since much of the predictability documented in the short-horizon forecasting literature appears not to be exploitable once transaction costs are incorporated (Moreno and Olmeda, 2007). The few studies that do model costs tend to simply provide a point estimate of the break-even costs (e.g. Della Corte *et al.*, 2010) or estimate results for a specific level of costs (e.g. Driesprong *et al.*, 2008). In contrast, this paper examines how economic gains fluctuate as transaction costs vary across a wide range. This cost implementation strategy accounts for the fact that an investor will trade less under higher transaction costs. Thus, it is possible for the strategy to be more profitable with higher transaction costs if the number of trades are reduced and on average more profitable trades remain. Considering how gains are influenced by the cost of an investment strategy is important as it determines which investor classes could profitably use the strategy. Once transaction costs are incorporated, there is evidence that silver and gold provide substantial gains for an investor that engages in market timing. Thus, substantial economic value can be earned via dynamic trading strategies relative to the benchmark by incorporating recent past return information from precious metals. These economic gains are robust to the imposition of reasonable transaction costs. The authors find that the economic evidence on the merit of forecasts is stronger than the purely statistical evidence based on reductions in the standard mean square forecast error (MSFE) measure.

Finally, the authors find that combining information from more commodities does not necessarily improve forecast accuracy nor economic gains. More specifically, three of the industrial metals (copper, nickel and platinum) provide no additional information beyond that contained in silver or gold, respectively (i.e., the industrial metals are encompassed).

Conclusions

This paper provides evidence that the returns from precious metals (gold and silver) enable consistent and substantial improvements in the OOS forecast accuracy of stock returns, in contrast with industrial metals. The hypothesis at work is that precious metal returns are impacted by variation in investor risk aversion and thus could contain information about expected future equity returns. The findings provide some validation for this hypothesis by reporting that precious metals forecast almost all G7 country market returns (with the exception of Japan). In contrast, most industrial metals do not provide significant gains.

By considering a wide range of trading costs, the paper demonstrates empirically that the net economic value of forecasting stock market returns can be substantial. The dynamic cost methodology is implemented for an asset allocation strategy (between equity and debt) and the empirical results indicate that within a realistic transaction cost range, forecasts from precious metals may prove useful to a wide spectrum of investors. Small investors including those using a tax-deferred account (for instance, a retirement account) could benefit from active management.

Endnote

The author of this digest article is also a member of the Editorial Advisory Board (EAB) of the *Global Commodities Applied Research Digest (GCARD).* The *GCARD*'s EAB membership is listed here: http://jpmcc-gcard.com/editorial-advisory-board/.

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Keywords

Return forecasting, G7, commodities, transaction costs, forecast combinations.

The Skewness of Commodity Futures Returns

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Accepted for publication in: *Journal of Banking & Finance* (forthcoming).

This article investigates the link between the skewness of the distribution of commodity futures returns and subsequent price changes. A trading strategy that goes long futures contracts with the most negative skew and shorts futures contracts with the most positive skew has historically generated significant alpha. A tradeable skewness factor can explain the cross-section of commodity futures returns beyond exposure to known risk factors. The rationale for these findings is investors' preferences under cumulative prospect theory and selective hedging practices.

Introduction

The question of whether asset skewness contains information about future asset prices has been the subject of a large empirical literature for equities. Behavioral theory predicts a negative relation between skewness and expected returns. Many empirical studies for equities show a significant relation, but the evidence on the sign is mixed.

This paper contributes to the commodity markets literature by addressing this question: Does skewness of the distribution of commodity futures returns tell us anything about expected returns? The authors address this question using both a time-series (portfolio formation) framework and a cross-sectional (pricing) framework.

Using firstly a time-series framework, they examine the out-of-sample (OOS) performance of a long-short portfolio formed according to a *total skewness* signal. Taking fully-collateralized long (short) positions in the commodities with the most negative (positive) skew generates a mean excess return of 8.01% and an alpha of 6.21% (both annualized) on average across pricing models. The second stage of the investigation is aimed at testing empirically the pricing ability of a tradeable skewness factor for the

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cross-section of commodity futures returns. The price of skewness is economically and statistically significant and positive, consistently across models.

Relevance of the Research Question

A study of the relation between skewness and expected returns is of interest to academics and practitioners. At a practical level, the findings are relevant for market practitioners suggesting the possibility of capturing excess returns (premia) through long-short portfolios formed according to an easy-to-measure skewness signal.

At a theoretical level, the significant negative relation between skewness and expected returns that the paper documents may instigate further research aimed at better understanding the price formation process in commodity futures markets. Traditional commodity pricing theories – the theory of storage of Kaldor (1939) and the hedging pressure hypothesis of Cootner (1960) – do not predict such relation, in contrast to the Barberis and Huang (2008) behavioral theory on *skewness preferences*. Barberis and Huang (2008) use the cumulative prospect theory framework of Tversky and Kahneman (1992) to show that overweighting the probability of the occurrence of tail events leads to a preference for positive-skew assets. This phenomenon induces overpricing of positively-skewed assets and subsequently lower returns. The overpricing is not necessarily arbitraged away by short positions because positive skewness has a non-negligible influence on commodity investors' utility functions.

The findings support the *selective hedging hypothesis* by which hedgers' perceptions of future price movements influence their optimal hedge ratio. Hedgers with lottery-type preferences may not only seek to minimize risk but also to maximize positive skewness. The findings of the paper are aligned with the notion that commercial traders have a propensity to take relatively greater (lower) hedges in positive (negative) skew commodities as a reflection of their preference for positive skewness.

Data and Skewness Signal

The main data are daily settlement prices from January 1987 to November 2014 on front-end and second-nearest futures contracts for 27 commodities from the agricultural, energy, livestock, and metal sectors together with random length lumber.

The trading signal is *total skewness* of daily commodity futures returns which is measured using the Pearson's third moment coefficient as follows

$$\widehat{Sk}_{i,t} = \left[\frac{1}{D}\sum_{d=1}^{D}\left(r_{i,d,t} - \hat{\mu}_{i,t}\right)^3\right] / \hat{\sigma}_{i,t}{}^3 \qquad (1)$$

where $t = 1, \ldots, T$ denotes each portfolio formation time (month-end in this analysis), $r_{i,d,t}, d = 1, \ldots, D$ are daily returns of the *i*th commodity within the most recent 12-month period (i.e., D is the number of daily observations within the [*t*-11, *t*] window) and $\hat{\mu}_{i,t} = \frac{1}{D}\sum_{d=1}^{D} r_{i,d,t}$ and $\hat{\sigma}_{i,t}{}^2 = \left[\frac{1}{D-1}\sum_{d=1}^{D}\left(r_{i,d,t} - \hat{\mu}_{i,t}\right)^2\right]$ are the mean and variance estimates.

At each month-end *t*, the authors rank the *i* = 1,…,*N* commodities in the cross-section (*N* = 27) according to their $\widehat{Sk}_{i,t}$ values and group them into five quintiles; quintile Q1 contains the 20% of commodities with the lowest $\widehat{Sk}_{i,t}$, and quintile Q5 contains the 20% of commodities with the highest $\widehat{Sk}_{i,t}$. The resulting long(Q1)-short(Q5) portfolio is held for one month, and then the signal is measured anew to form a new long-short portfolio (i.e., monthly rebalancing), and so forth until the end of the sample period.

Results of Time-Series Tests: Performance of Skewness-Sorted Portfolios

Examining the frequency with which each commodity enters the long (Q1) and short (Q5) portfolio per sector, the authors observe that none of the commodities is perpetually part of the Q1 or Q5 portfolios, namely, the Q1-Q5 return differential is not driven by the exceptional behavior of a few commodities.

The skewness long-short strategy generates a mean excess return of 8.01% a year, a Sharpe ratio of 0.7848 and an Omega ratio of 1.8136. Interestingly, these performance measures are far better than those of the long-short term structure, momentum and hedging pressure portfolios that are popular among academics and practitioners alike.

The authors measure the alpha of the skewness portfolio using a pricing model with four factors: the excess returns of an *equally-weighted long-only* portfolio of the 27 commodity futures, and the excess returns of three long-short (*term structure*, *momentum*, and *hedging pressure*) portfolios that proxy the risks associated with the backwardation/contango cycle of commodity futures. A significant alpha of 6.58% p.a. indicates that the profitability of the skewness portfolios is not merely a compensation for exposure to known commodity risk factors.

Cross-Section Tests: Pricing Ability of Tradeable Skewness Factor

The authors test whether the tradeable skewness factor explains the cross-sectional variation in commodity futures returns. The average price of skewness risk is a significant 5.02% *per annum*. Thus, investors demand a higher compensation or premium for exposure to commodity futures with more negative skewness. The paper provides evidence of a pervasive increase in explanatory power when a 'traditional' pricing model that includes risk factors that relate to the backwardation/contango cycle is extended with the tradeable skewness factor. The increase in explanatory power of about 4% across models is similar to that documented in equity market research.

Conclusions

This article investigates the relation between skewness and expected returns of commodity futures. A skewness long-short portfolio that buys (shorts) the most negatively (positively)-skewed commodities at each month-end from January 1987 to November 2014 generates attractive risk-adjusted performance. The skewness portfolio earns a sizeable alpha according to various commodity pricing models. Through cross-sectional pricing tests, the paper further establishes that the tradeable skewness factor is more strongly priced than any of the risk factors thus far considered in the literature.

The key finding of the paper is a negative relation between the skewness of the distribution of daily commodity futures returns and expected returns. More specifically, the findings suggest that the third moment of the return distribution contains information about subsequent price changes. Building on cumulative prospect theory, the paper confirms that the preference for lottery-type (positive skew) assets influences the utility function of hedgers, inducing overpricing and lower expected returns.

Endnotes

This commodity research paper is also included in the J.P. Morgan Center for Commodities' *Global Commodity Issues eJournal*. The author of this digest article is a member of the Editorial Advisory Board (EAB) of the *Global Commodities Applied Research Digest (GCARD).* The *GCARD*'s EAB membership is listed here: http://jpmcc-gcard.com/editorial-advisory-board/.

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Keywords

Skewness, commodities, futures pricing, selective hedging.

Common Miscalculations in Futures Trading

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Ms. Hilary Till, Solich Scholar at the JPMCC, lecturing on investment opportunities in commodities at the CME Group Executive Conference Center in Chicago on November 23, 2016.

In the article, "Commodity Derivatives Risk Management: The Differing Priorities among Commercial and Speculative Enterprises", Till (2017) notes how one common mistake in futures trading is targeting absolute returns rather than risk and the disastrous consequences thereof. This article describes two other frequent mistakes: (1) the use of inappropriate sizing and (2) a misunderstanding of the psychological discipline required for futures trading.

Inappropriate Sizing

Interestingly, natural gas seems to frequently be at the center of many trading debacles. Natural gas derivatives trading offers traders and investors a potentially alluring combination of scalability and volatility, and also at times, pockets of predictability.

Even with the natural gas markets, a surprisingly common mistake has been adopting the appropriate sizing for trading this seemingly scalable market. This has been a key lesson from several publicly known hedge fund natural gas trading disasters.

The commodity markets do not have natural two-sided flow. For experienced traders in the fixed income, equity, and currency markets, this point may not be obvious. The commodity markets have *nodal liquidity*. If a commercial market participant needs to initiate or lift hedges, large-scale transactions will take place, but not at a speculator's convenience. Before initiating a position, particularly one that is large compared to the size of the marketplace, a trader needs a clear understanding of what flow or catalyst will allow the trader out of a position.

A commodity-market observer can readily identify when a massively-sized distressed liquidation is occurring, particularly in a spread market. If no geopolitical, economic, or weather news exists about a market, and a spread relation changes by many standard deviations relative to recent history, this combination is a clear signal that a market participant is unwinding a position in a distressed fashion. In summary, a key risk-management objective in speculative commodity futures trading is to keep sizing within a relatively small fraction of daily trading volume and open interest. Apparently, this can be a difficult restriction for futures traders to live by when prior success brings an influx of capital that is beyond what a commodity trading program can nimbly manage.

Psychological Discipline and Risk Tolerance

In discussing the crucial elements of an investment process, a common mistake is to leave out one vital aspect of trading, and that is a manager's *risk tolerance*. Vince (1992) states that monetizing market inefficiencies: "requires more than an understanding of money management concepts. It requires discipline to tolerate and endure emotional pain to a level that 19 out of 20 people cannot bear. Anyone who claims to be intrigued by the 'intellectual challenge of the markets' is not a trader. The markets are as intellectually challenging as a fistfight. … Ultimately, trading is an exercise in self-mastery and endurance."

In futures trading, psychological discipline is just as crucial as finding structural sources of return and designing an appropriate risk management methodology around them. Taleb (2001) explains why following a disciplined investment process is challenging for a manager. He provides an example of a return-generating process that has annual returns in excess of Treasury Bills of 15 percent with an annualized volatility of 10 percent. At first glance, carrying out a trading strategy with such superior risk and return characteristics might be considered trivial. But Taleb also notes that with such a return-generating process, only a 54 percent chance of making money exists on any given day. If the investor felt the pain of loss say 2.5 times more acutely than the joy of a gain, then it could be potentially exhausting and perhaps almost impossible to carry out this superior investment strategy.

Conclusion

Gaining expertise in the commodity markets usually occurs through trial-and-error experiences, some of which can be quite painful. The goal of this article has been to provide readers with two cautionary examples so that they will hopefully not have to learn these lessons through the "school of hard knocks."

Endnote

This digest article was excerpted from the author's seminar on "Risk Management and Case Studies in Commodity Trading," which the author provided to staff from the Zhengzhou and Dalian Commodity Exchanges (of China) on October 17, 2017 in Chicago.

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Futures trading, risk tolerance.

Could Problems at MF Global Have Been Anticipated?

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As summarized in Heckinger (2016), "on October 31, 2011, the broker–dealer (B/D) and futures commission merchant (FCM) firm of the MF Global Group (i.e., MFG, the group, and all its parts) collapsed, causing substantial financial distress to its customers, many of whom were small investors or hedgers such as farmers, ranchers or commodity merchants such as grain elevator operators. About $1.6 billion of customers' funds were not immediately available for liquidation proceedings due to the apparent misallocation of customer funds, which were not segregated from firm accounts, and the use of the funds to fund proprietary trading, which resulted in the encumbrance of such funds."

Four years later, "recovery and distribution actions of the respective bankruptcy trustees and administrators appointed to liquidate the firm made all customers whole, depending on the jurisdiction and particular MFG business entity. Other creditors such as vendors or suppliers of services to MFG received around 95 percent of the value of their claims," wrote Heckinger (2016).

But back in the fall of 2011, futures market participants were caught off-guard when MF Global filed for bankruptcy. Essentially, this episode educated industry participants that customer protections in the U.S. commodity futures markets had been more ambiguous than expected. That said, there are a number of reforms that have been undertaken to help prevent future MF Globals.

This article takes the position that a number of red flags existed as far back as 2007, regarding the firm's financial weakness, which could have served as a warning to those investors relying on MF Global as a fiduciary. In discussing the MF Global debacle, this article will cover the following seven areas: (1) a brief background on the firm will be outlined; (2) warning signs will be identified; (3) the firm's final week will be recalled; (4) the response of regulators and bankruptcy trustees will be noted; (5) the shortfall in customer segregated funds will be described; (6) the CFTC's charges and settlement will be touched upon; and (7) reforms resulting from the MFG bankruptcy will be summarized.

Background

Before its bankruptcy filing, MF Global provided execution and clearing services for (a) exchange-traded and OTC derivatives products, (b) non-derivative foreign exchange products, and (c) securities in the cash market. Please see Figure 1 on the next page.

Figure 1
MF Global's Lines of Businesses

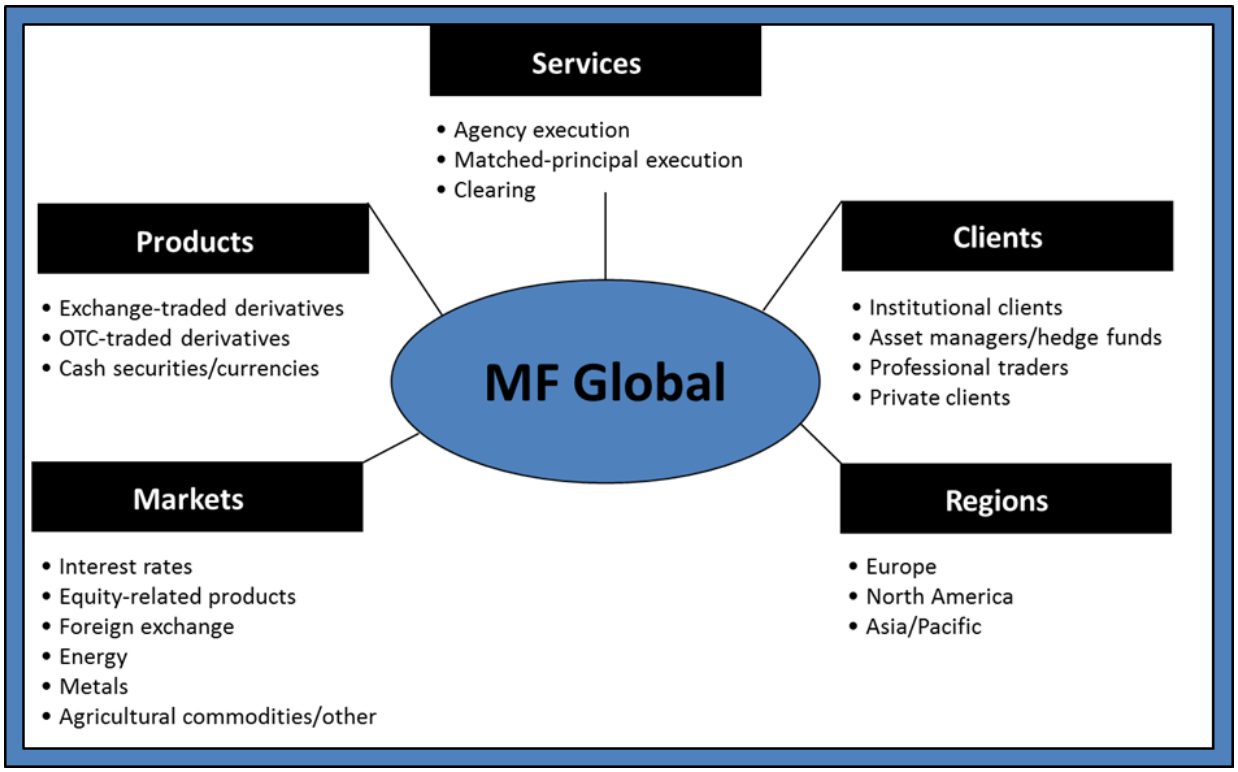

Diagram based on figure in MF Global (2007), page 33.

The firm had a worldwide client base of 130,000 accounts and operated in 12 countries on more than 70 exchanges. "Although a niche player on Wall Street, MF Global was a force on the Chicago Mercantile Exchange (CME). It had 3 million futures and options positions with a notional value of more than $100 billion. Its customers made up 28 percent of the trading volume on the CME," noted Gapper and Kaminska (2011).

Warning Signs

Prior to the firm's spin-out from its parent company in 2007, MF Global's business could be characterized as "dull normal." During the spin-out of MF Global, its then parent company, the Man Group, burdened MF Global with (arguably) an enormous short-term debt load, relative to the firm's profitability. We can see how large this debt load was from one of the company's publicly available financial statements. Please see Figure 2 on the next page.

Figure 2
Excerpt from MF Global Ltd. Form 10-Q as of December 31, 2007

MF GLOBAL LTD.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
(Unaudited)
(Dollars in thousands, except share data)

Short-term borrowings consist of the following:

	December 31, 2007	March 31, 2007
364-Day Bridge Facility	$ 1,400,000	$ -
Other short-term borrowings	$ 400,000	
Bank overdrafts	73,672	25,453
Current portion of long-term borrowings		56,552
Total	$ 1,873,672	$ 82,005

The spin-out occurred just before the onset of the global financial crisis, making it uncertain throughout 2008 how the firm would be able to refinance its short-term debt. Also because of a rogue trader incident, the firm was in a precarious capital situation (Till, 2016). That said, MFG was eventually successful in refinancing its short-term debt by the end of 2008. We can see how weak the firm was relative to other FCM's from examining data available on the CFTC's website. From CFTC data, one can examine each FCM's excess net capital, divided by customer funds. Using this metric, MF Global was the 6th weakest Futures Commission Merchant amongst the 151 competing firms of the time. Please see Figure 3 on the next page.

MF Global's business model became in particular jeopardy, starting in 2008, during the compression of yields available in fixed-income investments. Note the table in Figure 4 on the next page, which is excerpted from another publicly available MF Global financial statement.

Figure 3
Net Excess Regulatory Capital

MF Global Inc. (Formerly Man Financial Inc.)

A/O Date	Adjusted Net Capital	Net Capital Requirement	Excess Net Capital	Customers' Required Segregated Funds*	Excess Net Capital / Customer Funds	
05/31/2007	$ 581,103,464	$ 402,913,253	**$ 178,190,211**	$ 8,384,461,426	2.1%	
06/30/2007	$ 605,217,511	$ 364,381,766	**$ 240,835,745**	$ 8,235,595,803	2.9%	
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10/31/2007	$ 535,142,778	$ 427,261,012	**$ 107,881,766**	$ 9,929,407,496	1.1%	
11/30/2007	$ 645,473,966	$ 414,600,708	**$ 230,873,258**	$ 9,889,773,129	2.3%	
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02/29/2008	$ 640,913,963	$ 509,842,535	**$ 131,071,428**	**$ 13,007,347,859**	1.0%	<-- 6th Lowest Ratio Amongst 151 FCMs
03/31/2008	$ 771,268,907	$ 417,502,089	**$ 353,766,818**	$ 9,684,866,771	3.7%	<-- 26% Drop in Customer Segregated Funds
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05/31/2008	$ 782,299,749	$ 443,840,666	**$ 338,459,083**	$ 9,664,731,983	3.5%	
06/30/2008	$ 608,963,888	$ 456,329,713	**$ 152,634,175**	$ 10,566,911,049	1.4%	<-- On 6/13/08, company announces** plan to refinance $1.4 billion bridge loan. This includes using "excess funds."
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08/31/2011	$ 495,665,616	$ 328,485,943	**$ 167,179,673**	$ 7,270,301,248	2.3%	

Data Source: The Commodity Futures Trading Commission (CFTC) monthly reports on "Financial Data for FCMs," which are accessible at: http://www.cftc.gov/MarketReports/financialfcmdata/index.htm.

* *These figures only include funds "required" to cover margins. As of February 2012, the CFTC also released the total assets in customer accounts, according to Prezioso (2012).*

** *Source: MF Global (2008).*

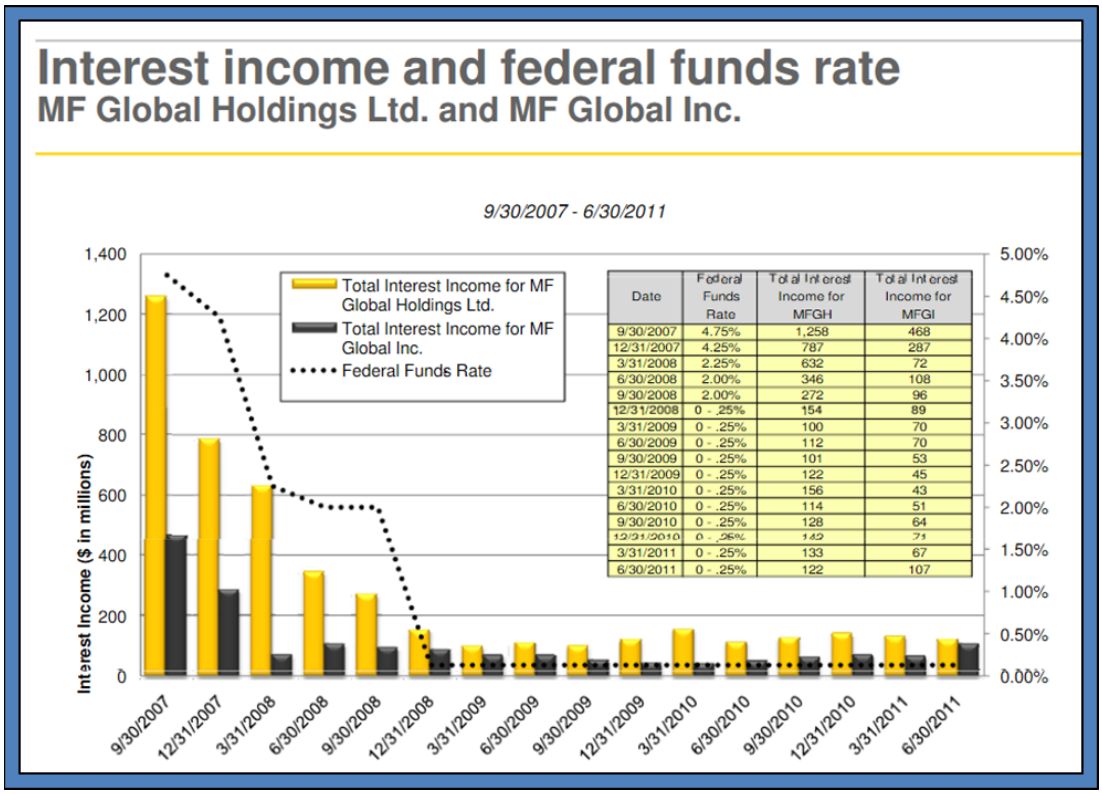
Figure 4
An Illustration of MF Global's Problematic Business Model

	YEAR ENDED MARCH 31,				
(Dollars in millions)	2011	2010	2009	2008	2007
Net (loss)/ income attributable to MF Global Holdings Ltd.	$ (81.20)	$ (137.00)	$ (49.10)	$ (69.50)	$ 188.00

Source: MF Global (2011), p.36.

As a futures commission merchant, the firm had strongly relied on income from the investment of customer collateral for its profitability. An FCM is allowed to credit back to customers only a fraction of the income the FCM earns on customer collateral. The firm was profitable in 2007, but then lost money for the following 4 years. One can see also how dire the trend was for MF Global's profitability from the June 4, 2012 MF Global Inc.'s bankruptcy trustee report (Till, 2013). Figure 5 on the next page shows how dramatic the drop-off in interest income for MF Global was as short-term interest rates were set to near zero in the aftermath of the global financial crisis. This chart covers the period, September 2007 through June 2011.

Figure 5
Drop-Off in Interest Income after the Global Financial Crisis



Date	Federal Funds Rate	Total Interest Income for MFGH	Total Interest Income for MFGI
9/30/2007	4.75%	1,258	468
12/31/2007	4.25%	787	287
3/31/2008	2.25%	632	72
6/30/2008	2.00%	346	108
9/30/2008	2.00%	272	96
12/31/2008	0 - .25%	154	89
3/31/2009	0 - .25%	100	70
6/30/2009	0 - .25%	112	70
9/30/2009	0 - .25%	101	53
12/31/2009	0 - .25%	122	45
3/31/2010	0 - .25%	156	43
6/30/2010	0 - .25%	114	51
9/30/2010	0 - .25%	128	64
12/31/2010	0 - .25%	142	71
3/31/2011	0 - .25%	133	67
6/30/2011	0 - .25%	122	107

Source: Hughes Hubbard & Reed LLP, Attorneys for James W. Giddens, Trustee for the SIPA Liquidation of MF Global Inc. (2012b), Annex A.

In 2010, MF Global hired Jon Corzine as its CEO. Corzine's background included a stint as the Chief Executive Officer of the investment banking and securities firm Goldman Sachs, and four years as the governor of New Jersey, as well as a partial term as U.S. Senator. Nonetheless, in Congressional testimony in December 2011, a few weeks after MF Global went bankrupt, Corzine admitted that he had little expertise or experience in the operational aspects of MF Global (Corzine, 2011). The CEO's plan was to eventually convert the futures broker into an investment bank, a near impossibility, especially given the firm's precarious capital situation and troubled business model. Thus, the CEO's task became how to make the firm profitable as soon as possible.

Corzine devised a strategy to enter into a large-scale, leveraged, proprietary trade on "peripheral" European bond markets in an attempt to ensure the firm's profitability in the face of a challenging environment for its business model. MF Global's stated balance sheet exposure to European bond markets became larger than that of the exposure of Goldman Sachs and Morgan Stanley combined, as shown in Figure 6 on the next page.

Figure 6
Stated Sovereign Exposure

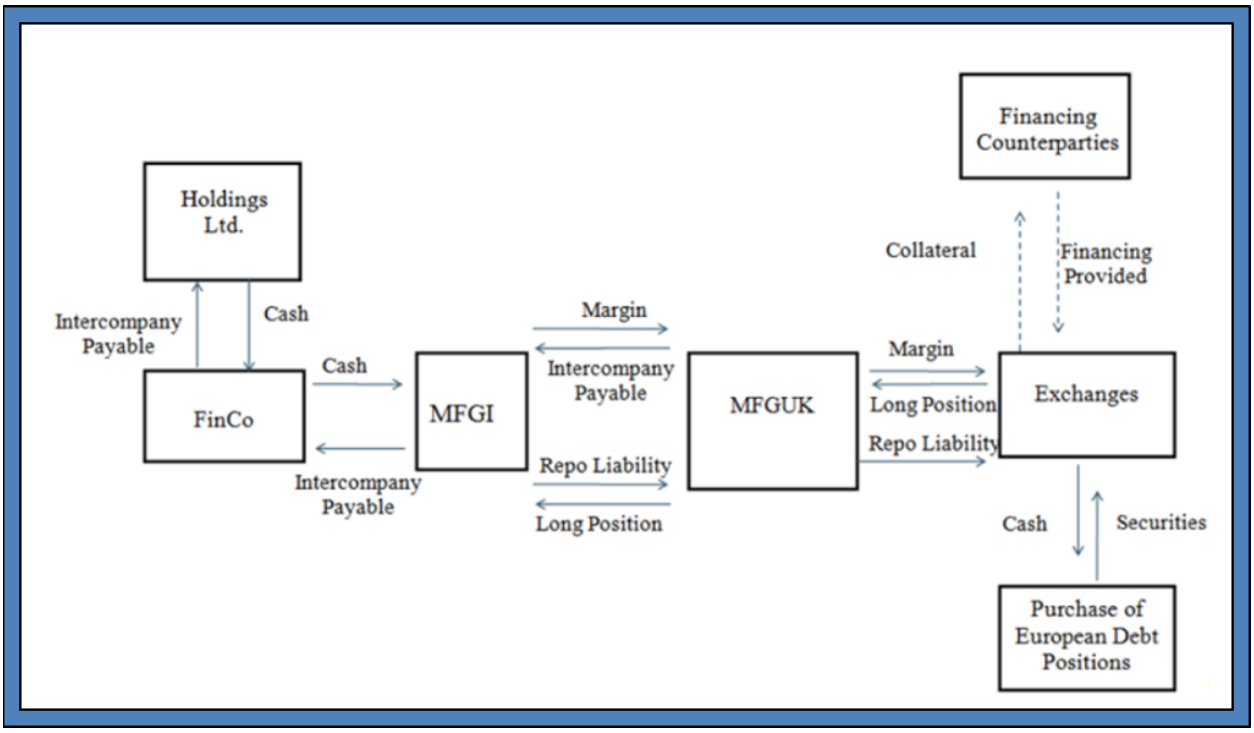
Company	Stated Balance Sheet Exposure*	Exposure as a % of Q End Equity	Exposure as a % of Q End Assets	Quarterly VaR Average	VaR as a % of Q End Equity
MF Global (MF)	$6.4 B	460.6%	13.9%	$3.0 M	0.2%
Citigroup (C)	$13.5 B	7.7%	0.7%	$184 M	0.1%
Goldman Sachs (GS)	$1.9 B	2.6%	0.2%	$101 M	0.1%
Jefferies (JEF)	N/A	N/A	N/A	$12.7 M	0.4%
JP Morgan (JPM)	$14 B	7.7%	0.6%	$94 M	0.1%
Morgan Stanley (MS)	$2.0 B	3.4%	0.2%	$145 M	0.2%

*as measured under a firm's internal approach

Source: Hughes Hubbard & Reed LLP, Attorneys for James W. Giddens, Trustee for the SIPA Liquidation of MF Global Inc. (2012b), p. 89.

The structure of how MF Global was able to enter into this leveraged trade with such little capital is illustrated on the next page in Figure 7, which is drawn from MF Global Holdings Ltd.'s bankruptcy trustee report of April 4, 2013. The figure diagrams how MF Global carried out its leveraged European sovereign-debt trades, focusing on the various financing relationships in doing so.

Figure 7
End-to-End Structure of MF Global's Euro RTM Transaction



Source: Morrison & Foerster LLP, Attorneys for the Chapter 11 Trustee (2013), p. 33.

Notes: "MFGI" is an abbreviation for MF Global Inc., "an indirect subsidiary of MF Global Holdings Ltd."

MFG UK is an abbreviation for MF Global U.K. Limited, which "was the MF Global entity that was a member of the clearinghouses in Europe."

The "Euro RTMs" were trades in European sovereign debt, which, in turn, were "financed through repurchase to maturity transactions."

"On the dates MFGI entered into the various Euro RTMs, it recognized a gain in the amount of the difference or spread between (1) the effective interest rate received by MF Global on the debt securities and (2) the repurchase rate (or the financing rate) paid by MF Global to the counterparty. MFG UK recognized a gain in the amount of the markup for its role as counterparty to both MFGI and the clearinghouses. The trades were held by MFGI so that it, rather than MFG UK, bore the risk of default or restructuring of the sovereign debt.

On July 1, 2010, MFGI and MFG UK entered into an investment management agreement related to the Euro RTM trades, which provided that MFG UK would identify market opportunities related to the sovereign debt of certain European governments. Pursuant to this agreement, MFG UK received 80% of the consolidated net revenue of such transactions, while MFGI received 20% of the revenue, held the trades, and took the risk that the sovereigns would default or restructure their debt."

The financing for purchasing the bonds was done through MF Global's U.K. subsidiary. U.K. law has effectively allowed more opportunity for leverage by broker-dealers than U.S. law, which is apparently why the transaction was executed in London. The bond trade was also documented in MF Global UK's

Special Administrator report (KPMG, 2011). The rationale for executing this trade was that the interest rate offered by the short-term "peripheral" European bonds was much higher than their financing rate; and the bonds seemed to be good risks since they were backstopped by the European Financial Stability Facility, which in turn was financed by members of the eurozone. The problem was that MF Global had very little capital to sustain any meaningful mark-to-market fluctuations.

Before the firm's downward liquidity spiral, the bond trade's mark-to-market materially improved MF Global's profitability, as discussed in the MF Global Inc.'s trustee report of June 4, 2012. But astonishingly, the firm did not have a plan for how to exit these trades if the firm became stressed and would not be able to make margin calls. This particular fact is covered in an MF Global Board of Directors' presentation from the summer of 2011 that is accessible through the *New York Times'* website, and as referenced in MF Global Holdings Ltd. (2011).

Final Week

At the end of October 2011, in rapid succession, the firm experienced a credit downgrade and announced worst-than-expected earnings, leading investors, clients, and creditors to doubt the sustainability of the firm's business model. At that point, MF Global rapidly liquidated some of its European bond bet; attempted to meet additional margin calls that resulted from its ratings downgrade; and attempted to meet customer redemptions as clients left the firm *en masse*.

One interesting question from this case is as follows: how could a seemingly functional firm collapse in a week? This is the type of question that also comes up with the Bear Stearns and Lehman bankruptcies of 2008. Roe (2011) has argued that an aspect of the U.S. Bankruptcy Code provides the explanation. A bank may choose to provide repo financing for a weak counterparty since the bank is allowed to seize collateral quickly if the weak counterparty goes bankrupt, so the bank does not have to worry about the creditworthiness of the counterparty. Normally when a firm is going bankrupt, creditors cannot immediately seize assets because the effort is to protect the company so that it can reorganize successfully. Once banks lose confidence in a weak financial firm and quickly terminate repo financing, the weak firm spirals quickly into bankruptcy.

A second interesting question from this case is as follows: why in late October 2011 did the firm have worst-than-expected earnings? Its $186.6 million loss during the 3rd quarter of 2011 was its worst ever. The explanation here has to do with an aspect of U.S. accounting conventions. According to Worstall (2011) and Weil (2011), most of the loss came from writing down *deferred-tax assets*. "Basically this item represented the money MF [Global] had thought it would save on taxes in the future, assuming it would be profitable," wrote Weil (2011). When a company has losses, one can carry forward those losses, and net them against future profits, thereby paying less taxes in the future. This future ability to pay less taxes is counted as an asset: a deferred-tax asset. By writing off the firm's deferred-tax assets, that is basically admitting that there is no visibility for the firm to become profitable in the foreseeable future. In the earnings announced on Tuesday, October 25, 2011, MF Global wrote off its deferred-tax assets, which signaled that either the firm or its accountant did not see profitability on the horizon. The company's credit downgrade and worst-than-expected earnings immediately set off a liquidity crisis.

During later hearings before the U.S. Senate Banking, Housing, and Urban Affairs Committee in April 2012, Chicago Mercantile Exchange Executive Chairman Terrence Duffy pointed out that MF Global's bankruptcy trustee "had said that the company had a liquidity crisis, and their increases went from $200 million to $900 million on their margin calls. That money had to come from somewhere, and if there's a liquidity crisis, where was that money coming from?" On June 4, 2012, the MF Global Inc. bankruptcy trustee showed that MF Global had dealt with its liquidity crisis through using funds from futures customer accounts (Hughes Hubbard & Reed LLP, 2012b). One week after MF Global's liquidity crisis began, in the morning of Monday, October 31, regulators lost confidence in the firm when it was unable to reconcile its books and satisfactorily explain a significant shortfall that had been discovered in the firm's customer segregated accounts. This shortfall was without precedent in the history of the futures industry (United States House of Representatives, 2012). A potential deal for another firm to buy MF Global collapsed, given the shortfall in customer segregated accounts.

The Response of Regulators and Bankruptcy Trustees

On October 31, 2011, MF Global's holding company declared bankruptcy under Chapter 11 of the Bankruptcy Code; and the Broker-Dealer/Futures Commission Merchant subsidiary was put into liquidation in a Securities Investors Protection Act proceeding. The legal procedures, though, which cover the liquidation of securities firms, can potentially be interpreted such that they conflict with the legal procedures that were designed for the bankruptcy of futures firms. Normally, a futures firm is put through another type of bankruptcy process where there are explicit procedures that are customized for futures firms. This was not done for MF Global. Again, the firm was put through a process designed for securities firms. That said, there is a credible body of law that futures customers should have priority over all other claimants (Corcoran, 1993 and Melin, 2012). But it did take 5 weeks for the MF Global Inc. trustee to publicly verify this information.

An inspector general report on the CFTC's actions was released in May 2013. One gets a sense of the shock that there was actually a shortfall in customer segregated accounts. Accordingly, it was only at about 5am on Monday, October 31, 2011 that a decision was made to put the company in bankruptcy and have a trustee become responsible for the company. Also, given that MF Global was regulated by so many different international regulators, there was an enormous coordination problem amongst regulators during the firm's final weekend.

Within the United States, MF Global was regulated by the Securities and Exchange Commission as a broker-dealer and also by the Commodity Futures Trading Commission as a futures commission merchant. According to Collins (2012), the decision to put MF Global through a bankruptcy process that had been designed for securities firms "baffled futures industry participants who felt it would delay customers being made whole." Added Collins, "futures regulators in the past had gone to court to fight for jurisdiction when an asset freeze would be adverse to futures industry customers."

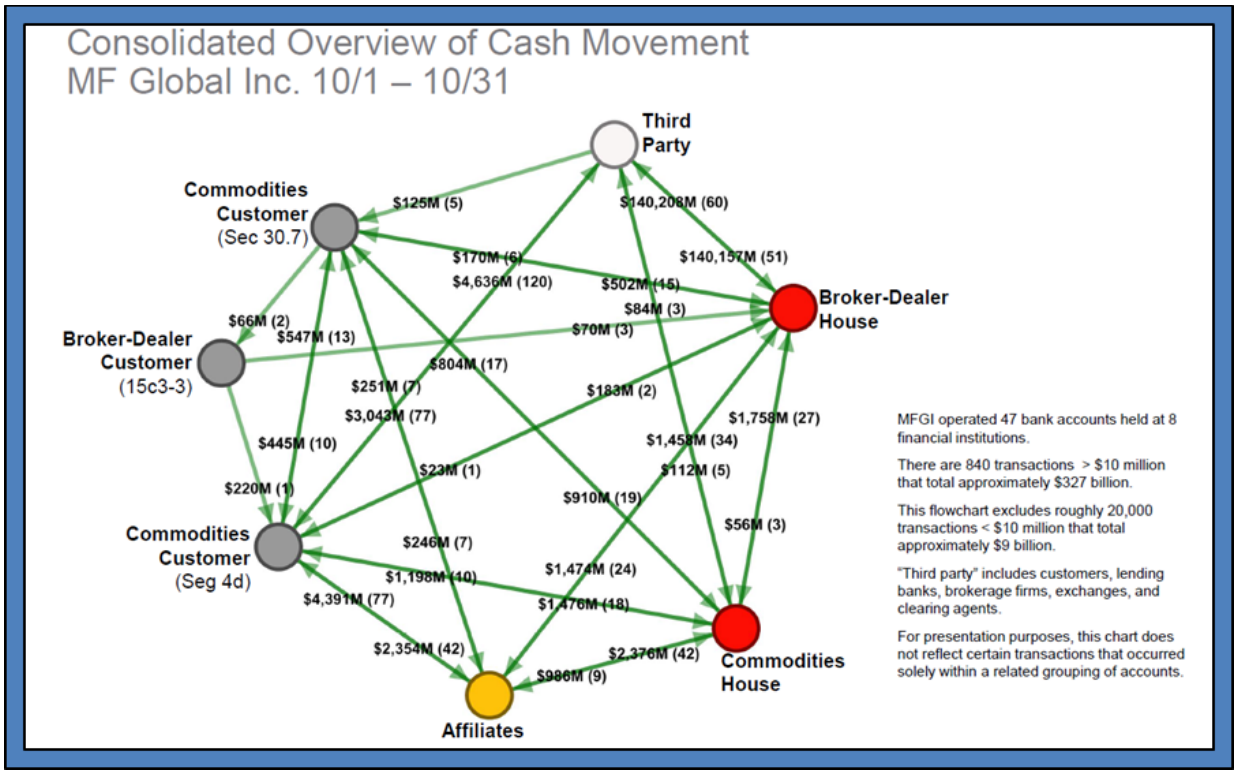
Starting on October 31, 2011, MF Global customers' funds and futures positions were frozen on and off for days. Astonishingly, "[w]hen the MFG bankruptcy was filed, *nobody* appeared in court to represent the interests of customers, or to oppose the claims of creditors whose interests were directly adverse to customers," observed Bry and Jaffarian (2012). Within days of the bankruptcy, the trustee did work with

the CME and the CFTC to move customer positions and some of the margin associated with these accounts to other FCMs (Collins, 2012).

The trustee responsible for liquidating MF Global Inc. had to go through "a steep learning curve regarding futures operations," reported Collins (2012). Because protections under the Commodity Exchange Act potentially conflict with the U.S. Bankruptcy Code, regulators had in the past moved customer positions and margins from weak FCMs to healthy FCMs before the weak FCM declared bankruptcy. This action did not happen in the case of the MF Global bankruptcy, which is a key reason for the chaos surrounding its bankruptcy.

In summary, the firm did not have enough capital for its various lines of business. As cited in Stewart (2012) during the summer of 2011, the Assistant Treasurer of MF Global Inc. in Chicago "became worried about the firm's growing liquidity needs and where the cash would come from." She wrote in an email in August 2011: "Why is it I need to spend hours every day shuffling cash and loans from entity to entity?", describing the process as a "shell game," reported Stewart (2012). Figure 8 illustrates how money was continuously loaned from entity-to-entity during the firm's final month.

Figure 8
Entity-to-Entity Movement of Funds



Source: Hughes Hubbard & Reed LLP, Attorneys for James W. Giddens, Trustee for the SIPA Liquidation of MF Global Inc. (2012a), Appendix A.

On June 27, 2013, the CFTC charged that:

"MF Global [had] unlawfully used nearly one billion dollars of customer segregated funds to support its own proprietary operations and the operations of its affiliates …. [Former MF Global CEO Jon] Corzine bears responsibility for MF Global's unlawful acts. He held and exercised direct or indirect control over MF Global and Holdings and either did not act in good faith or knowingly induced these violations" (CFTC, 2013).

On January 4, 2017, Corzine settled with the CFTC and paid $5 million to settle claims from the case. The regulator also set a lifetime ban on him personally trading other people's money in the futures industry.

Reforms

Regarding reforms, the CFTC "approved new NFA rules that cover foreign accounts; controls on the use of excess segregated funds; and reporting and recordkeeping requirements," according to CFTC (2012). In addition, the NFA approved a requirement for "each futures commission merchant … to provide its Designated Self-Regulatory Organization … with view-only access via the Internet to account information for each of the FCM's customer segregated funds account(s) maintained and held at a bank or trust company," announced NFA (2012).

Conclusion

This article provided examples from publicly available financial reports that demonstrated MF Global's financial weakness, dating back four years before its bankruptcy, which as time went on indicated that the firm's business model was of questionable viability. Even so, this observation does not excuse unlawful practices. MF Global effectively (and arguably unlawfully) used customer funds in large-scale proprietary trades that the firm ultimately could not fund, leading to its chaotic bankruptcy, as also noted in Till and Heckinger (2017).

Endnotes

The author presented an abbreviated version of this paper during presentations at (1) ESSEC Business School's Energy and Commodity Finance Research Center (France) on June 12, 2017; (2) the Commodity and Energy Markets Conference at Oxford University on June 15, 2017; and at (3) a Cass Business School (City, University of London) Finance Research Workshop on June 16, 2017. This article was also referenced by Harvard Law School's Bankruptcy Roundtable.

Ms. Till's ESSEC Business School lecture is available for viewing at: https://www.youtube.com/watch?v=--cZVVparPk.

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Keywords

MF Global, bankruptcy, liquidation, CFTC, futures commission merchant.

Wheat Futures Contracts: Liquidity, Spreading Opportunities, and Fundamental Factors

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Both hedge funds and asset managers have the choice of two futures contracts at the CME Group for expressing views in the wheat markets: either via the Chicago soft red winter wheat (W) contract or the Kansas City hard red winter wheat (KW) contract. Regarding the latter contract, the CME Group acquired this contract in late 2012 when it purchased the Kansas City Board of Trade. Table 1 on the next page summarizes that both wheat futures contracts have a combined $17.6 billion in open interest exposure (Panel A) and are also represented in the main commodity indices with an estimated $5.4 billion in total exposure (Panel B), as of the writing of this article.

Once a decision has been made to gain exposure to wheat futures contracts, possibly as part of a broad-based reflationary investment strategy, how should a fund manager analyze the two classes of wheat represented by CME Group futures contracts? This article will assist in answering this question, but first will provide some brief fundamental background on soft red winter wheat and on hard red winter wheat.

Background on Wheat Classes

Types of wheat are classified according to three broad factors: (1) the timing of planting (encompassing winter or spring); (2) the level of protein (low, medium, or high); and (3) the color of the kernels (red or white). The more the protein, the "harder" the type of wheat is. Correspondingly, the less the protein, the "softer" the type of wheat is. Hard red winter (HRW) wheat "has excellent milling capabilities and baking characteristics … and is used in artisan and pan breads, Asian noodles, hard rolls, flat breads, and general purpose flour" while soft red winter (SRW) wheat is used in "pastries, cakes, cookies, crackers, pretzels, flat breads, and for blending flours," as explained by the California Wheat Commission (2017). HRW wheat has tended to trade at a premium to SRW because of its higher protein content. As depicted in Figure 1, HRW wheat is by far the largest class of wheat produced in the U.S. According to estimates in Bond and Lierfert (2016), HRW wheat accounted for 45% of U.S. wheat production while SRW wheat accounted for just 16% of production.

Table 1
CME Group Wheat Futures Contract Statistics at a Glance

Panel A Open Interest and Trading Volume as of 4/7/17

	Aggregate Open Interest (in contracts)	Aggregate Open Interest (in dollars)	Aggregate Trading Volume (in contracts)	Aggregate Trading Volume (in dollars)
Chicago SRW Wheat Futures Contract (W)	521,179	11,419,714,725	184,604	4,014,661,875
Kansas City HRW Wheat Futures Contract (KW)	280,004	6,148,551,025	54,083	1,185,593,950

Panel B Commodity Index Exposure Estimates

	S&P GSCI (in dollars)	BCOM (in dollars)	Total (in dollars)
Chicago SRW Wheat Futures Contract (W)	1,950,000,000	2,145,000,000	4,095,000,000
Kansas City HRW Wheat Futures Contract (KW)	550,000,000	780,000,000	1,330,000,000

Panel C CFTC COT Report as of 4/7/17

	Non-Commercial Spreading Contracts	5-Year Average Non-Commercial Spreading Contracts
Chicago SRW Wheat Futures Contract (W)	102,351	75,284
Kansas City HRW Wheat Futures Contract (KW)	28,276	19,766

Panel D 5-Year Correlation as of 4/7/17

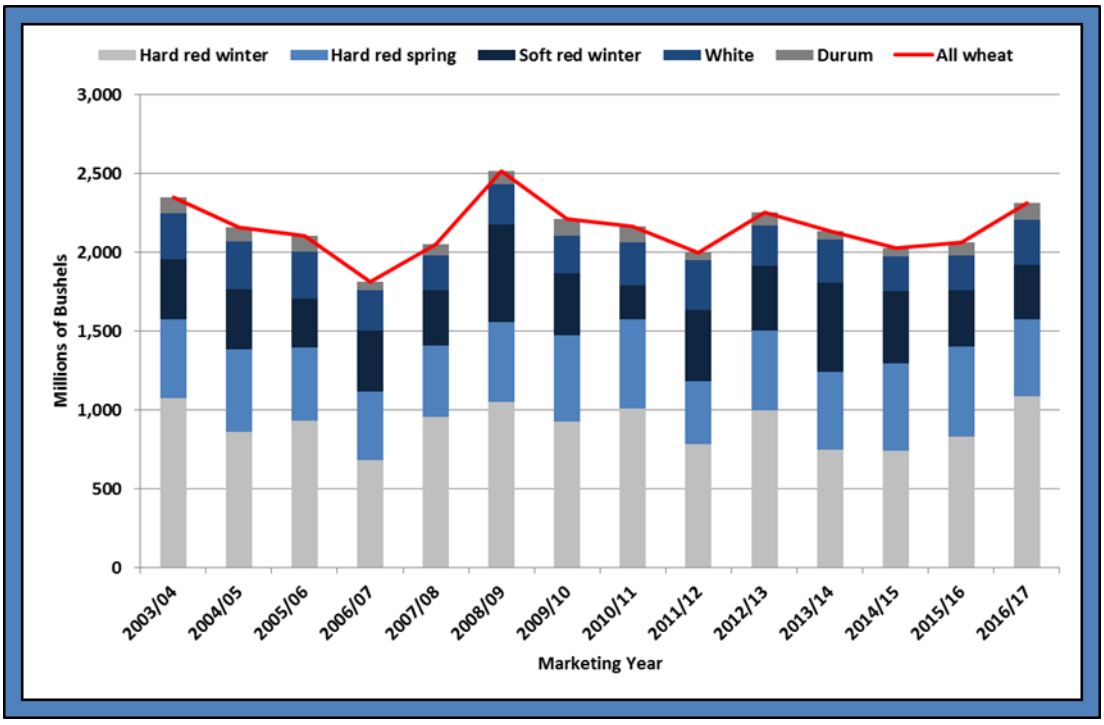
Correlation of Front-Month W Contract with Front-Month KW Contract using weekly data and percent changes: 92%

Data Source for Panels A, C, and D: The Bloomberg.

For Panel B, the commodity index exposure estimates are based on S&P Global (2016) and Bloomberg (2016) press releases along with Keenan (2017) index investment estimates.

Abbreviations:
SRW: Soft Red Winter
HRW: Hard Red Winter
CFTC: Commodity Futures Trading Commission
COT: Commitments of Traders
S&P GSCI: Standard and Poor's Goldman Sachs Commodity Index
BCOM: Bloomberg Commodity Index

Figure 1
U.S. Wheat Production by Class



Data Source: USDA Economic Research Service Wheat Data: Yearbook Tables,
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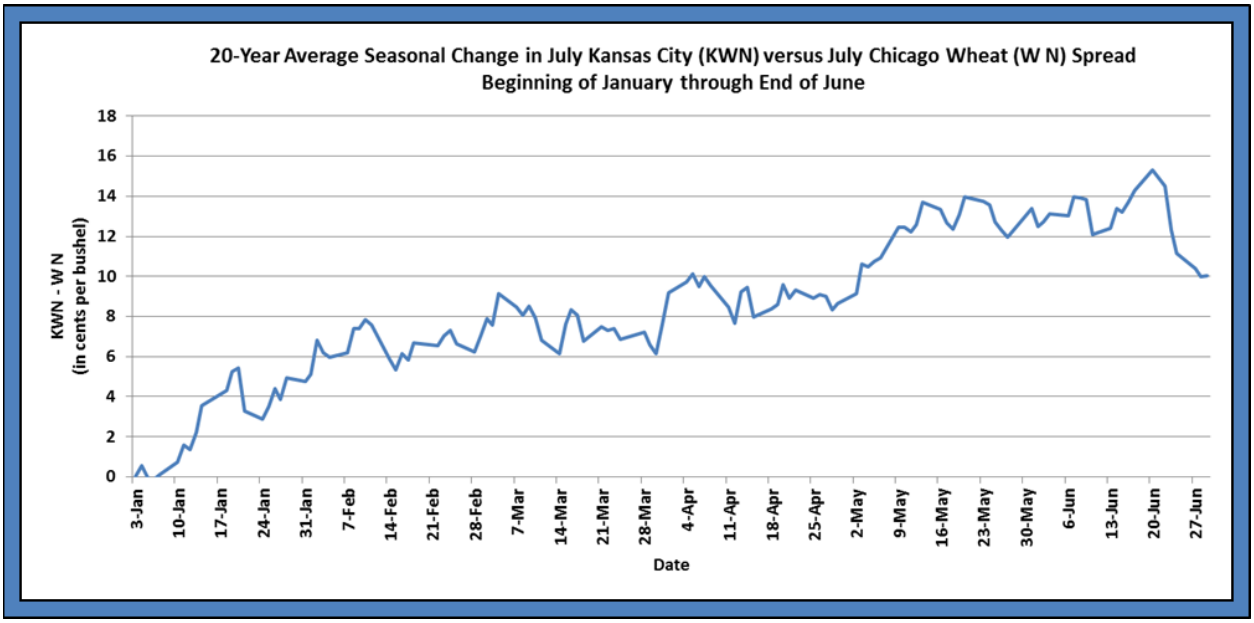
This manner of presenting data is based on Bond and Lierfert (2016), Figure 1.

The Two Wheat Futures Contracts: Liquidity and Spreading Opportunities

Despite the relative economic ordering of HRW and SRW wheat, the futures contract on SRW is where hedgers can obtain the greatest amount of liquidity provision from speculators. This can be ascertained both from Panel A of Table 1, showing the greater open interest and trading volume in the Chicago SRW contract versus the Kansas City HRW contract, and also from Panel C of Table 1, showing the greater amount of speculative spreading activity in the SRW contract. Futures contract liquidity providers typically manage risk by spreading so the amount of speculative spreading provides an indication of the level of speculative services that a commercial hedger may be able to access. One might expect that at least some commercial hedging in Kansas City HRW wheat futures contracts would have to be risk-managed by speculators using the Chicago SRW futures contract, given (a) the latter contract's greater liquidity, and (b) how correlated the two contracts are, as shown in Panel D of Table 1. In this scenario, a commercial hedger would be entering into a short position in KC HRW futures contracts and a liquidity provider would correspondingly take the other side of this position by entering into a long KC HRW futures contract, and then hedge that position with a short Chicago SRW futures contract. But for this liquidity provision service to be consistently provided, there would likely have to be a statistical edge in

the resulting speculative spread position (KC HRW futures – Chicago SRW futures) being a profitable trade over time. Winter wheat is usually harvested in the summer so one might expect hedging would be focused on the summer contracts. Figure 2 shows, as might be expected from the necessities of liquidity provision, that the July KC HRW futures contract has on average outperformed the July Chicago SRW futures contract over the past 20 years. What this long-term graph obscures is that the spread was only profitable twelve out of the last twenty years, but also that periodically the trade has had very large gains, giving a long-options-like payoff profile to this position. This latter feature is very attractive to investors and speculators alike and also helps in compounding returns. In fact, according to Bloomberg data, the futures-only returns from buying and rolling front-month KC HRW contracts has outperformed a similar strategy for Chicago SRW contracts by 4.0% per year from 2000 through 2016.

Figure 2



Data Source: The Bloomberg.

Fundamental Factors Impacting Wheat Spread Opportunities

What this initial analysis points to is that a fund manager should not automatically choose Chicago SRW wheat (W) futures contracts as the vehicle to express a bullish view on wheat. There has historically been a statistical edge in choosing Kansas City HRW wheat futures (KW) contracts. One might even term the spread strategy identified in Figure 2 as earning a type of risk premium where on average there is a return for liquidity provision by taking exposure in the less liquid contract relative to the more liquidly traded contract. But hedge fund managers and asset managers alike have higher expectations for trades and investments: an actively managed position must have superior (entry-and-exit) timing and risk-management rules and should not just passively involve entering into a spread trade with a statistical expectation of profit.

Amongst the fundamental factors that can materially impact the KW – W spread from year-to-year include (1) whether SRW supply is particularly low; (2) whether HRW export demand is particularly low; and (3) the fluctuating protein content in HRW wheat. For example, regarding the first two points, Ehmke (2015) provided the following explanation for the steep premium of SRW to HRW, which occurred in November 2015: "Driving SRW's rally against HRW is the serious shortage of quality SRW supplies … while HRW inventories are abundant because of its weak export pace," quoting an official from U.S. Wheat Associates.

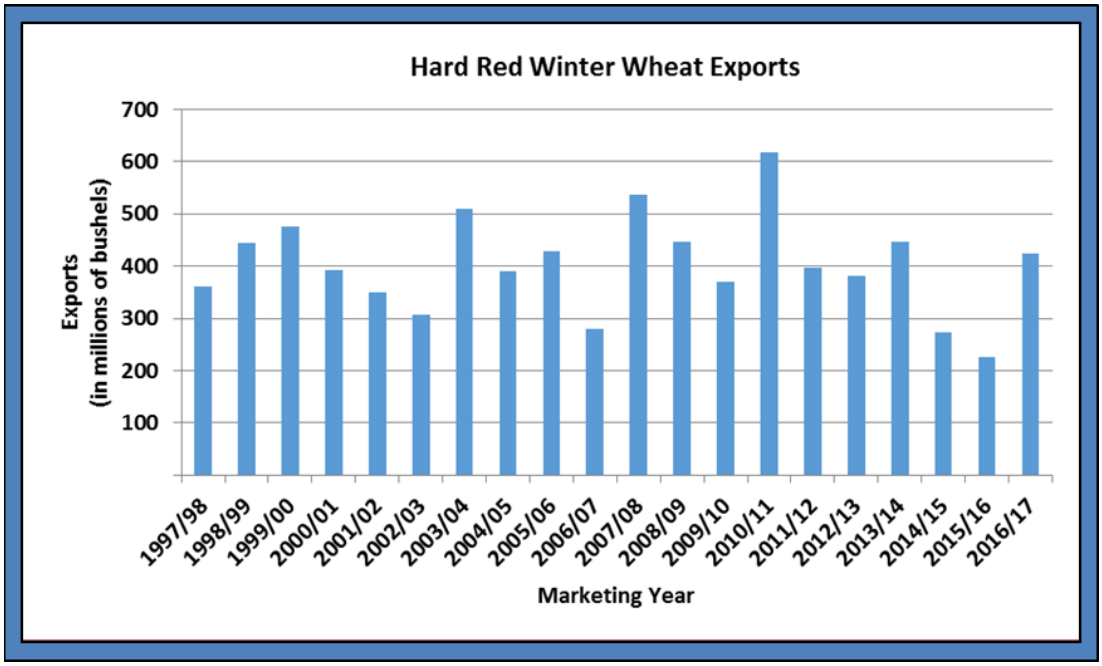
SRW Wheat Supply

The data sources for monitoring the three factors noted above include not only U.S. Department of Agriculture (USDA) reports, but also information gleaned from Commodity Futures Trading Commission (CFTC) data. The CFTC helpfully produces the weekly Disaggregated Commitments of Traders (DCOT) report, which provides a breakdown of commodity futures positions across the following four categories: (1) Producer/Merchant/Processor/User; (2) Swap Dealers; (3) Managed Money; and (4) Other Reportables. The first category provides a window into the amount of commercial hedging (and therefore, amount of supply that is being hedged for a commodity.) When SRW wheat supply is particularly low, one would expect two results: (1) the amount of producer hedging would be low, and (2) the KC HRW – Chicago SRW spread level would not be particularly high, as there would be upward pressure on SRW wheat prices. And indeed since June 13, 2006, the start of data in the DCOT report, when the Chicago wheat futures contract's Producer/Merchant/Processor/User short-hedging participation has been one standard deviation below average, the KC HRW – Chicago SRW spread has been below average.

HRW Wheat Exports

Regarding the relevant USDA data, Figure 3 on the next page draws from the USDA's Economic Research Service in showing the history of HRW exports. The HRW exports in the 2014/2015 and 2015/2016 marketing years were one to two standard deviations below average since the 1997/1998 marketing year. In both of these years, the July KC HRW – July Chicago SRW spread did not appreciate as in the typical pattern shown in Figure 2.

Figure 3

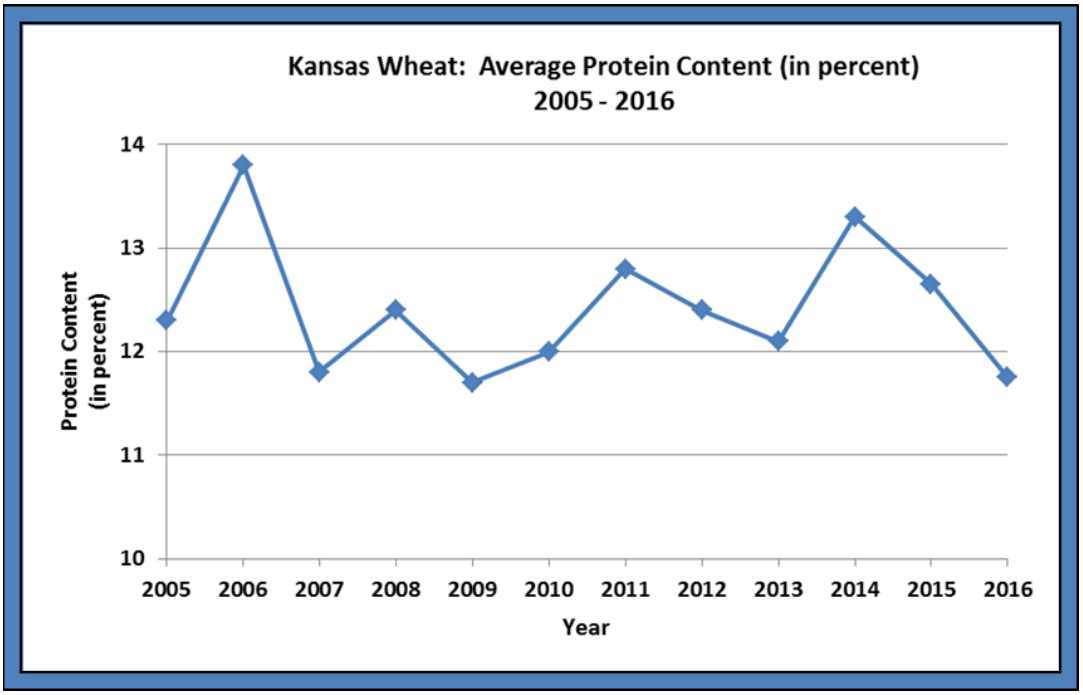


Data Source: USDA Economic Research Service Wheat Data: Yearbook Tables, https://www.ers.usda.gov/data-products/wheat-data/, Wheat Data-Recent.xls, Table 7, in which the data was run on 3/10/17.

Protein Content in Kansas Wheat

One can also refer to USDA reports for information on the fluctuating protein content of wheat grown in Kansas, as shown in Figure 4 on the next page. Ninety-five percent of wheat grown in Kansas is HRW, and 40% of U.S. HRW production is grown in Kansas. The above average protein-content showings in 2006, 2011, and 2014, depicted in Figure 4, correspond to times when the July KC HRW – July Chicago SRW spread did explosively well.

Figure 4



Source: Groskurth (2016).

Conclusion

How should fund managers choose amongst wheat futures contracts if they are interested in expressing bullish economic and inflationary views through positions in the agricultural futures complex? They should consider the various factors that drive the relative performance of different classes of wheat futures contracts, as briefly covered in this digest article.

Endnotes

This article is based on Till (2017).

The author is grateful for research assistance from Hendrik Schwarz and Katherine Farren, CAIA. That said, the views expressed in this article are the personal opinions of Hilary Till.

This article is provided for educational purposes only and should not be construed as investment advice or an offer or solicitation to buy or sell securities or other financial instruments. The information contained in this article has been assembled from sources believed to be reliable, but is not guaranteed by its author. Any (inadvertent) errors and omissions are the responsibility of Ms. Till alone.

And finally, this article made liberal use of historical data and analyses in discussing past empirical relationships in the wheat futures markets. Consequently, the reader should be aware that the paper's past results are obviously not guaranteed to continue into the future. The reader should be further aware that all commodity futures trading endeavors are, in practice, quite risky.

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Keywords

Wheat futures contracts, liquidity.

Chinese Economic Growth and Commodity Performance

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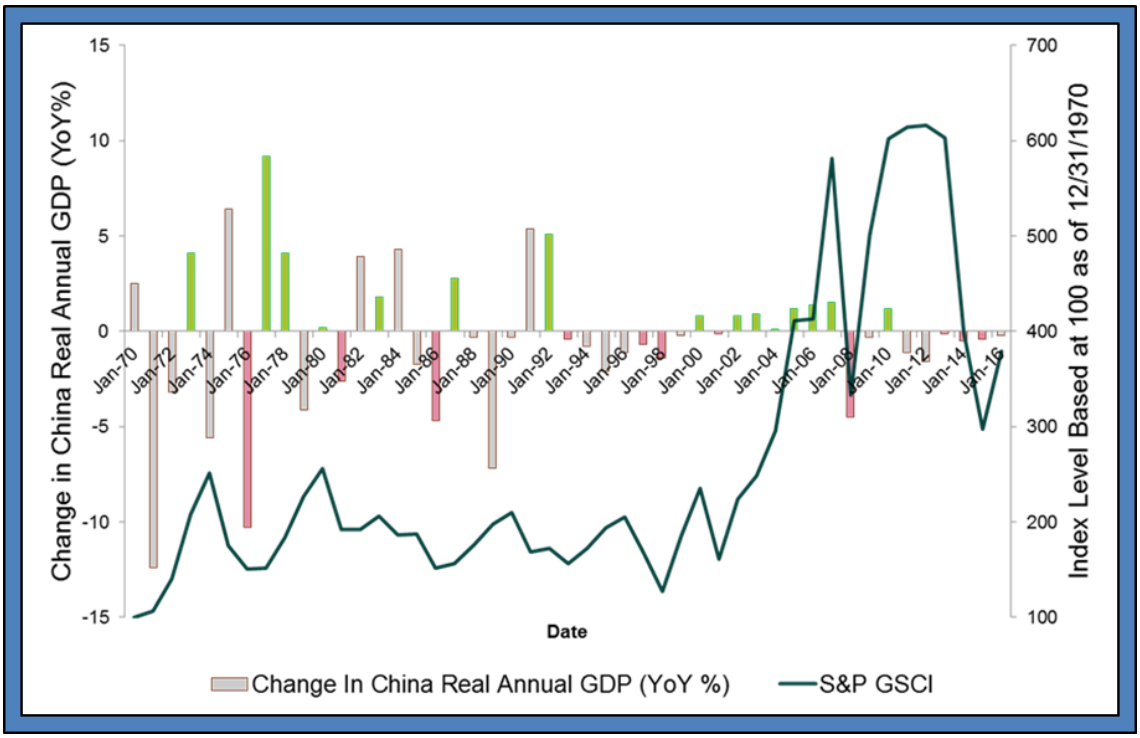
Ms. Jodie Gunzberg, CFA (standing), Managing Director, Head of U.S. Equities at S&P Dow Jones Indices, presented at the *GCARD*'s panel on Chinese commodity demand during the J.P. Morgan Center for Commodities' international commodities symposium, which was held at the University of Colorado Denver Business School from August 10, 2017 through August 11, 2017. The session's other panelists were Dr. Keith Black, Ph.D., CFA, CAIA (left), Managing Director, Chartered Alternative Investment Analyst (CAIA) Association; and Dr. Kevin (Kaifeng) Chen, Ph.D., Chief Strategist, Hywin Capital Management. The panelists are founding Editorial Advisory Board members of the *GCARD*. In addition, CAIA was a co-sponsor of the symposium.

Many news headlines point to rising or falling Chinese economic growth as a main influence of commodity performance. However, there are many other factors like the U.S. dollar[1] and interest rates[2] that can drive commodities. Even in the Chinese market, there are forces besides industrial demand growth to analyze like demand for storage[3] and demand for metals to be used as financial collateral.[4] In

this digest article, we look beyond the headlines to examine what the actual impact of the fluctuating fortunes of the Chinese economy appears to have been on the price performance of commodities overall, as well as on commodity sectors and individual commodities, using year-over-year data.

Overall the S&P Goldman Sachs Commodity Index (GSCI)[5] only moves in the same direction as Chinese Gross Domestic Product (GDP) in about 57% of the past 46 years. However, *when Chinese GDP is split into rising and falling periods, commodity returns seem to be more influenced by rising growth than slowing growth*, as shown on Figure 1. Of the past 46 years, Chinese economic growth rose 19 times with 15 of those years exhibiting positive annual commodity returns. The slowing growth years seem much less influential, occurring simultaneously with commodity performance declines in only 11 of 27 years. That said, years with notably negative economic growth such as in 1976, 1981, 1986, 2008, and times with consecutive years of falling growth such as in 1997-98 and in 2013-15, may have contributed to negative commodity performance during those years.

Figure 1
Changes in Chinese GDP versus Commodity Performance

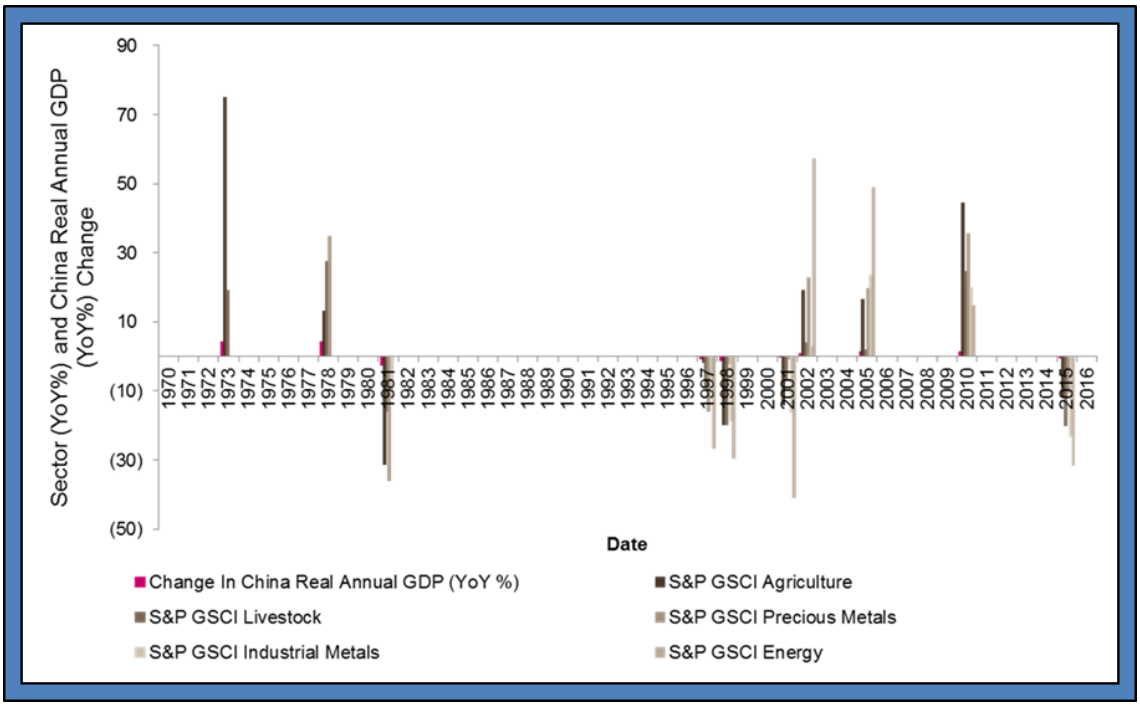


Sources: S&P Dow Jones Indices and Bloomberg Chinese GDP growth data. Green bars show simultaneous positive Chinese GDP changes and positive commodity returns. Pink bars show simultaneous negative Chinese GDP changes and negative commodity returns.

Additionally, *it is infrequent to see all five commodity sectors move together in the same direction with Chinese GDP changes*, but again they appear to be more influenced by rising growth, as shown on Figure 2 on the next page. All sectors moved in the same direction as Chinese GDP changes 22% of the time.

However, all sectors simultaneously gained in 26% of the rising growth years, while all sectors simultaneously lost in just 19% of the declining growth years.

Figure 2
All Five Commodity Sectors Have Rarely Moved Together in the Same Direction with Chinese GDP Changes



Sources: Bloomberg and S&P Dow Jones Indices.

The evidence suggests commodity sector diversification may protect the S&P GSCI from declining Chinese growth and may help with rising growth, as documented in Table 1 on the next page. The composite index loses in just 41% of falling growth periods, which is less frequently than any single sector loses with falling growth. It is interesting that the industrial metal sector, which has an over 40% weighting to copper, has been the least sensitive sector to rising Chinese GDP, rising in just 53% of years together. It is also interesting that energy has been the least sensitive to falling growth, dropping together in just 43% of years. The seemingly least sensitive sectors to macro factors, *agriculture and livestock, may have been the most influenced by moves in Chinese GDP growth.*

Table 1

Fraction of Time that Commodities and Their Constituent Sectors Have Moved in the Same Direction as Chinese Economic Growth

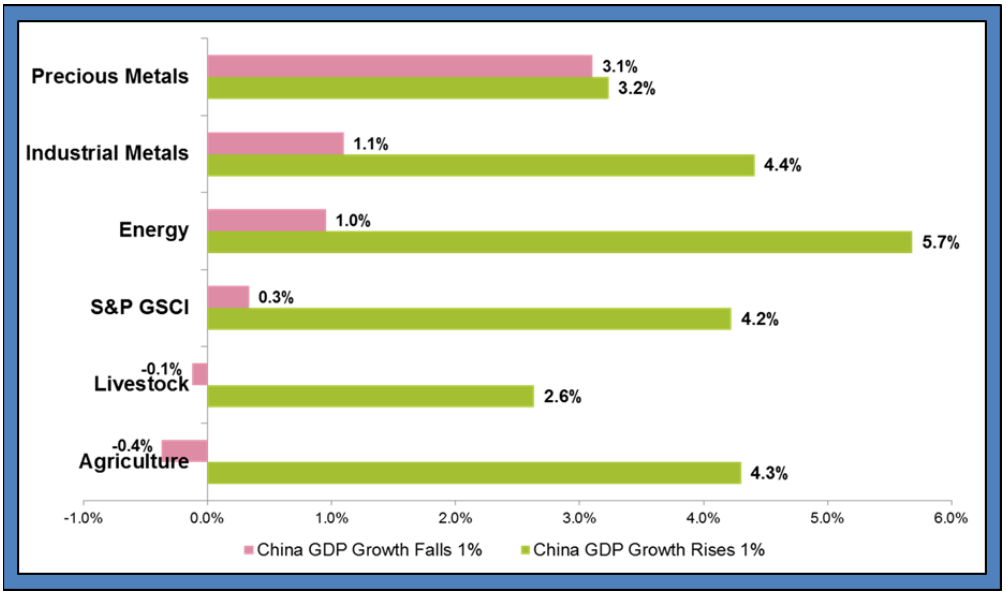
		S&P GSCI Sectors				
Chinese GDP Growth Changes () / Commodity Returns ()	S&P GSCI	Agriculture	Livestock	Energy	Industrial Metals	Precious Metals
Moving Together (+)/(+) or (-)/(-)	**56.5%**	63.0%	67.4%	51.5%	57.9%	53.5%
Rising Together (+)/(+)	**78.9%**	68.4%	84.2%	66.7%	53.3%	61.1%
Falling Together (-)/(-)	**40.7%**	59.3%	55.6%	42.9%	60.9%	48.0%
Ratio Rising Together/ Falling Together	**1.9**	1.2	1.5	1.6	0.9	1.3

Source: S&P Dow Jones Indices.

Agriculture and livestock have also been the only sectors that have declined on average for every 1% drop in Chinese GDP, as shown on Figure 3. While a 1% rise in Chinese GDP has been associated with positive performance in every sector, a 1% drop in Chinese GDP has only been associated with a reduction in positive returns overall and for metals and energy. For precious metals, although its returns and Chinese growth have moved together more frequently when Chinese growth has been up rather than down, the average returns during a change of Chinese GDP growth by 1% has been about the same, regardless of whether the growth change was positive or negative.

Figure 3

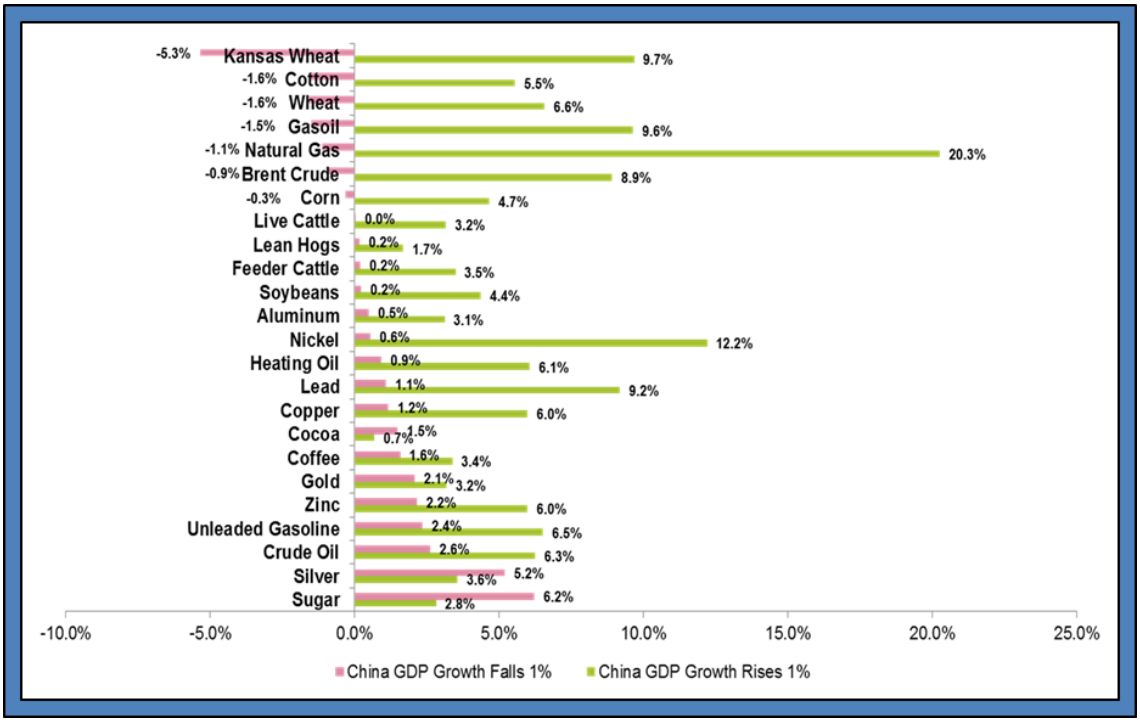
All S&P GSCI Sectors Have Had Positive Performance on Average with Rising Chinese Growth; Only Agriculture and Livestock Have Fallen on Average with Declining Chinese Growth



Source: S&P Dow Jones Indices.

Lastly, *every single commodity in the S&P GSCI has risen with rising Chinese GDP*, while only wheat, cotton, gasoil, Brent crude and natural gas have fallen on average with a 1% drop in Chinese GDP, as shown in Figure 4.

Figure 4
All Commodities Have Had Positive Performance during Rising Chinese Economic Growth



Source: S&P Dow Jones Indices.

Conclusion

The results in this brief article suggest that the impact of changes in Chinese economic growth may have been different across the five commodity sectors in the S&P GSCI. This article documented the degree to which this may have been the case in the past. Most surprisingly, despite the press attention to seemingly more economically sensitive commodities, this article shows that it may be the agricultural and livestock sectors that have responded the most consistently to changes in Chinese economic growth.

Endnotes

1 http://www.indexologyblog.com/2016/04/04/every-commodity-benefits-from-a-falling-dollar/

2 http://www.indexologyblog.com/2013/11/26/the-exponential-power-of-interest-rates-on-commodities/

3 https://oilprice.com/Energy/Energy-General/Is-Chinas-Oil-Demand-Growth-About-To-Plummet.html

4 See Black (2016).

5 http://us.spindices.com/performance-overview/commodities/sp-gsci

This article is excerpted from Ms. Gunzberg's August 10, 2017 presentation at the J.P. Morgan Center for Commodities' international commodity symposium, which was held at the University of Colorado Denver Business School. The original version of this article can be accessed here: https://www.indexologyblog.com/2017/08/21/chinese-demand-growth-lifts-every-commodity/.

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Jodie M. Gunzberg is Head of U.S. Equities at S&P Dow Jones Indices (S&P DJI). She is responsible for the product management of S&P DJI's U.S. Equity indices, including the S&P 500® and The Dow®, the most followed equity indices in the world. Ms. Gunzberg is the chief spokesperson and product strategist for these indices, educating the market about their benefits and risks, and she sources market feedback to manage continued product development for growth opportunities. She also oversees certain indices relevant to retirees, including the S&P Target Date and S&P STRIDE index series.

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Futures Trading Opportunities: Fundamentally-Oriented and Convergence Trading

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Professor Isabel Figuerola-Ferretti, Ph.D., Universidad Pontificia de Comillas (Madrid), presenting on the statistical properties of crude oil prices at the European Financial Management Association conference in Athens (Greece) on June 28, 2017.

In the article, "Commodity Futures Trading Strategies: Trend-Following and Calendar Spreads," Till and Eagleeye (2017) describe two futures trading strategies: trend-following and calendar-spread trading. In that article, the authors provide a brief description of trend-following, and they also discuss the fundamental underpinnings of two types of calendar-spread strategies. This article, in turn, covers fundamentally-oriented trading (in contrast to trend-following) and also characterizes calendar-spread strategies as a type of convergence trading.

Fundamentals-Based Trading

In fundamentally-oriented trading, market participants closely follow macroeconomic data to make subsequent trading decisions. U.S. macroeconomic data such as the amount of jobless claims and the change in nonfarm payrolls can potentially be used in trading decision-making. Such indicators have

been highly efficient in reflecting information that is important for forecasting market performance. Indeed the 2008-2009 Global Financial Crisis (GFC hereafter) was preceded by a continuous trend in the deterioration of U.S. macroeconomic data, starting in 2006. For commodity traders, an ability to anticipate the GFC would have been quite valuable, given the disastrous performance of commodities at the time: the returns on the S&P Goldman Sachs Commodity Index in 2008 were -46.5%. Figure 1 illustrates the dramatic collapse in world trade that temporarily occurred from October 2008 to January 2009 during the GFC.

Figure 1

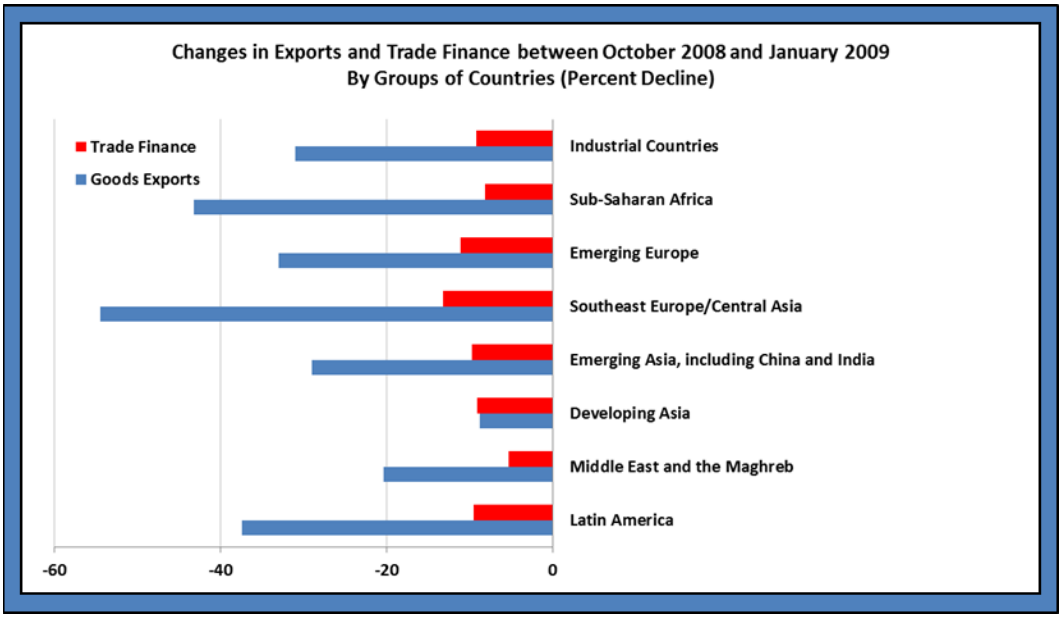


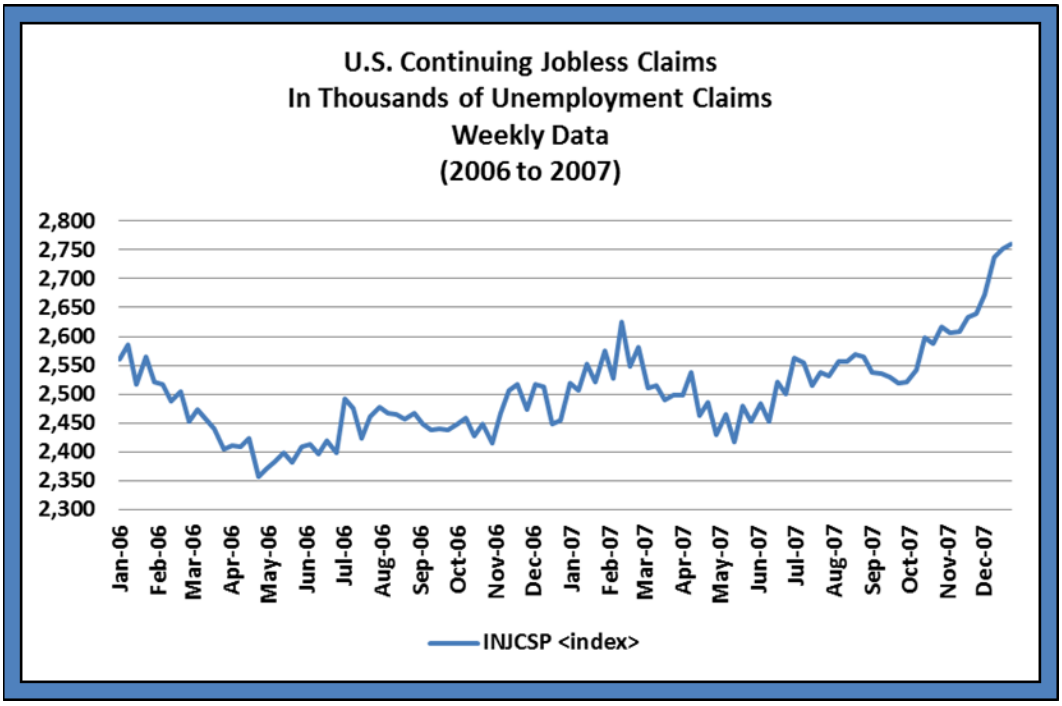
Chart based on Contessi and de Nicola (2012), Figure 1, which in turn is excerpted from Asmondson *et al.* (2011), Table 2, 3rd and 4th columns.

In what follows, we use data sets provided by Bloomberg to describe the set of macroeconomic indicators that signaled the poor macro-based performance that preceded the start of the GFC.

A detailed analysis of U.S. macro-based indicators shows that in June 2006 there were important signals of worsening economic health conditions arising as a consequence of deteriorating employment data. Labor market figures are important indicators of U.S. economic conditions. As stated by Yamarone (2012), consumer spending constitutes the largest percentage of U.S. Gross Domestic Product (GDP), accounting for roughly two-thirds of total economic output.

Figure 2 on the next page illustrates the evolution of U.S. continuing jobless claims. A close look at the figure shows that unemployment claims started to grow in April 2006, and continued an upward trend that culminated in a 9.6% increase from the end-of-September to the end-of-December 2007.

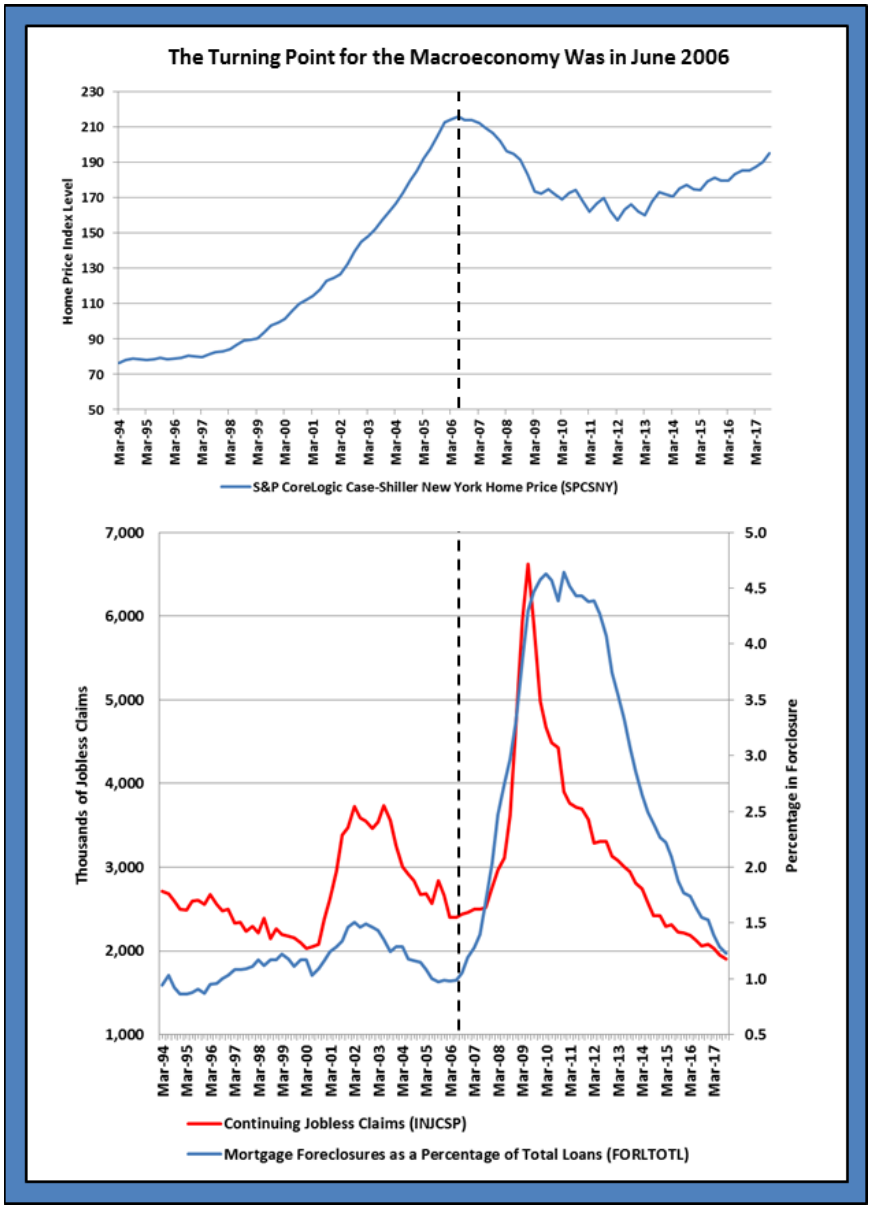
Figure 2



Source of Data: The Bloomberg.

Over the same period, there was a declining demand for homes that led to a contraction in home prices in June 2006. As home prices fell, a number of borrowers started to owe more than their homes were worth, and this led to a surge in mortgage foreclosures. The turning point for U.S. macro metrics therefore took place in June 2006. This effect is depicted in Figure 3 on the next page, which shows the time series plot for the following three Bloomberg series: (1) the S&P CoreLogic Case-Shiller New York home price index, (2) mortgage foreclosures measured as a percentage of total loans, and (3) continuing jobless claims.[1]

Figure 3
The Turning Points for Three Macroeconomic Variables Prior to the 2008 Global Financial Crisis
Quarterly Data
(March 1994 to September 2017)

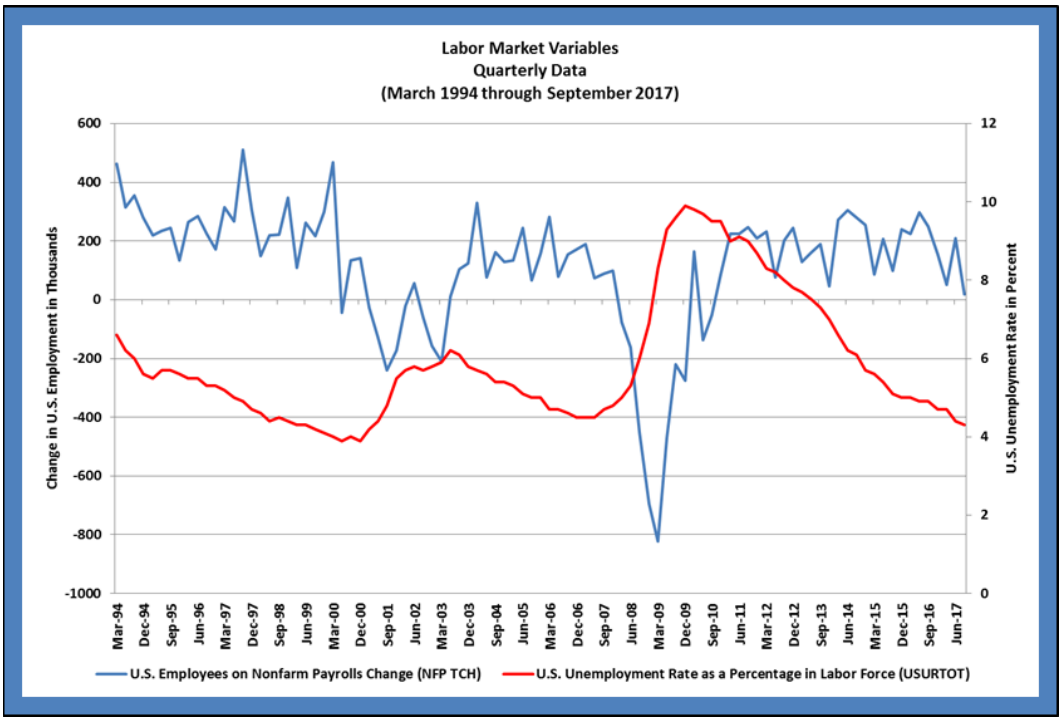


Source of Data: The Bloomberg.

After the 2006 turning point, changes in nonfarm payrolls, which measure the net creation of non-agricultural employment in the U.S., exhibited a downward trend, later translating into about 34-thousand and 20-thousand employment losses in July and August 2007 respectively. Worsening labor market conditions were also manifested in the U.S. unemployment rate, which increased from 4.4% to 5.0% from May 2007 to December 2007. This pre-GFC employment deterioration is illustrated on the next page in Figure 4, which includes time series plots of both the change in U.S. employees on non-farm

payrolls as well as the U.S. unemployment rate. In December 2007, the worsening in U.S. macroeconomic conditions continued apace, and the U.S. economy entered into a recession. This latter fact is documented on the next page in the second row of Table 1, which shows the dates of turning points in different business cycles as decided by the Business Cycle Dating Committee of the National Bureau of Economic Research. That said, the official announcement of this turning point did not take place until December 2008.

Figure 4



Source of Data: The Bloomberg.

Table 1

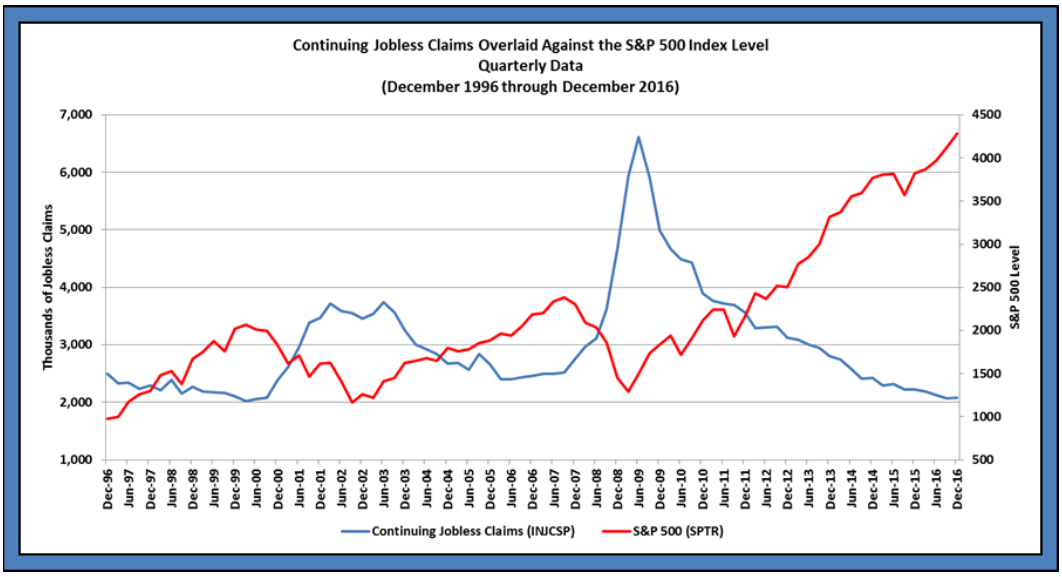
Turning Point Dates of the U.S. Business Cycle with Their Announcement Dates

Turning Point Date	Peak or Trough	Announcement Date
June 2009	Trough	September 20, 2010
December 2007	Peak	December 1, 2008
November 2001	Trough	July 17, 2003
March 2001	Peak	November 26, 2001
March 1991	Trough	December 22, 1992
July 1990	Peak	April 25, 1991
November 1982	Trough	July 8, 1983
July 1981	Peak	January 6, 1982
July 1980	Trough	July 8, 1981
January 1980	Peak	June 3, 1980

Source of Data: National Bureau of Economic Research.

The previously described sets of data provided early signals of subsequent sizable market losses. As depicted in Figure 5, the S&P 500 equity market index started falling at the end of 2007, after U.S. labor market indicators had already begun signaling deterioration.

Figure 5



Source of Data: The Bloomberg.

One year later in the fall of 2008, "the largest fall in international trade since the Great Depression" occurred, "as imports and exports contracted by nearly 30 percent relative to GDP," and as reported by Contessi and de Nicola (2012). And according to the International Energy Agency, oil demand in 2008 correspondingly fell for the first time since 1983. Thus, we can see that a careful examination of U.S. macroeconomic data would not have only been useful for equity trading, but also for commodity trading.

Convergence Trading

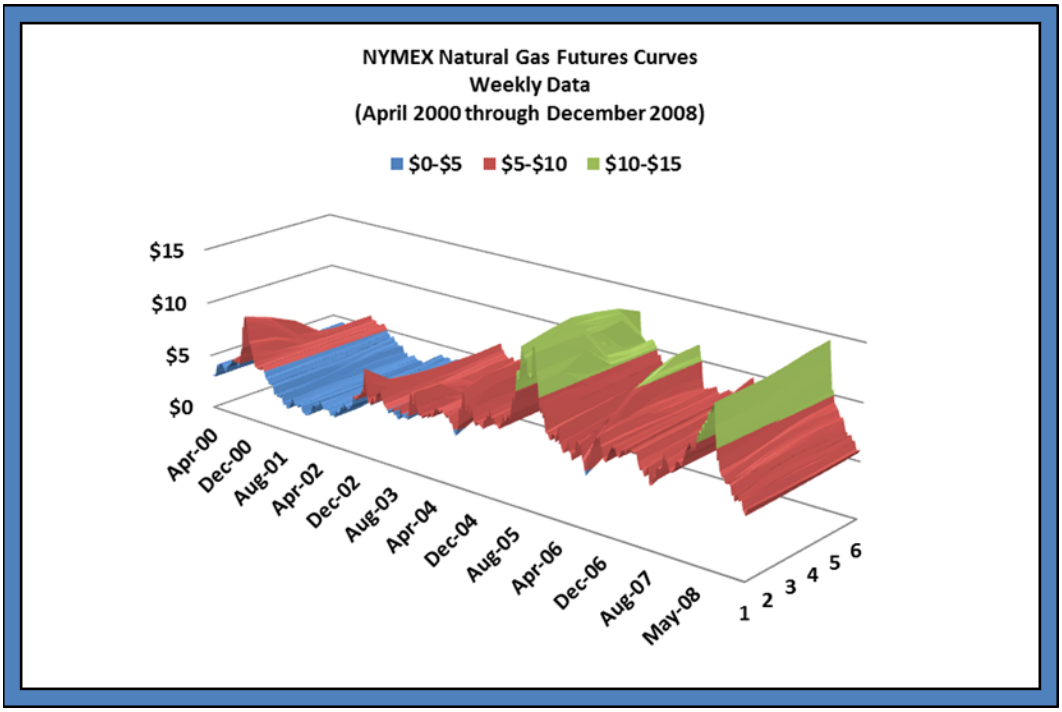
In addition to approaching the markets from a macroeconomic perspective, market participants also adopt purely mathematic approaches to trading. For example, convergence trading is a popular strategy pursued by hedge funds. This strategy, also known as pairs trading, involves entering into simultaneous long-and-short positions in highly correlated markets that are trading beyond a threshold spread level, which are then closed if and when the spread relationship mean-reverts. Pairs trading strategies are therefore designed to earn profits from relative mispricings of closely related assets. While pairs trading strategies are mainly applied to equity prices (see for instance, Gatev *et al.,* 2006), they can also be constructed with commodity price spreads that are linked by common fundamentals, as discussed in Kanamura *et al.* (2010).

Kanamura *et al.* (2010) propose a profit model to understand the effects of volatility and mean reversion in the profitability of *calendar-spread trading*. In review, within all commodity futures markets a different price typically exists for each commodity, depending on when the commodity is to be delivered. For example, with natural gas, a futures contract whose delivery is in October will have a different price than a contract whose delivery is in December. Accordingly, a futures trader may trade the spread between the October versus the December futures contract, which is one type of calendar spread.

In Kanamura *et al.* (2010)'s empirical application, the authors examine the historical performance of spread trading strategies in the energy markets using historical NYMEX prices for crude oil, heating oil and natural gas prices. They find that total profits from natural gas and heating oil spread trading are positively affected by seasonality. More importantly, natural gas spreads generate the largest total profits while heating oil and West Texas Intermediate crude oil spreads exhibit the second and third highest excess returns. Similar conclusions are obtained when performance is measured in terms of Sharpe ratios or risk-adjusted returns. The authors also demonstrate that pairs trading performance is related to volatility and the speed of mean reversion.

Because the natural gas market exhibits higher volatility and higher mean reversion than heating oil or crude oil spreads, natural gas pairs trading delivers higher profitability, according to the authors' study. Figure 6 illustrates just how volatile the outright price of U.S. natural gas futures contracts and their calendar-spread relationships have been, as referenced in the Kanamura *et al.* (2010) study.

Figure 6



This graph illustrates the price evolution of six delivery months in the U.S. natural gas futures market, tracing from the first- through sixth-month contracts. The x-axis is the date of observation; the y-axis is the delivery month; and the z-axis is the price level for each natural gas futures contract in dollars per MmBtu. The color key is the price level of natural gas in five-dollar increments, as shown on the z-axis. Presenting data in this fashion is based on an exhibit in Kanamura *et al.* (2010).

Source of Data: The Bloomberg.

By way of further reference on natural gas spread trading, Till and Eagleeye (2017) describe the fundamental reasons for the historical profitability of this calendar-spread strategy while Till (2017) provides a cautionary note on the limits to scalability of this strategy based on past hedge fund debacles.

Conclusion

Gaining expertise in derivatives markets typically occurs by working in firms that have strict rules on keeping their trade secrets proprietary. This article aims to help fill the knowledge gap about these markets by providing useful information on two types of trading strategies.

Endnotes

1 For a detailed account of the effect of the fall in home prices on mortgage foreclosures, please see Bernanke (2013).

This article is partially excerpted from the author's discussant presentation at the Commodity and Energy Markets Conference, which took place at Oxford University on June 15, 2017.

Acknowledgement

The author would like to thank Ramon Bermejo for his comments and assistance in the collection of the article's data.

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The History of a Supply-Driven Bear Market: Part 1 of 2
Oil Price Surprises from 2014 through 2015

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Introduction

This article is the first in a two-part series. This series of articles will provide insights into the complex dynamics of oil price formation from 2014 onwards. Part 1 focuses on the events influencing the oil markets from 2014 through 2015 while Part 2, which will appear in the next issue of the *GCARD*, will cover the oil-market-moving events from 2016 through the present. Part 2 will also cover projections on the oil market through 2025 based on work with the Clingendael International Energy Programme, which, in turn, is a think tank on energy in The Hague, Netherlands.

Price formation is characterized by highly dynamic interactions amongst a wide set of drivers, each one sometimes dormant, and at other times, hyperactive. These drivers can be clustered into four overarching categories: (1) Supply & Demand Fundamentals, (2) Geopolitics, (3) Geo-Finance, and (4) Technology & Innovation. The reader will recognize them all in this article. Oil, like all commodities, is not an anticipatory asset and pricing expectations typically eventually prove self-negating. Hence, in contrast to equities, oil does not have much expectation value and is thus far more of a spot asset class. For that reason, big structural changes, such as we witnessed in 2014, always seem to come as a big surprise.

This article starts with Saudi Arabia's (then) Minister of Petroleum and Mineral Resources, Ali Al-Naimi, hinting that a major shift in oil policy was pending, but ultimately failed to get his message across. The article then describes what actually happened in the market over the course of the next two years along with the difficulties that oil analysts experienced in providing accurate projections.

Late 2013 Through 2014

In late 2013 Saudi Arabia's Minister of Petroleum and Mineral Resources, Ali Al-Naimi, tacitly noted that the Kingdom would not necessarily cut production by itself to balance oil markets. Those signals, which were first presented in an interview with *MEES* (*Middle East Economic Survey*, a weekly newsletter published by Middle East Petroleum and Economic Publications), were evidently not heard. At that time, the expectation in oil and financial capitals around the world was that Saudi Arabia would once again cut production to support oil prices. And thus analysts felt comfortable about a floor in oil prices of around $80 per barrel (bbl), which would be fiercely defended by Saudi Arabia in its capacity as the world's "central bank of oil." It took another nine months or so before market participants were brutally awakened to the fact that indeed Saudi Arabia could not persuade OPEC and key non-OPEC producers to act together, but instead the oil market had to stabilize itself eventually, triggering a new era for oil.

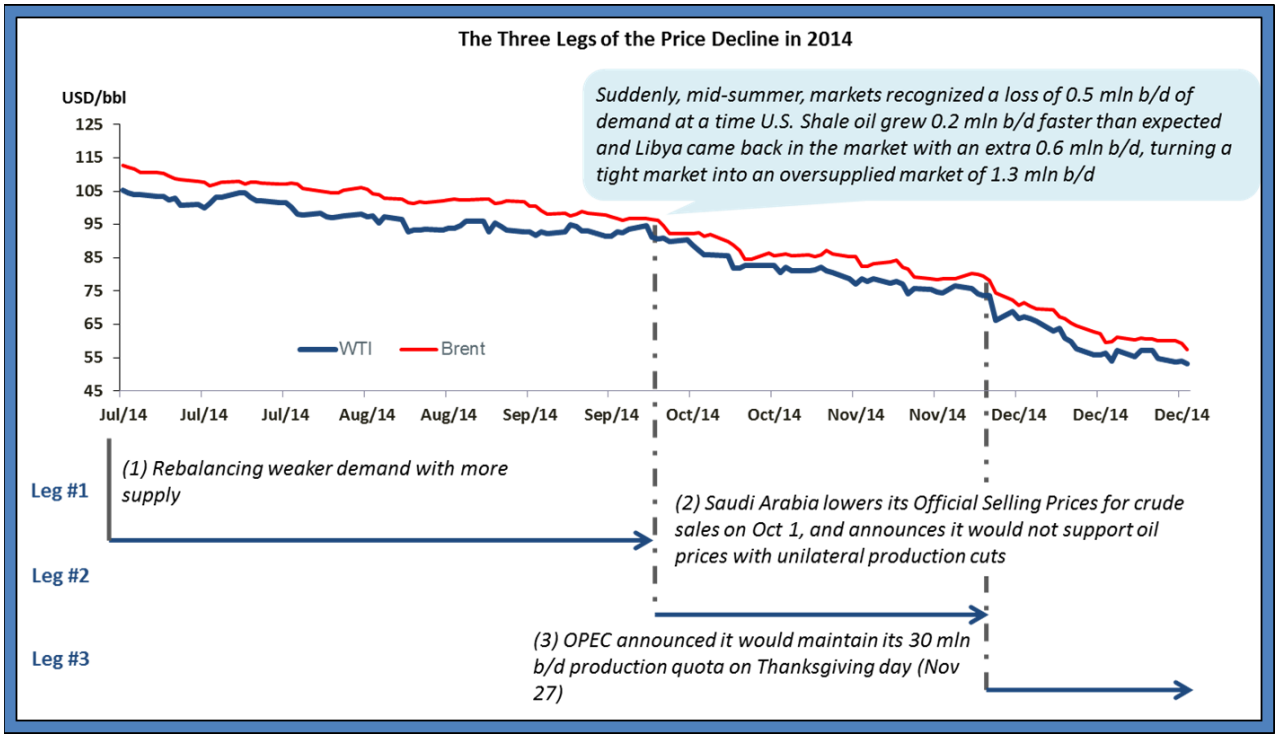
Nevertheless, in December 2013, it was already flagged that Saudi Arabia would be key to global balances and oil prices during the upcoming year. Again the key question was raised as to how willing OPEC, and in particular Saudi Arabia, would be to balance what was expected to become an oversupplied market. Between 2010 and 2013, U.S. shale liquids had grown 3.2 million barrels per day (mb/d), a nearly unparalleled growth spurt only achieved once before in the oil world by Saudi Arabia between 1970 and 1974. The Bakken field had just touched 1 mb/d (from about 0.2 mb/d five years earlier), and the U.S. Energy Information Administration (EIA) had published its projections that U.S. crude oil production would reach a whopping 10 mb/d before 2020. But the feared oversupply from the spectacular growth of U.S. tight oil had not (yet) materialized due to offsetting supply losses from other non-OPEC and OPEC countries, notably Libya and Iran. That said, the U.S. was already "crude long" between 2011 and the summer of 2013, which was reflected by a deep discount in West Texas Intermediate oil versus Brent oil, resulting in the Atlantic Basin becoming "crude long" as well. However, growing Iraqi output was becoming a pressing issue for Saudi Arabia, as was (a) the pending return of Iran to the oil market and (b) the possibility that Libya could see a sudden upswing in production as well. Saudi Arabia thus had enough time to strategize on what to do at a time when oil prices were still comfortably above $100/bbl as well as how it would communicate its reluctance to act as the sole swing producer. History alone already suggested that Saudi Arabia would not acquiesce to large Iraqi or Iranian output increases, foregoing any response to a decline in its market share. Hence the possibility that Saudi Arabia would abandon the role of the swing producer and would fiercely compete to maintain its market share was looming large and would imply a very different oil world in the years to come.

Let us fast forward to the 165th Meeting of the OPEC Conference, which convened in Vienna on June 11, 2014. The conference participants decided to retain the production ceiling of 30 mb/d of crude for the Organization's 12 Member Countries, a level of production which was first agreed by the OPEC Ministers at their Conference in December 2011. Right then, Abdalla Salem El-Badri, OPEC's Secretary General, mentioned that "we have a very comfortable crude oil price, the market is stable and OPEC is producing 30 mb/d of crude, more or less. The consumers are getting their supplies and the producers a good price. Everybody is happy." His comments of optimism were echoed by OPEC Ministers before and after the Conference, irrespective of the broad awareness within the cartel of the increase of shale outpacing demand, and that demand was suffering from high oil prices. Even Ali Al-Naimi observed before the Ministerial talks that oil markets were stable and that current oil prices were satisfactory for both producers and consumers. "Everything is in good order. Supply is good. Demand is good. The price is good," he affirmed. But perhaps he knew better; his advisors had already offered him a gloomy prognosis of the year ahead at the end of 2013, helping him to draft a new strategy for Saudi Arabia. Meanwhile, markets were of the opinion that demand was growing, backed by a strong signal from the International Energy Agency (IEA) suggesting a rise in demand of 1.3 mb/d for that year. When OPEC's production ceiling was kept intact, oil prices continued to rise and reached their peak of $115/bbl for Brent crude about a week after the meeting. Goldman Sachs analysts wrote in a June 10 report that "going forward, we expect continued growth in U.S. shale oil production, combined with normalization in non-OPEC production growth outside North America to allow a gradual decline in crude oil prices, with our 2015 year-end Brent price forecast at $100/bbl." Meanwhile the break-even oil price required for new developments to compensate for lost production from fields in decline and to satisfy the global growth in oil demand over the coming 15 years was calculated at $85/bbl.

As the weeks passed, prices slumped. Gradually but slowly, it became clear that East of Suez could no longer accommodate all the crude being produced, and the oil market moved to the next phase from "Atlantic (Basin) crude long" to "Globally crude long" during the summer. The first leg of price declines was still gentle, but suddenly during mid-summer, markets recognized a loss of 0.5 mb/d of demand when U.S. shale oil grew 0.2 mb/d faster than expected. In addition, Libya came back in the market with an extra 0.6 mb/d, turning a tight market into a heavily oversupplied market of 1.3 mb/d by September. At that time, the 1-versus-3-month time spread in the front of the futures curve turned into contango. A second leg of price declines, now at an accelerated pace, was initiated by Saudi Arabia. The Kingdom unexpectedly lowered its Official Selling Prices for crude oil sales on October 1 to protect market share. Still market participants had difficulties with accepting this change of events. Oil analysts' conviction in $100/bbl was waning, but they were not yet willing to lower their price projections. After all, they noted that inventories were still low, and they expected demand acceleration. Their view was that the sharp price decline to $94/bbl had overshot their near-term price targets. Instead of a price crash overnight, as occurred in 2008 when the financial crisis broke out, Brent crude prices drifted lower to $85/bbl in October and to the high $70s in November.

Pressure was building up within OPEC. Clearly the market expected them to cut production. But at meetings amongst members, Al-Naimi said, "I don't think it's fair for us to defend prices just for the sake of defending prices. It will come at the expense of our market share." He added: "If we want to cut back then it has to be in collaboration with other non-OPEC producers who need to come to the table." Several meetings took place, but at a meeting between Saudi Arabia, Venezuela, Russia and Mexico, a couple of days ahead of the next OPEC meeting planned on Thanksgiving day, November 27, Al-Naimi took the blunt decision to say that "it looks like nobody can cut, so I think the meeting is over" and stood up to shake hands and left. Finally the market understood the new situation. Brent crude oil futures plunged 6.7% to $72.58/bbl immediately after the Thanksgiving 2014 meeting. In addition, the contango further deepened to more than $10/bbl twelve months out, and spot prices crashed to below $50/bbl early in January 2015. The oil-market events of the second half of 2014 are illustrated in Figure 1 on the next page.

Figure 1



Behind the weak fundamental backdrop as described above, financial flows probably had a hand in exacerbating moves in flat price and time spreads. Open positions on ICE Brent reached a record high in November 2014. Since the start of the first leg of the sell-off during the summer, the sharp decline in the net speculative length in the futures market likely contributed to oil prices being pressured lower. And with investors also piling into spreading positions, there was a risk of short-term volatility coming from length liquidation. Ultimately crude oil prices moved into a region where many of the put options purchased by producers had been struck in order to hedge their oil risk exposure. These put options are typically sold by financial houses (swap dealers) and other non-commercial traders to oil producers looking to hedge their exposure to declining oil prices. By selling a put, the non-commercial traders agree to take exposure to downside price risk, which they typically hedge by selling crude oil futures. The number of crude oil futures that must be sold to hedge a short position is called the "delta" of the short position, hence this risk management practice is known as delta-hedging. Importantly, the number of oil contracts that must be sold to hedge a short put position depends on the oil price. More specifically, as the price of crude oil falls, as it did on October 14, 2014, the delta of the short position increases, requiring more futures to be sold and thereby helping to push prices down, as discussed in Ngai (2014). That prices can be temporarily driven by purely technical effects such as the hedging of option deals is also described in Till and Eagleeye (2017). Many of the puts were concentrated around strikes of $70 to $85/bbl for West Texas Intermediate (WTI) oil (and went deep-in-the-money). Moreover, the sell-off in oil in the second half of 2014 was arguably driven largely by positioning (in the futures market) based upon expected fundamental shifts, as opposed to observable fundamental shifts. In other words, the market was trying to price in a more than 2 mb/d inventory build by the end of 1Q2015.

Many analysts evidently could not believe that such a rapid inventory buildup was likely and concluded that prices had likely overshot to the downside. More specifically, Citi analysts wrote at the end of 2014: "The era of $100/bbl oil is over. Citi's base case oil price scenario at $80/bbl Brent for 2015 and $85 for 2016 is slightly below the curve, but this assumes both some coordinated OPEC action and some deterioration in one of the many geopolitical hot spots around the world. The geopolitical backdrop remains troubling and is, we think, underpriced at the moment. If nothing 'bad' happens, and OPEC does not come together, then the outlook is decidedly bearish and Citi's bear case puts Brent at $65/bbl. Citi ascribes a probability of 45% to the base case, 40% to the bear case, and just 15% to the bull case which involves a material disruption to global supplies over and above the already severe levels priced into the market, in which case Citi sees prices rally to $90/bbl Brent, but Citi views this as a low probability outcome."

Likewise Barclays analysts wrote at the time: "OPEC's decision to leave targets unchanged ushers in a new phase for the global oil market. We believe that the fundamental oversupply will take up to a year to clear, but we are already a quarter into the price adjustment. OPEC crude supply is poised to increase by January, but the quality of its crude is shifting heavier. Non-OPEC supplies will be pushed further to respond, but U.S. tight oil will not be the only lever to adjust. Longer term, collateral damage will be found in Canadian Oil Sands and other non-OPEC supplies due to less drilling, more maintenance and project deferrals and cancellations. We expect prices to fall further, to $67 in 1H15, signaling an adjustment period that is likely to also include OPEC more closely adhering to the demand for its crude and U.S. tight oil producers cutting back spending. However, in contrast to 2008-09, oil demand does not face equivalent headwinds. Hence, non-OPEC supplies will likely adjust over the next six months, leading to prices of about $80 in 2H2015. Even OPEC supplies are involuntarily adjusting." Further, Goldman Sachs analysts concluded: "WTI oil prices are already at levels today equivalent to expected 1H2015 lows outlook. The price next year will depend on 2 factors: 1) whether in fact U.S. oil producers will have enough confidence in $70-75/bbl WTI oil to drive enough of a production response in 2H2015 and FY 2016; and 2) whether Organization for Economic Co-operation and Development (OECD) inventories build at a faster rate than currently foreseen (0.4 mb/d in 1H2015)." Finally, J.P. Morgan had a forecast of $82/bbl for 2015 and $87.75/bbl in 2016.

One might question how this optimistic picture could have persisted, given the ten-month-old signals from Saudi Arabia on not willing to continue accepting the swing producer role. Late in October 2014, most commodity desks still had a forecast of $85/bbl or more for Brent in 1H2015 and some even higher for 2016. There was still a strong belief that these sell-offs had far exceeded the actual weakening in fundamentals, and there was an expectation that OPEC would announce a modest cut at their November 27, 2014 meeting.

Why was the message of Saudi Arabia, which we had discussed at the outset of this article, not heard or accepted? In review, Minister Al-Naimi had already announced in December 2013 that "Saudi Arabia does not oppose cuts, but cuts have to be collective and burden shared. … Saudi Arabia will not cut output unilaterally." Thus, far before the fall in oil price, Saudi Arabia started sending clear signals regarding its intentions. At a *MEES* interview during that month, Al-Naimi added: "We (Saudi's) have learned our lesson. Every time we go for quotas, who bears the brunt? Us. We have learned our lesson. We are no longer the swing producer. Who needs quotas?" His comments appear to have

reflected a desire to cause long-term damage to high-cost production, most of which is in non-OPEC countries and which had been encroaching on OPEC market's share. Secondly, the oil minister was openly questioning why it would be reasonable to expect a highly efficient producer, i.e., Saudi Arabia, to reduce output. In contrast, the producers of poor efficiency oil, i.e., the "Most-Expensive Oil" category with breakeven prices of $75/bbl or higher such as (a) U.S. shale oil producers, (b) deepwater producers and (c) Canadian oil sand producers, would continue to produce. To Minister Al-Naimi, this may have not made sense, regardless of the fact that OPEC had followed this logic for decades with its oil production quota system and with the role of swing producer for Saudi Arabia. Apparently, his remarks presented too big a departure from the cartel's traditional policy of reducing supply to stabilize prices to have made an impact.

Looking back into the weekly bank analyst reports of that year, the *MEES* article was never mentioned. At best, it was seen as a tactical move, and the oil minister's message was not seen as a realistic perspective. There was a strong perception that OPEC (or rather, Saudi Arabia) would step in to stabilize prices. That understanding started to only break down early in October 2014 when the IEA cut demand forecasts, and Saudi policy started to show its colors by the lowering of Asian Official Selling Prices to maintain market share. Then came the OPEC meeting at the end of November and it became clear that Saudi Arabia was prioritizing market share, not price, and had given up its role as the central bank of oil. It was now a free for all, but the new situation was still not well understood.

2015

Without any production restraint, prices continued to drop. Since OPEC's November 27, 2014 meeting, attention completely shifted to the U.S. shale oil producers and their financiers: how quickly would they throttle back production due to low prices? U.S. producers were now considered as the major marginal supplier of oil instead of OPEC. Clearly, the fast growth of shale production in the U.S. had been disruptive. In fact, high and stable crude prices in combination with ultra-cheap money from Quantitative Easing had worked against both OPEC and the International Oil Companies (IOCs) by having encouraged competition from many small entrepreneurial oil companies. Only lower oil prices could stop this growth since presumably this would shut down financing for the more leveraged U.S. shale players and thereby arrest the roll out of the shale oil revolution. And indeed, shale producers were cutting their budgets early in 2015, but not enough to slow the decline in oil prices.

Meanwhile, too much oil – on average more than 1 mb/d – was produced relative to demand, and this surplus had to be stored in tanks and tankers. This caused a deep contango in the futures market. The steepest contango of -$6.5 a barrel for the 1-versus-7-month Brent futures spread was reached on February 13, 2015. But by the summer of 2015, many analysts expected that the market would begin to rebalance and inventories would begin to drain. Under that scenario, there would be a slow but gradual recovery in the oil price in 2016, back to the marginal cost of supply, which, in turn, was projected at $70/bbl. Markets were convinced that prices had to and would move back to this level in order to incentivize oil companies to take final investment decisions on new (and in many cases deferred) oil field developments. These decisions would be needed in order to keep their production from falling as a result of underlying field declines in their existing producing fields. Thus, while oil prices were revised down to $42/bbl Brent for 1Q2015 in January 2015, by 4Q2015 Brent was already set at $64.50 and

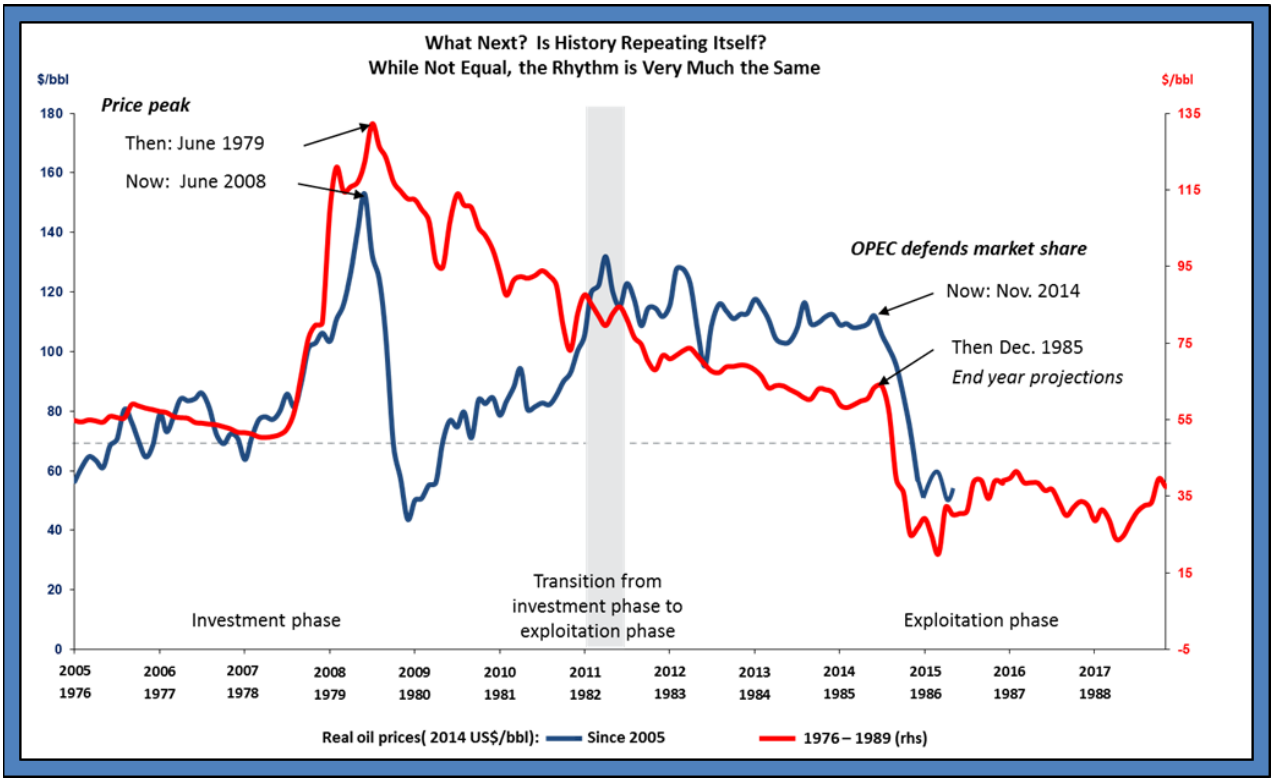
forecasted to be $70/bbl in 2016. Such forecasts relied on there not being a fundamental structural change in the oil markets, which turned out to be what was actually happening.

Quoting at the time from Jesse (2015b), "we [are] now witnessing [an] Oil (Price) Regime Change, the first one since 1982 when OPEC introduced a system of quotas, and Saudi Arabia subsequently decided in 1986 to defend market share (and raise production) … [to] halt non-OPEC supply growth and stimulate demand. Even today, the market has still not fully understood the message from Saudi Arabia in the past few months." In addition, we noted in Jesse (2015a) that the late 1990s period was a good proxy for comparing what we could expect in the coming years. Examining the shifts of the futures curve in the late 1990s when the price of oil dropped to $10/bbl, a stylized pattern in the sell-off and subsequent recovery of spot and long-dated oil prices emerges. When oil prices were trading at $26/bbl in January 1997, the oil futures curve was in a strong backwardation. A year later, prices dropped to $18/bbl as supply and demand factors became misaligned, and the futures curve turned into a mild contango. This was basically repeated between May and October 2014 when the sell-off took place in an orderly manner.

In the next phase of the analogy, in July 1998 the spot price sharply dropped to below $12/bbl, and the futures curve was pushed into an extremely deep contango. Importantly, falling spot prices, a futures curve in contango, and rising inventories are all symptoms of the same fundamental market weakness. Not much later, the back end of the curve also collapsed as long-dated prices began to fall. Even after spot prices had troughed, it would then take several quarters before supply and consumption would fully adjust. And indeed, it took the full following year to see a bit of a recovery with the curve still in contango. Only after the turn of the century did the curve trade in backwardation and oil prices started to rise. These market signals indicated a normalization of the oil market and an adjustment to a new equilibrium. At that time, it also introduced a new phase in the oil cycle, out of the "exploitation phase" of 1982-2001 and into the "investment phase" of 2001-2013.

A historical analogy, overlaying past oil market action with recent oil price trends, is illustrated in Figure 2 on the next page.

Figure 2



Graph based on Goldman Sachs Global Macro Research (2015).

The sharp drop in the U.S. oil rig count from a peak of 1,112 horizontal oil rigs to 800 between October 2014 and February 2015 triggered large rallies in oil prices. But this rig flexibility and associated cost deflation, along with both significant producer hedging that had occurred during these price rallies and the accompanying wave of equity issuance, raised the risk that the U.S. production slowdown would be delayed. Moreover, productivity gains were expected to accelerate in a lower price environment, as producers started to concentrate on drilling the most prolific resources only, while seeking to minimize costs through efficiency gains and lower services costs. Oil prices needed to remain lower in the coming quarters in order for the announced capital expenditure ("capex") guidance and rig reduction to materialize into sufficiently lower production growth. More precisely, as capital (available to U.S. shale producers) was the new margin of adjustment, oil prices had to remain lower for longer to keep capital sidelined and allow the rebalancing process to occur uninterrupted.

Outside the U.S., oil producers responded strongly to the fall in oil prices with the most aggressive capex cuts the industry had seen since the 1980s. In Jesse (2015a), we introduced the "Triple 20% Rule for Oil": a -20% reduction in capex spent by the international oil companies in 2015 and 2016; a -20% reduction in unit costs throughout the value chain, and at least 20% overcapacity in oil services equipment and manpower. The reactions to this prediction were fiercely negative, but in hindsight, this prediction was still too conservative. It was expected that these capex cuts would flow to production, with U.S. shale oil growth set to slow markedly in 2H2015. In addition, the lower spend in

predominantly mature offshore regions around the world and the cancelling of new projects was expected to increase the risk of rising decline rates and the emergence of a supply gap in the near future. However, just as U.S. activity was quick to respond to low oil prices, U.S. producers were increasingly primed for a recovery, which was seen as a likely cap on an oil price recovery. At the same time, warnings came out that U.S. inventories would continue to build at a rapid pace, and OECD inventories would also start to build over the coming months. And indeed, U.S. crude oil inventories had already increased by 100 million barrels to 490 million barrels by March 2015. But later in 2H2015, it was expected that this trend would gradually reverse as the market would reach a new normal. Indeed, in April 2015 it was expected that U.S. crude oil inventories would peak in that month followed by average monthly draws of about 350 thousand b/d during the summer. This was based on the Brent 24-month time spreads, which had substantially narrowed, and were pricing in a meaningful draw in inventories. In addition, producers' focus on high grading, productivity gains and shorter drilling times continued, leading to an expectation that while U.S. Lower-48 production would likely peak in April, it would start rising again before the end of the year with a 170 thousand b/d quarter-over-quarter gain in 4Q2015, and a 550 thousand b/d year-over-year gain in 2016. And indeed, the price rally derailed the market rebalancing. Higher prices settling above $60/bbl led U.S. producers to ramp up activity, drawing down a large well backlog and also to hedge, given improved returns with costs down by already 20%. Meanwhile OPEC announced after its June 2015 Ministerial meeting that it would maintain its 30 mb/d production target. The OPEC press conference, though, did not feature commitments for enforceability or country quotas (which had already been abandoned in 2011.) This decision was in line with market analysts' consensus expectations, with higher OPEC production forthcoming in the months ahead. In fact, analysts forecasted that Saudi Arabia and other low-cost producers would continue to increase output as this was seen as the next logical step for maximizing revenues in the face of shale oil's scalability.

A strong consensus was developing that OPEC should grow production to its capacity, as shale short-cycle production had created a competitive oil market where a cartel could no longer exist. Importantly, the oil market had already moved from the investment phase to the next exploitation phase due to (a) the return of "Cheap Oil" growth in Iraq in 2010 and Iran in 2015, (b) the giant "Medium-priced Oil" discoveries that were made offshore Brazil since 2007 and that were now being developed, and (c) the swift move from "Most Expensive Oil" U.S. shale oil to "Medium-priced Oil" category, having made all other "Most Expensive Oil" prospects obsolete. While the "Most Expensive Oil" developments drove the price to all-time highs in the 2000s, and allowed the low-cost Middle Eastern producers to constrain production growth in order to maximize value from high prices, this time the merit-order was prevailing. And as long as "Cheap Oil" and "Medium-priced Oil" could meet demand, there was no need to sanction and develop any of the "Most Expensive Oil" projects, and the marginal barrel would be determined where the new equilibrium was found. In 2015, this equilibrium was found in U.S. shale oil, which was effectively seen as the new swing producer and as was further explained in Till and Jesse (2016). This also left the major oil companies with a lot of "Most Expensive Oil" projects in their portfolios. They had no alternatives but (a) to cancel their most expensive developments not yet sanctioned, (b) to reengineer their slightly cheaper ones so that they would fall in the "Medium-priced Oil" category and could compete with U.S. shale, and (c) to sell and restructure their overall portfolios to raise money needed for their transition.

Moreover, given that the companies were hit hard by their legacy projects, built when oil prices were more than $100 per barrel, these majors – and actually the oil industry as a whole – were not earning their cost of capital. But commodity markets are not priced at legacy fixed costs; instead pricing is only about today's cost to bring on a marginal barrel. Hence, the major oil companies focused on restoring their balance sheets instead of sanctioning new projects. Only after balance sheet restoration is completed and return-on-average-capital-employed (ROACE) has materially improved, could one expect more activity in new oil production via the major oil companies. Meanwhile, these companies banked on production growth from fields that were sanctioned before 2014 and were still coming on-stream or were in the ramp-up phase. But even with this calculus, these legacy projects would be expected to eventually plateau in their oil production and would start showing declines, and a supply gap would thereby emerge. Taking this picture into account, since 2015 industry analysts have formed into two camps. One camp strongly believes that prices would move back again to $75 to $90/bbl before the turn of the decade. This view is based on the opinion that the severe capex cuts would create a gap that could not be filled by "Cheap Oil" from the Middle East and "Medium-priced Oil" from Brazil, U.S. and Russia alone. Simultaneously, bank analysts such as at Citi and Goldman Sachs led the other camp in 2015 with an oil price forecast for the remaining part of this decade set by the marginal cost of U.S. shale oil. So far, the latter scenario seems to have won out, but the former have not given up, perhaps only postponing their prediction date.

Besides the fundamental drivers as described above, it is also important to look to short-cycle price dynamics within the financial markets. One could argue that with the withdrawal of Saudi Arabia as the central bank of oil, price formation has become more short-term driven, erratic and unpredictable, having resulted in more self-defeating rallies and price cycles than ever. Moreover, it is important to note that shale oil operates at the margin of global oil supply and is highly sensitive to price. The interaction between physical and financial markets has also changed due to the arrival of shale oil, which in its current role is quite a dominant force. The financial world of oil is highly concentrated with a relatively small number of influential players, the majority based in the U.S. and not (well) known outside the oil trading community. This sensitivity (of shale producers to price) has translated into active positioning on NYMEX and ICE, the premier oil futures market for WTI and Brent respectively. In line with swings in positioning, oil prices moved up and down between the low $30s and low $60s in 2015.

In the last week of August 2015, one of the largest price spikes in recent years took place in a matter of days. Market players not only saw a further deterioration in fundamentals in the weeks before the spike, but were also decreasing their confidence in a quick rebound in prices and started to recognize that the rebalancing of supply and demand would likely prove to be far more difficult than was previously priced into the market. A lower-for-longer picture was emerging, with risks substantially skewed to the downside. Between the middle of June and end of August prices sharply dropped, first to $38/bbl, but then unexpectedly recovered to $49/bbl in the space of less than a week, before gyrating around the mid $40s in September, and later to further fall to the high $30s by year-end. At first sight, the jump of more than 27 percent in U.S. crude prices to $49/bbl in three trading days late in August could not be explained by fundamentals. Far more important was the unusually large concentration of short derivatives positions in U.S. crude held by hedge funds. Starting in the middle of June, hedge funds applied an increasingly bearish filter to market news, emphasizing bearish developments in supply

and demand while minimizing bullish ones. As more and more hedge funds established larger and larger short positions, prices fell, seeming to validate their bearish expectations. Large concentrations of hedge fund long or short positions have at times preceded a sharp reversal in prices, as also happened in March that year, when an unusual concentration of short positions preceded a sharp $18 rally.

Hedge funds and other money managers held short futures and options positions in the main U.S. crude markets equivalent to -157 million barrels of oil at the end of trading on Tuesday, August 25, two days before the rally began, and almost three times greater than had been the case two months previously, when they stood at just -56 million barrels. The number of hedge funds with reportable short positions stood at 61 with the average position at 2.6 million barrels. With so many hedge funds heavily committed to a strategy that relied on a further decline in prices, any factor that caused the market to start rising, however insignificant, had the potential to start a race to cover short positions. In a complex system, a small trigger can result in an outsized movement in prices through positive feedback and a cascade effect. And that was exactly what happened during the last week in August 2015.

In the latter part of 2015, it became increasingly clear that supply was still too strong due to U.S. productivity gains and legacy surprises, notably from regions such as Russia and the North Sea, with the biggest from OPEC, which was producing 2 mb/d above their 30 million target.

On the U.S. side, this all occurred despite the fact that production had started to fall as the rig count reduction started to bite. In April 2015, U.S. oil production reached its latest new peak of 9.4 million b/d (with the U.S. Lower-48 producing 7.5 mb/d). As a result, the expected inventory draw, foreseen for 2H2015 only a couple of months before, was no longer valid. Instead, analysts were seeing inventories building further out over 2H2015 and into 2016. The oil price forecasts were lowered to $40/bbl WTI for the next six months and $45 for the year on average, keeping financial pressure on producers and cutting off long-lead projects. And indeed, the path of price declines accelerated towards the end of 2015. Lower for even longer became a fact although the forecasts were still for $60 WTI for 2017. The global oil market had become heavily oversupplied as production was 3 mb/d higher than a year previous, with a market imbalance of more than 2 mb/d. This resulted in a rapid, and counter-seasonal stock build around the world, nudging in the direction of 450 million barrels of crude oil in the U.S. alone, and about 140 million barrels higher than the 10-year median. Likewise, OECD crude inventories had shown a substantial increase during 2015, growing to 1.2 trillion barrels. It became increasingly clear that there was no requirement for U.S. shale oil to grow until 2017. Only by then would supply and demand likely find a balance, but even that would not mean a sharp rebound in prices, as many other factors could weigh on prices. OPEC announced on December 4, 2015 that the cartel would aim to keep production near existing levels (31.8 mb/d), effectively setting aside its production ceiling of 30 million b/d, setting the stage for a further fall in oil prices in early 2016.

Conclusion

In Part 2 of this series, we will continue providing a historical record of the events and analyses of the oil markets, focusing on 2016 through the present. We will also summarize the results of a full field-by-field study for 72 oil producing countries, which JOSCO Energy Finance and Strategy Consultancy carried out in conjunction with The Netherland's Clingendael International Energy Programme. In addition, Part 2

will examine how long the new Oil Order may stay with us and will also provide insights on the key drivers that will plausibly determine oil prices in the 2020s.

In the meantime, the following is what we consider are the important factors for the oil market in 2018: (1) whether there will be a further decline in commercial crude inventories; (2) what the decisions are regarding extending the production cuts by ROPEC (Russia and OPEC) and the tapering thereof; (3) how aggressive U.S. shale producers will be in drilling new wells and bringing them into production; (4) how far U.S. shale producers will be allowed by investors and capital markets to spend beyond their means; (5) what will happen with cost inflation versus further efficiency improvements in 2018; (6) how influential the return of geopolitical risk will be in oil price formation; and (7) from a macroeconomic point of view, how rising interest rates might impact the state of the economy and the demand for oil. Altogether these factors have made the oil market even more fragile, both from a fundamental and from a financial and geopolitical point of view.

Endnote

This digest article is based on bank and industry research reports as well as analyses from the EIA and IEA.

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Mr. Jesse's involvement with the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School not only includes his membership in the Editorial Advisory Board of the *GCARD*, but also his participation in the JPMCC's Knowledge Exchange lecture series in 2016. Mr. Jesse previewed some of the work featured in this digest article during his talk at the JPMCC on "the strategic impact of shale and renewables and gaining confidence in higher oil prices."

Inferring Petroleum-Complex Fundamentals through Price-Relationship Data

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Introduction

This paper will discuss inferring crude-oil-market fundamentals through price-relationship data, largely through the perspective of a commodity futures trader. In doing so, the paper will briefly cover (1) the promise of big data; (2) the reality of data "black holes"; (3) the wealth of futures price data; (4) what

futures prices potentially reveal about petroleum-complex fundamentals; and (5) caveats on the use of price data.

The Promise of Big Data

After the 1970s energy crisis, the United States committed to a very "ambitious and comprehensive effort to collect detailed information on the production, processing, distribution and consumption of energy," as described by Kemp (2015). "The result is [that] the market has [very] good real-time data on what is happening to fuel supply and demand in the United States" via the U.S. Energy Information Administration (EIA), observed Kemp (2015). A further consequence is that there is a great deal of promise for the use of "big data" in the U.S. energy markets, whether it is for (1) algorithmic trading, (2) industry cost reduction, or (3) tapping the value of data embedded in the energy industry, as noted by Anderson (2017a).

The Reality of "Black Holes"

Emerging Markets

Even though there are a number of potential applications for big data in the U.S., one should also note the reality of "black holes" in emerging markets and even in some aspects of the petroleum-complex markets in the U.S. As pointed out by Kemp (2015), emerging markets accounted "for more than half of global oil demand for the first time in 2013 and 2014," so now most of the oil market is not transparent. As a result, the head of Citi's commodity research department, Ed Morse, stated in CFTC Talks (2017): with "emerging markets … [becoming] increasingly dominant in the international economy, we have more and more 'black holes'" in data coverage. For example, "China … has a lot of missing barrels, a lot of missing molecules, [and] a lot of missing tons of grains because their inventory [data] is a state secret. … So [data] black holes are getting larger and larger and impacting our understanding of [commodity] fundamentals," concluded Morse in CFTC Talks (2017).

Some Markets in the U.S.

But to be complete, not every physical market location in the U.S. has immediately available data. The following example is from Martin (2017) of J.P. Morgan Commodities Research. The August and September 2017 hurricanes "hit the Texas refining system hard." The "true impact" of refinery outages could not be immediately and directly understood because not all affected markets published data, so Martin (2017) noted that commodity researchers would be looking "at price signals as a guide for the underlying [crude oil and product] market dynamics." And that introduces the central concept of this paper: how oil-market traders and analysts have learned to make use of price-relationship data to attempt to infer petroleum-complex fundamentals.

The Wealth of Futures Price Data

Because we have such a wealth of futures price data, an analyst does not need to be a member of a cartel or a large corporation to gain insights into the oil market. Figure 1 on the next page provides a

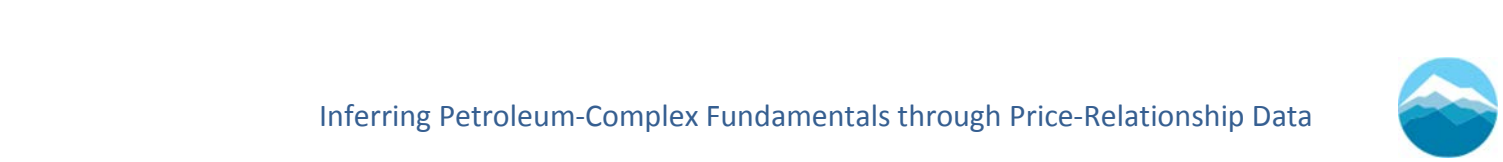
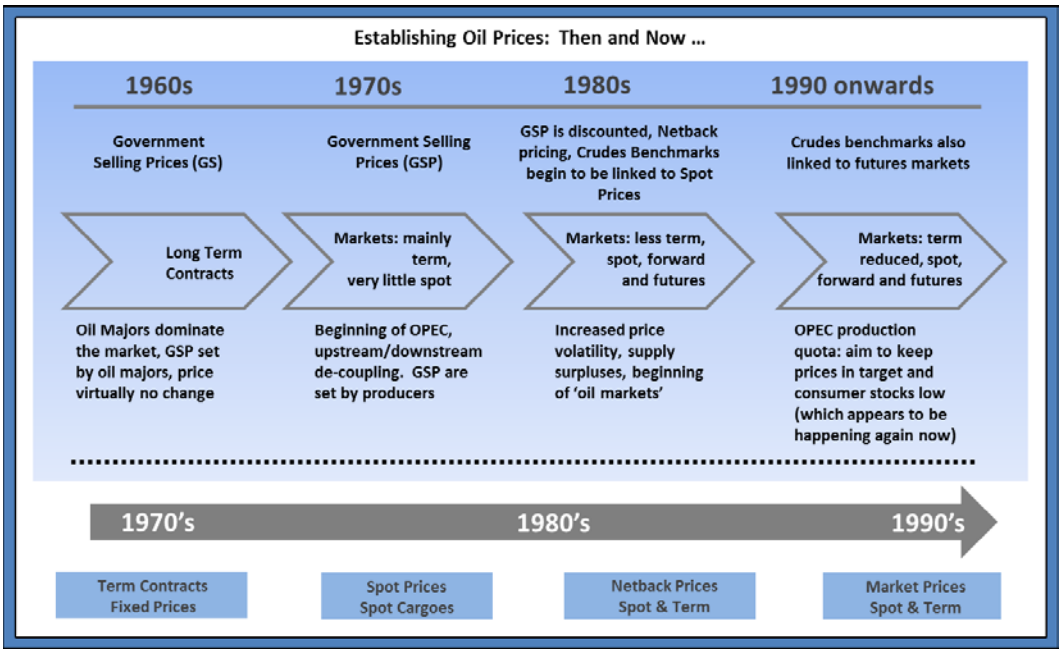


diagram on the evolution of pricing in the oil markets since the 1960s from long-term contracts to more spot-oriented market pricing, which enables us to potentially deduce market fundamentals.

Figure 1



Graphic Based on Tchilinguirian (2006), Slide 4.

Even when fundamental data on the oil markets are sparse or opaque, large-scale supply-and-demand shifts leave footprints in futures-price relationships, from which one can potentially infer the market's fundamentals (Till, 2008).

What Futures Prices Reveal about Petroleum-Complex Fundamentals

We will now launch into the heart of the paper, which is what price data can potentially reveal about petroleum-complex fundamentals. This section discusses how price relationships can (a) incentivize fundamental behavior; (b) drive fundamental behavior, (c) provide proxies for physical market information, (d) furnish an understanding of Chinese demand (through 2008), (e) signal how well domestic U.S. crude oil surplus was absorbed (from 2011 through 2013), and (f) indicate what the market's perception is of the marginal cost of production for crude oil.

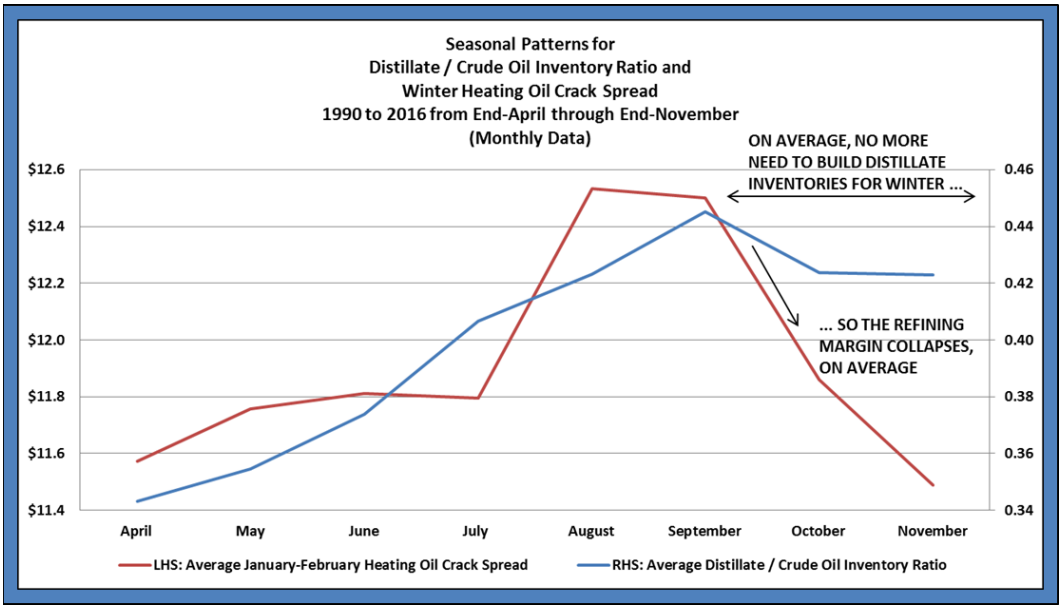
<u>Incentivizing Fundamental Behavior</u>

A futures trader interprets a commodity's price as part of a dynamic process. A commodity's price moves in whatever direction is needed in order to elicit a supply or demand response that will balance a commodity market. It may be useful to review the technical aspects of this interplay.

Building Distillate Inventories before Winter (1990 to 2016)

Figure 2 shows the typical seasonal pattern of building distillate inventories from April through the fall in the U.S. before the winter. In this graph, distillate inventories are represented as a fraction of the prevailing crude oil inventories. The graph illustrates that on average, once sufficient inventories are built, the winter heating oil crack spread collapses: there is no more need to incentivize the production of heating oil. For clarification, the heating oil crack spread is the difference between the price of heating oil and the price of crude oil and provides the profitability of refining crude oil into heating oil.

Figure 2
Building Distillate Inventories before Winter (1990 to 2016)



Source: Premia Research LLC.

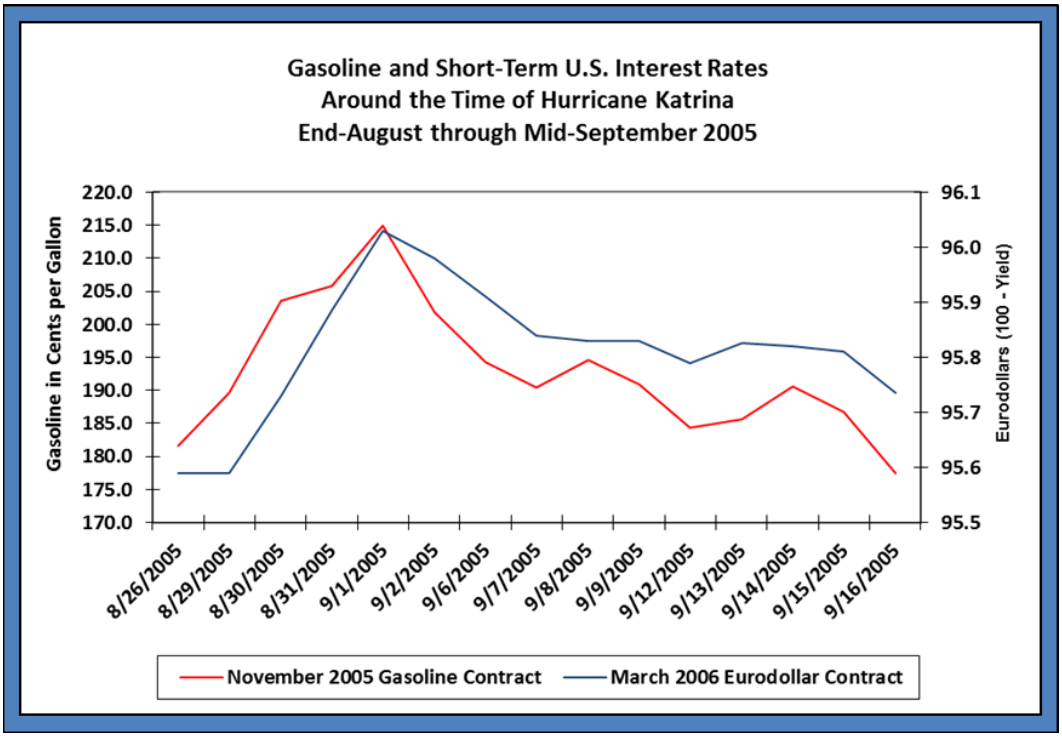
Data Source: The Bloomberg.

Notes on Data: Bloomberg ticker for EIA Distillate Inventory Data: "DOESDIST Index"; Bloomberg ticker for EIA Crude Oil Inventory Data: "DOESCRUD Index"; and definition of January-February Heating Oil Crack Spread: January Heating Oil contract price minus February WTI Crude Oil contract price in dollars per barrel.

Hurricane Katrina (2005)

One can also examine the aftermath of Hurricane Katrina in the United States in 2005 for another good example of the dynamic interplay between an oil product's price and its supply-and-demand situation. According to a 2005 *Dow Jones Newswire* report, "[Hurricane] Katrina shut in nearly all of oil and gas production in the Gulf of Mexico. The large scale supply disruption and fear of an economic shock triggered a massive [domestic and international] government[al] response." The dramatic governmental response caused gasoline prices to decline from their post-Katrina peak, as shown in Figure 3 on the next page.

Figure 3



Source: Premia Research LLC.

Data Source: The Bloomberg.

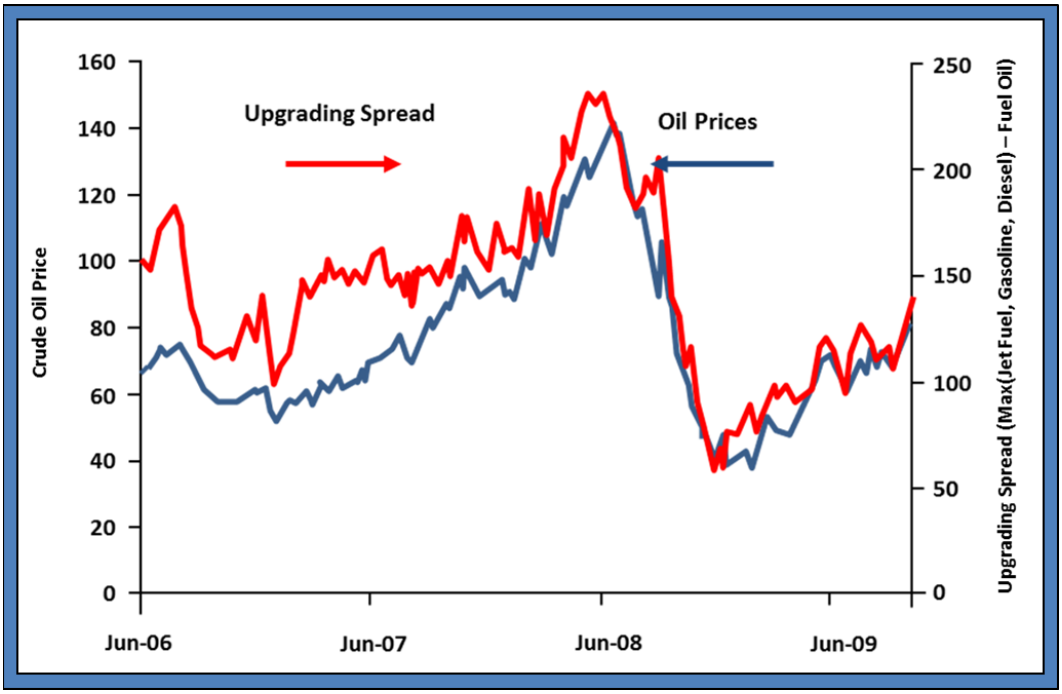
Further, and as also illustrated in Figure 3, with that response, fears of an economic slump diminished, which in turn caused deferred interest-rate contracts to decline, as the market resumed pricing in the expectation that the Federal Reserve Board could continue tightening interest rates at the time (Till, 2008).

Refinery Constraints (2008)

Another example of price incentivizing fundamental behavior is from 2007 through mid-2008. At that time, "refiners were using more marginal capacity and could not raise gasoline or diesel output without producing excess fuel oil," explained Ribeiro *et al.* (2009) of J.P. Morgan Global Asset Allocation & Alternative Investments Research. As the International Energy Agency (2006) had earlier noted, "[f]or refiners to run profitably, gasoline and diesel prices ha[d] to rise to offset the discounts needed to clear the fuel oil surplus and to encourage marginal refiners to process additional crude oil." This phenomenon became visible in the upgrading spread, which can be defined as the difference between the maximum price of transportation fuels and the price of fuel oil. When the upgrading spread widened as much as it did from 2007 to mid-2008, as shown on Figure 4 on the next page, analysts inferred that there was "a shortage of refinery capacity" and that there was "insufficient flexibility in the refining system to meet the demand for lighter products" that are used as transportation fuels, as stated in Ribeiro *et al.* (2009). When markets are tight, prices increase "to provide the right incentives for both

current production and future investment," as put forth by the J.P. Morgan researchers. And in fact, "the first half of 2009 [was to] represent … the first large increase in refinery capacity additions," observed Tchilinguirian (2008), having previously noted that "oil refining capacity [had] peaked in 1981" in Tchilinguirian (2006).

Figure 4
Oil Prices and the Upgrading Spread
June 2006 through October 2009
(Weekly Data)



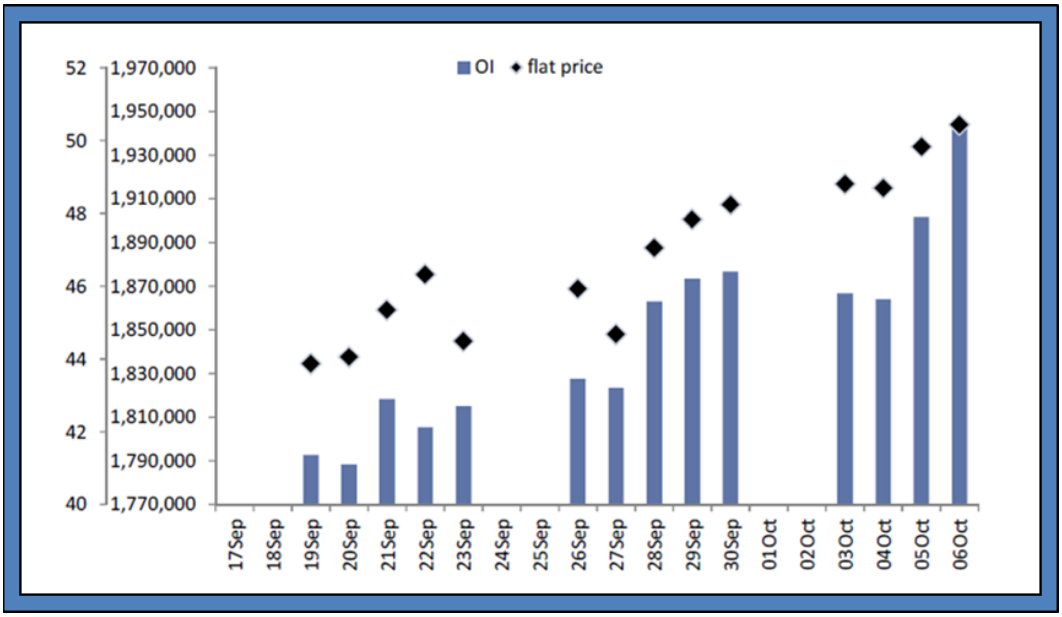
Source of Graph: Ribeiro *et al.* (2009), Chart 2.

Notes on Graph: the crude oil price on the left-hand-side of the graph is in dollars per barrel while the upgrading spread on the right-hand-side is in dollars per metric ton.

Driving Fundamental Behavior

Arguably, hedging opportunities became much more relevant in the crude oil markets with the shale oil revolution. Regarding shale oil, "from a financing perspective, the great bulk of the positive cash flows occurs early in each project's life. This is preferred from a general risk and discounting perspective, but also figures very importantly … [in] hedging efforts, as the oil [derivatives] market … offers liquidity only out about 2 to 3 years or so. So there's a [good] … match between forward market liquidity and the shale oil production profile," as explained by Anderson in Till and Jesse (2016). As a result, one can monitor when there is a sharp pick-up in hedging activity, as shown in Figure 5 on the next page, which would be expected to translate into U.S. rig count additions under this analysis.

Figure 5
Open Interest in West Texas Intermediate (WTI) Oil (LHS, in Contracts) and WTI Flat Price (in $/bbl)



Source of Chart: Goldman Sachs Equity Research (2016), Exhibit 19.

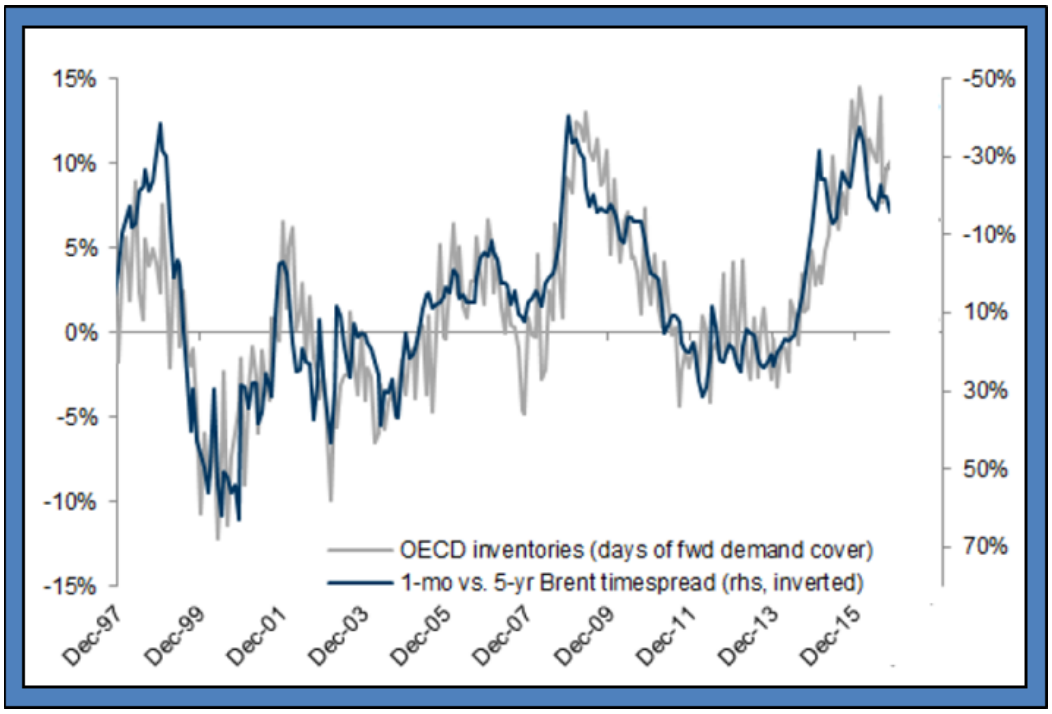
Authors' Data Source: The Bloomberg.

Proxying the Physical Market with Futures Spreads

Example from 1997 to 2016

One can also potentially infer aspects of the physical oil market by examining the level of futures calendar spreads. A "calendar spread" consists of taking offsetting positions during the different delivery months of a particular futures contract. There is a considerable amount of evidence that one can proxy the amount of crude oil commercial inventories, at least in Organization for Economic Co-operation and Development (OECD) countries, by reference to the level of crude oil futures spreads. As explained by Longson and Volynsky (2015), "Prompt [term] structure can be a good real-time proxy for the physical [oil] market, and the data proves that out." For example, one can see the direct relationship between OECD commercials stocks and the 1-month-to-5-year ICE Brent crude oil spread in Figure 6 on the next page.

Figure 6
Inventories vs. Brent Time Spreads



Graph Excerpted from Goldman Sachs Commodity Research (2016), Exhibit 7.

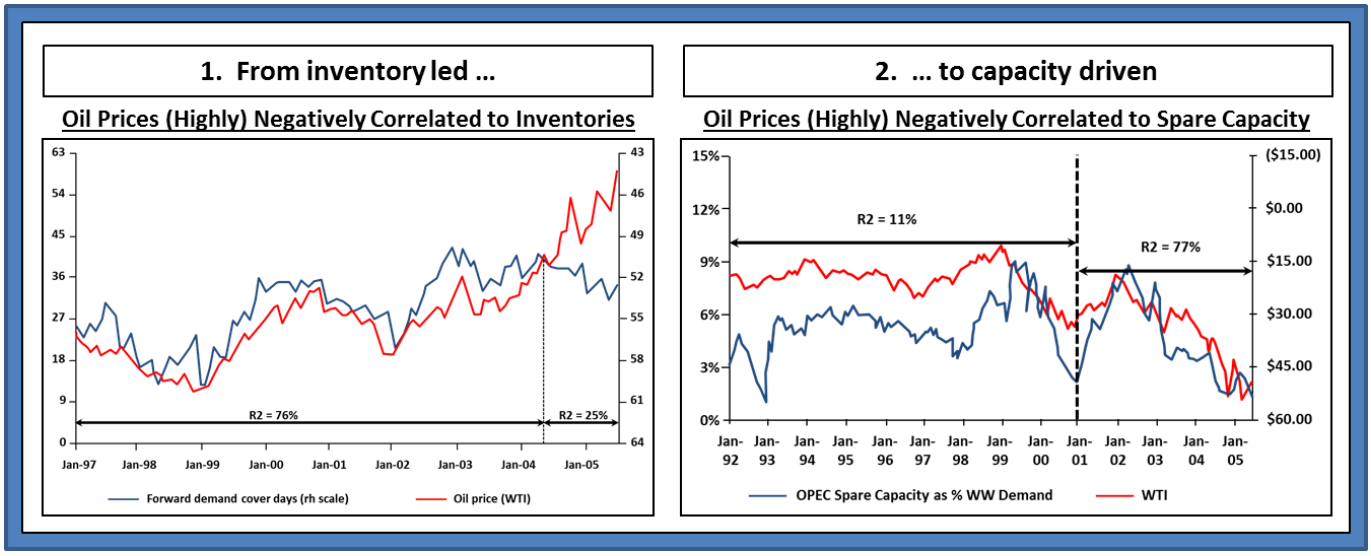
Authors' Data Source: International Energy Agency and Goldman Sachs Global Investment Research.

Notes on Graph: OECD Commercial Stocks (Excluding U.S. NGLs) in Days of OECD Demand Coverage vs. 3-Year Average (LHS) vs. 1-Month to 5-Year Brent Time Spreads (%, RHS, Inverted).

Caveat: Inventories are Only Part of the Picture

There are several caveats on the importance of inventory-related data. The previous figure showed a contemporaneous relationship between futures spreads and inventory data. The historical relationship of inventory data to the outright price of crude oil can be a bit more complicated, which is illustrated in Figure 7 on the next page.

Figure 7



Graphs Excerpted from Hicks and Smith (2006), Slide 5.

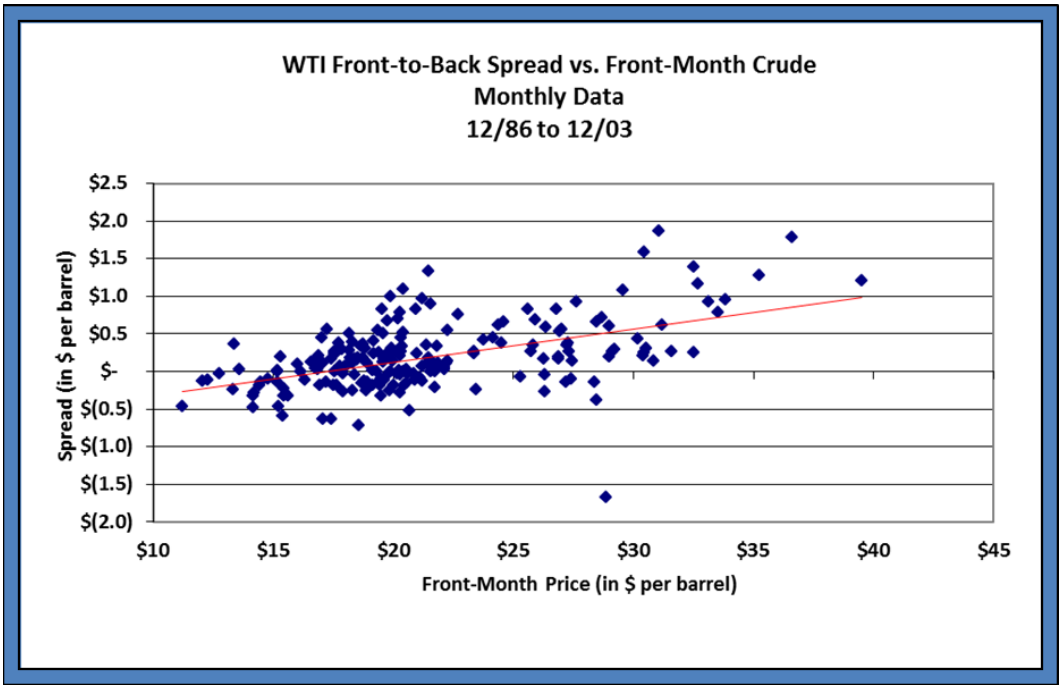
Authors' Data Sources: Smith Barney, Bloomberg, and CIR.

On the left-hand-side graph of Figure 7, we can see that the price of oil had been highly negatively correlated to the OECD inventory situation before OPEC spare capacity started becoming an issue in 2004. At that point, the outright price of oil and oil inventories were not very correlated from mid-2004 through the end of 2005. The left-hand-side graph represents OECD industry oil stocks in terms of the number of days covering forward demand. The right-hand-side graph of Figure 7 completes the picture. Once OPEC spare capacity started becoming under pressure, oil prices became highly negatively correlated to spare capacity as a percentage of worldwide (WW) demand. These two graphs are meant to illustrate that inventories are only part of the picture in examining the drivers for the outright price of oil. When OPEC spare capacity had become low, inventories were no longer a significant driver of price, a point covered in Till (2016).

Additional Caveat: Spare Capacity Has Mattered in Interpreting the Oil Futures Curve Shape

Figures 8 and 9 on the next two pages show that the interpretation of the crude oil futures curve has depended on the spare capacity situation.

Figure 8



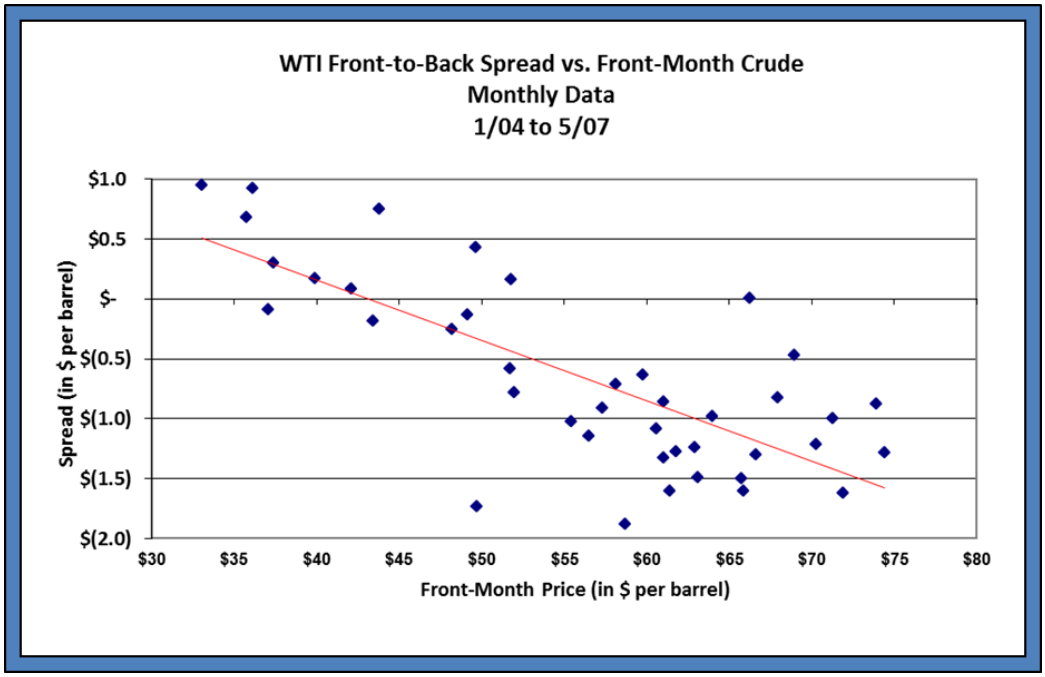
Source: Premia Research LLC.

Data Source: The Bloomberg.

Prior to 2004, if there were scarcity in the crude-oil market, one could expect two outcomes: (1) increasing spot prices; and (2) for the front-month price to trade at an ever larger premium to deferred-delivery contracts. In this state-of-the-world, the market would be encouraging the commodity's immediate use rather than for it to be stored. In this case, the outright price of oil and the front-to-back spread were highly positively correlated, as illustrated in Figure 8. During 2004, OPEC's immediately-deliverable spare capacity collapsed.

When there has been inadequate spare capacity, a futures curve has needed to provide a return for storage since there would be a pressing need to incentivize precautionary stockholdings in oil. In this state-of-the-world, the prompt futures price has traded at ever more of a discount to provide a sufficient return for storage, and the spot price of oil has increased to encourage consumer conservation. In this case, the outright price of oil and the front-to-back spread have been highly negatively correlated as illustrated in Figure 9 on the next page.

Figure 9



Source: Premia Research LLC.

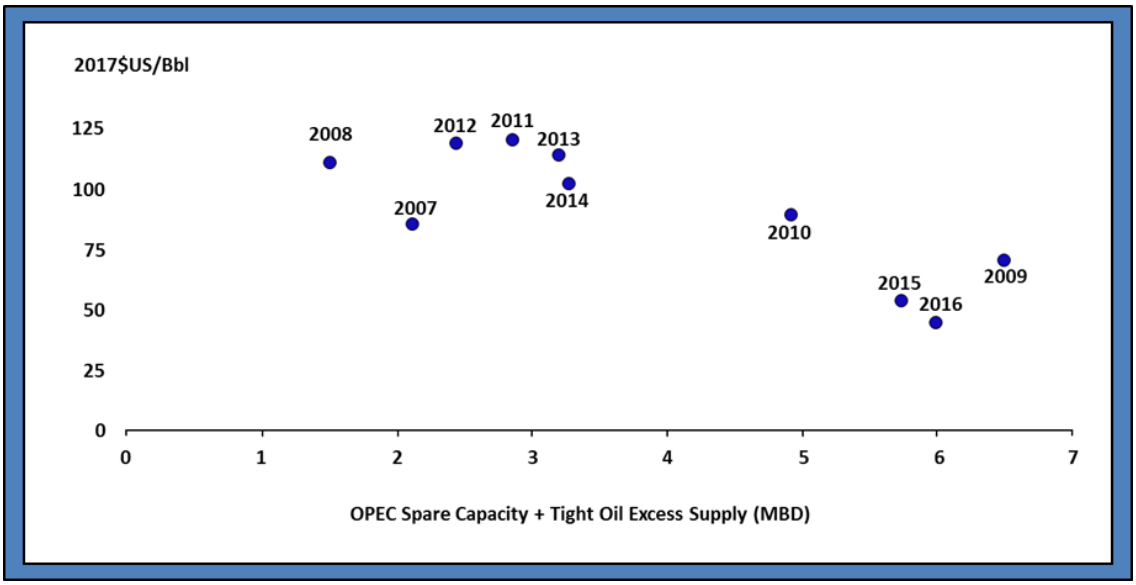
Data Source: The Bloomberg.

Eventually a demand-destroying oil price spike occurred in 2008 at low levels of OPEC spare capacity, followed by a dramatic drop in the price of oil. With the demand destruction that occurred as a result of the price spike, OPEC spare capacity recovered.

A Further Caveat on Spare Capacity

One should note that an analyst now needs to also include U.S. tight oil excess supply and not just OPEC spare capacity, as shown in Figure 10 on the next page, in considering spare productive capacity.

Figure 10
Brent Crude Oil Prices and Spare Productive Capacity (2007 to 2016)



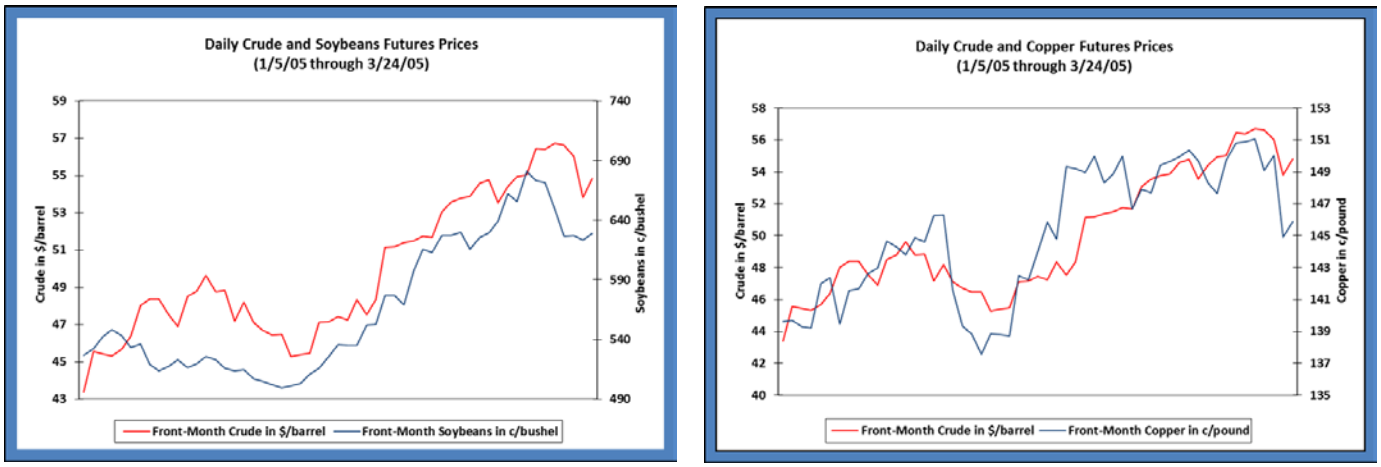
Graph Excerpted from Foreman (2017), Slide 6.

But again, regarding outright prices, as long as surplus capacity has not approached pinch-point levels, inventories have been an important driver of the price of oil.

Understanding Chinese Demand (Through 2008)

Oil futures traders first became aware of *not* solely relying on OECD data to make predictions on the direction of oil-price relationships in 2005. It was at that time that the potential impact of temporarily-concentrated Chinese demand started to reveal itself through various futures-price relationships. Figure 11 on the next page provided an early indication of the structural changes to come in the commodity markets, and particularly, in the oil markets.

Figure 11
Common Waxing and Waning of Commodity Prices around the Chinese New Year's Holiday in 2005



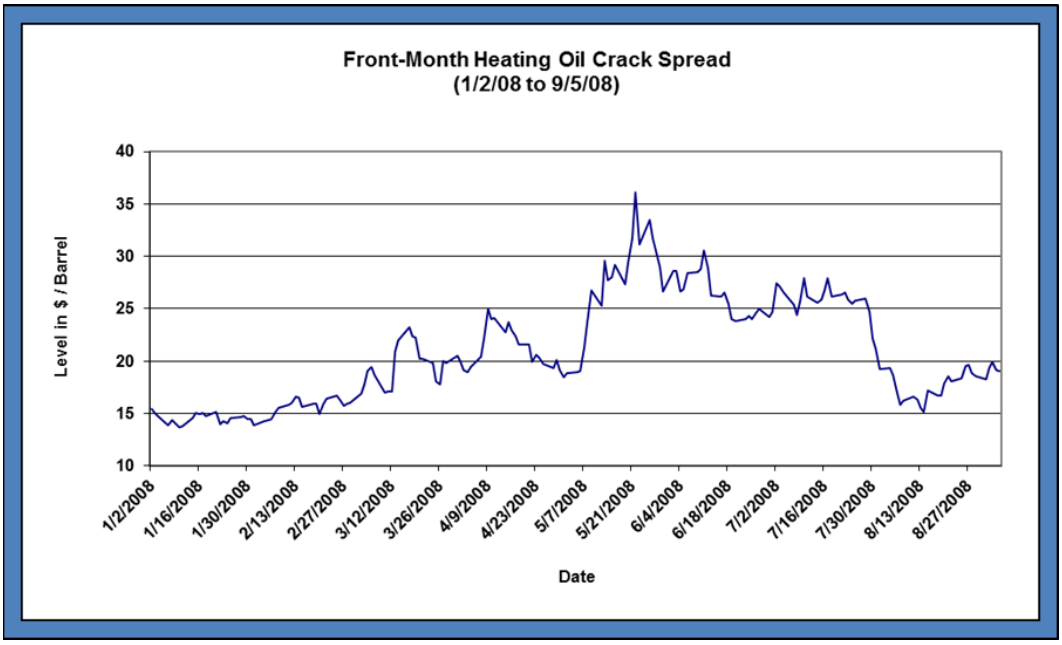
Source of Graph: Till (2008), Figure 8.

Data Source: The Bloomberg.

In this graph, we see a common waxing and waning of prices in crude oil, soybeans, and copper coincident with the Chinese New Year's holiday in 2005, presumably when Chinese demand was temporarily absent. This factor appeared to overwhelm any other factor in these three markets. Stein (2005) wrote that 2005 marked the "first business cycle where Chinese demand is having a global effect on prices, notably of energy and other raw materials."

Later, in the summer of 2008, the heating-oil crack spread indicated extraordinary demand for middle distillates, as shown on the next page in Figure 12. There were no severe weather events, supply disruptions, or large-scale trading blowups in the U.S. or Europe at the time, so it was not immediately apparent why this spread should spike so extraordinarily.

Figure 12



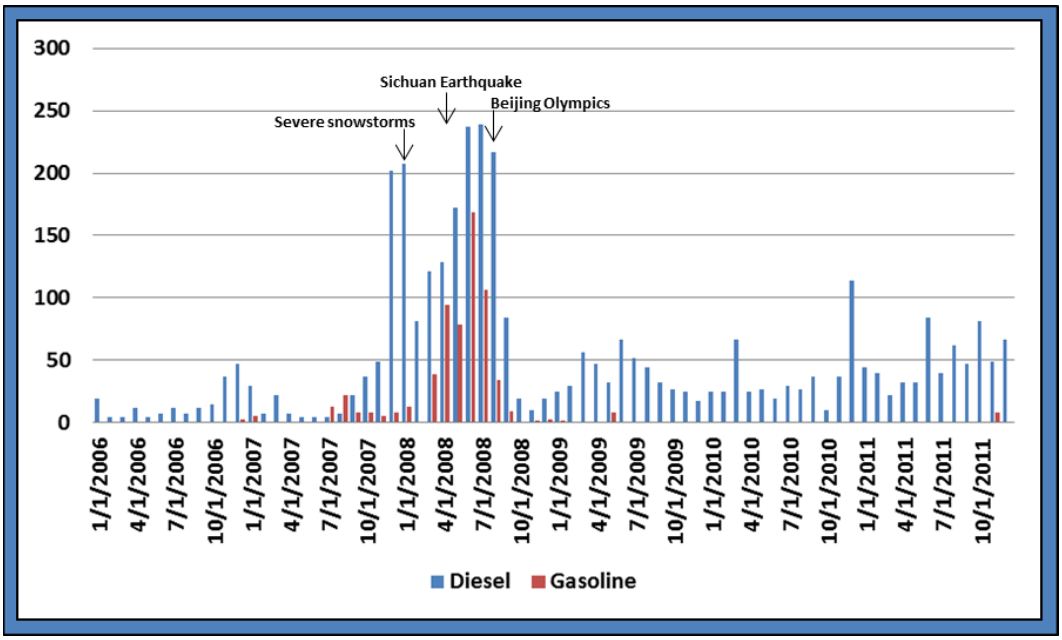
Source of Graph: Till (2008), Figure 13.

Data Source: The Bloomberg.

That is, except for news from China, including the devastating earthquake in China, which damaged power-supply grids, and also pre-Olympic petroleum-product stocking in order to ensure that there would be no shortages during the historic Beijing Olympics. These were amongst the key events in China that drove a spike in diesel and gasoline imports.

In Figure 13 on the next page, one can note that the spike in demand for refined product imports is consistent with the spike in the heating oil crack spread in Figure 12.

Figure 13
Chinese Gasoline and Diesel Imports Surged in 2008 Due to a Number of Key Events in China (Thousands of Barrels per Day)



Graph Based on Fenton (2012), Slide 24.

Data Source: China Customs General Administration and The Bloomberg.

Notes on Data: Bloomberg ticker for Diesel imports: CNIVDF <Index>; Bloomberg ticker for Gasoline imports: CNIVGSOL <Index>. Bloomberg data was converted from monthly tonnes to barrels per day using the CME Group's Conversion Calculator, which was accessed at: http://www.cmegroup.com/tools-information/calc_refined.html on November 27, 2017.

As discussed in the *Financial Times*' Alphaville section (2013), "[i]n oil market analyses, it is essential that refined products are also taken into account, as it is misleading to solely look at crude prices, crude inventory, and crude supply … in isolation," which we can also conclude from this article's earlier section on upgrading spreads. One should also add that we are now in a different market environment than in 2008; since that time, there have been both additions in refinery capacity and a surplus in light sweet crude oil from the post-shale environment. Therefore, the type of dramatic price impact discussed in this section, resulting from a Chinese product import surge, is currently unlikely.

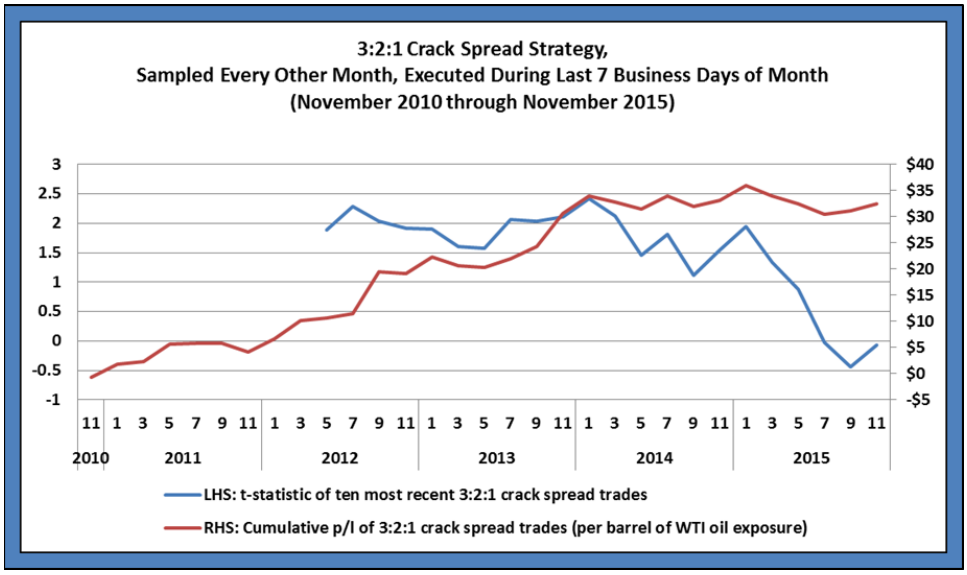
In understanding past Chinese-related demand through price signals, one can also draw from Kaufmann and Ullman (2009). These researchers investigated "where changes in the price of crude oil originate and how they spread …" Their paper did so "by examining causal relationships among prices for crude oils from North America, Europe, Africa, and the Middle East." The authors looked into where "innovations in world oil prices enter the market," using price data from a variety of grades of oil from both OPEC and non-OPEC nations from 1987 through March 2008. One of their results was that the spot price for Dubai-Fateh oil had been a "'gateway' for innovations to crude oil prices." "A large fraction of

the crude oil shipped to Asian nations from the Middle East (more than 10 … [million barrels per day]) uses the spot price for Dubai-Fateh as a benchmark … As such, innovations in the spot price for Dubai-Fateh may [have] reflect[ed] increasing demand [over time] in Asia," inferred Kaufmann and Ullman (2009).

Managing the Domestic U.S. Crude Oil Surplus (2011 through 2013)

At the end of 2013, alert futures traders had an early signal that, as phrased by J.P. Morgan Commodity Research (2013), "the boom in … [domestic oil] production ha[d] been well absorbed by existing U.S. infrastructure." Refinery margins no longer needed to consistently rally at the end of each month to provide an extraordinary return for transporting domestic crude oil, in whatever way possible, to U.S. refineries. This observation is illustrated in Figure 14, which shows the degradation in performance of a bullish refining-margin trading strategy, starting in late 2013. This graph displays the cumulative performance of entering into futures spread trades that represented near-month refinery margins from the end of 2010 through the end of 2015.

Figure 14



Source of Graph: Premia Research LLC.

Data Source: The Bloomberg.

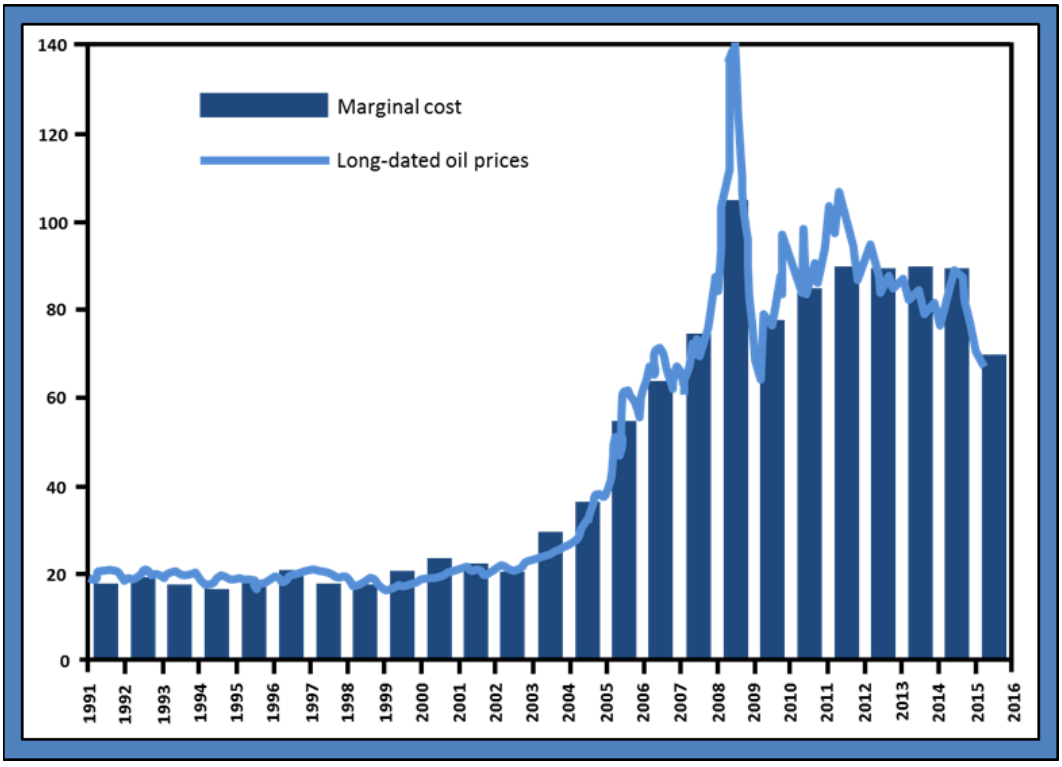
Notes on Graph: "A 3:2:1 crack spread reflects gasoline and distillate production revenues from the U.S. refining industry, which generally produces roughly 2 barrels of gasoline for every barrel of distillate. The 3:2:1 crack spread is calculated by subtracting the price of 3 barrels of oil from the price of 2 barrels of gasoline and 1 barrel of distillate," as noted in https://www.eia.gov/todayinenergy/detail.php?id=1630, accessed on October 12, 2017. Here, the 3:2:1 crack spread was calculated using these proportions, but then the total was divided by 3, thereby expressing the spread as per one barrel of crude oil. Further, the spread was calculated with the gasoline and heating oil nearby futures contracts and also with the WTI crude oil second nearby futures contract.

Figure 14 specifically shows (a) how the cumulative performance of the bullish refining-margin strategy leveled off at the end of 2013, and (b) how, as of the end of 2013, the rolling t-statistic for this trade began falling off. At that time, the markets no longer needed to incentivize extraordinary profits for transporting and refining burgeoning domestic crude oil supplies.

The Marginal Cost of Production for Crude Oil

As a final note on what futures prices can potentially reveal about petroleum-complex fundamentals, Figure 15 illustrates the market's perception of the then-current marginal cost of oil production: through the examination of the five-year futures price. Explained Goldman Sachs Economic Research (2015): "[T]he long-dated commodity price … [is usually] a reflection of [a] … commodit[y's] marginal cost of production …"

Figure 15
Marginal Cost (Defined as the Average of the Highest Cost (or Bottom Quartile) Producers) vs. 5-Year WTI Futures Price in $/Bbl



Source of Graph: Goldman Sachs Economic Research (2015), Exhibit 2.

Anderson (2017b), though, cautions that one should perform a more precise analysis of long-run variable costs than simply inspecting five-year forward market prices.

Caveats on the Use of Price Data

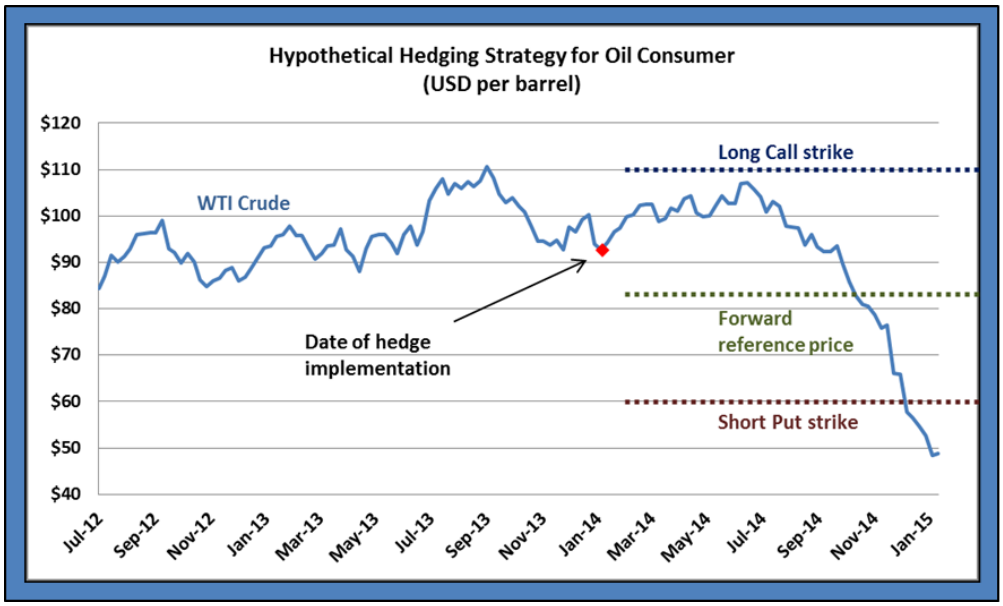
This paper will conclude with some caveats on the use of price data, namely that prices can be driven by purely technical effects and that forward prices are not predictions.

Purely Technical Effects

Dynamic Hedging

One purely technical effect is the temporary impact on futures prices from the hedging of option deals. Figure 16 illustrates a hypothetical hedging strategy of an oil consumer (like an airline) buying an out-of-the-money call option, financed by selling an out-of-the-money put option in 2014. As the price of oil became closer to the put option strike, the consumer may have decided to close out this hedge.

Figure 16



Source of Graph: Cembalest (2015).

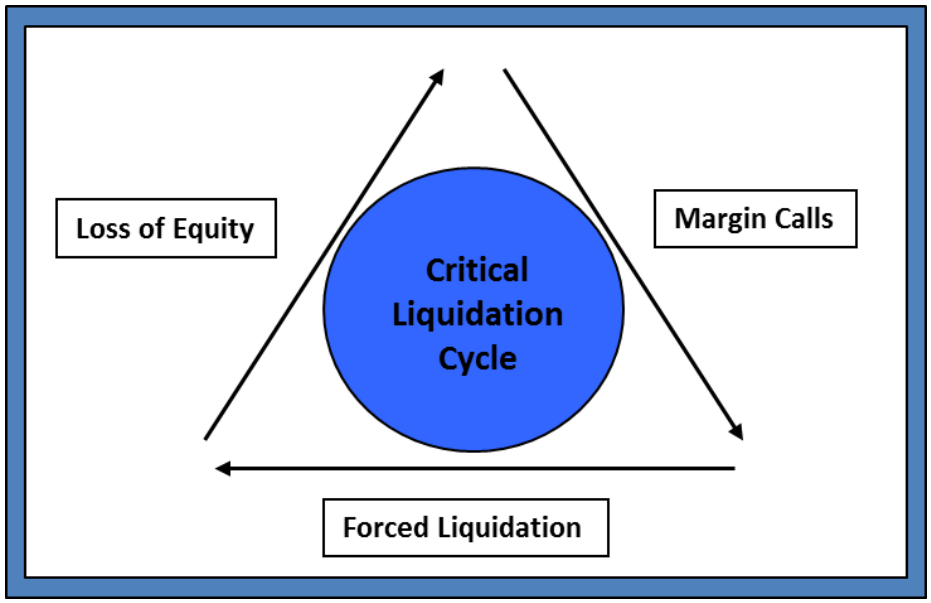
Cembalest (2015) wrote that "the speed and magnitude of the oil price decline [in the fall of 2014] [reflected] the impact of hedging unwinds." At the time, "Wall Street banks … scrambled … to neutralize their exposure to big oil options trades, adding to the downward spiral in crude prices as they s[old] futures contracts to offset options deals that … [became] unexpectedly in the money," as reported by Ngai (2014).

Liquidation Pressure

Another purely technical factor is the temporary effect of liquidation pressure. Futures traders are aware that when traders have to liquidate large positions that this can be a temporary, but meaningful,

driver of price. Figure 17 illustrates how a highly leveraged fund can enter into a "critical liquidation cycle," whereby once a fund crosses a threshold of losses, a cycle of investor redemptions can occur and/or the fund's credit providers may demand the reduction of leverage, and the value of a fund's holdings would thereby decline precipitously as the fund would sell off holdings in a distressed fashion.

Figure 17
Critical Liquidation Cycle



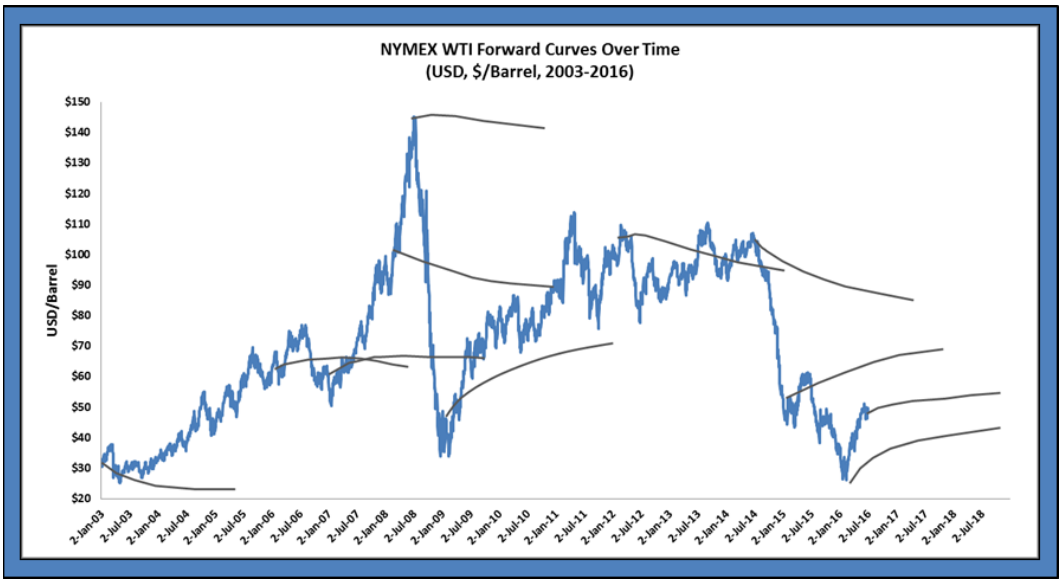
Source of Graph: de Souza and Smirnov (2004).

Both of the technical factors mentioned in this section can cause a temporary overshooting of prices.

Not Predictions

Finally, a futures market is not a forecasting agency; it facilitates risk sharing and the efficient allocation of resources. To expect futures prices to only reflect predictions of future prices ignores its other functions. Figure 18 on the next page shows how the "forward curve [for oil has] not [been] a good price predictor, but still functions well for hedging storage costs and requirements," citing a Center for Strategic and International Studies (CSIS) presentation.

Figure 18
Nymex WTI Forward Curves over Time Overlaid Against Crude Oil Front-Month Futures Price Realizations



Source of Chart: CSIS and Citi Research.

Conclusion

Instead of asking whether the fundamentals justify the oil price, this paper adopted the view of a veteran oil futures trader and asked the opposite question: what is the price telling me about fundamentals? The reason for this outlook is as follows: the market imposes sufficient discipline to prevent a trader from ignoring price except for a very short space of time!

Endnotes

Ms. Hilary Till, the co-author of this article, presented this paper at the 7th International Trading Conference, which was co-organized by the Ulsan National Institute of Science and Technology (UNIST) in South Korea on October 24, 2017. Research assistance from Katherine Farren, CAIA, of Premia Risk Consultancy, Inc. is gratefully acknowledged. The paper also benefitted from helpful research from Hendrik Schwarz and Jan-Hein Jesse. Please note, though, that the ideas and opinions expressed in this article are the sole responsibility of the authors.

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Hilary Till is also a principal of Premia Research LLC, which designs investment indices that are calculated by S&P Dow Jones Indices. Prior to Premia, Ms. Till was the Chief of Derivatives Strategies at Putnam Investments where she oversaw the strategy development and execution of about $90 billion annually in exchange-traded and over-the-counter derivatives; and before Putnam, Ms. Till was a Quantitative Analyst at the Harvard Management Company, the university's endowment firm. Ms. Till's additional academic affiliations include her membership in the North American Advisory Board of the London School of Economics and her position as a Research Associate at the EDHEC-Risk Institute (France.)

In Chicago, Ms. Till is a member of the Federal Reserve Bank of Chicago's Working Group on Financial Markets and serves on the Advisory Board of DePaul University's Arditti Center for Risk Management. She also has provided seminars (in Chicago) to staff from the Shanghai Futures Exchange, China Financial Futures Exchange, Zhengzhou Commodity Exchange, and the Dalian Commodity Exchange. In addition, Ms. Till is a board member of the International Association for Quantitative Finance (New York).

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Previously, Mr. Eagleeye was a senior derivatives strategist at Putnam Investments. While at Putnam, Mr. Eagleeye researched, back-tested and implemented systematic, relative-value derivative strategies, which spanned the bond and commodity markets, as well as co-managing Putnam's institutional commodity program. Prior to joining Putnam Investments, Mr. Eagleeye developed programmed trading applications for Morgan Stanley's Equity Division.

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Mr. Eagleeye has presented at the following industry conferences: *Financial News*' "The Next Generation of Commodity Investment: A Strategic Conference for Active Investors" (in London); the World Research Group's "Performance Attribution" conference (in New York City); the Chicago exchanges' "Annual Risk Management Conference" (in Huntington Beach, California); and at Terrapinn's "Commodities Week – MENA" conference (in Dubai).

Mr. Eagleeye holds a B.S. in Applied Mathematics from Yale University and an MBA from the University of California at Berkeley.

U.S. Haynesville Shale Gas Production

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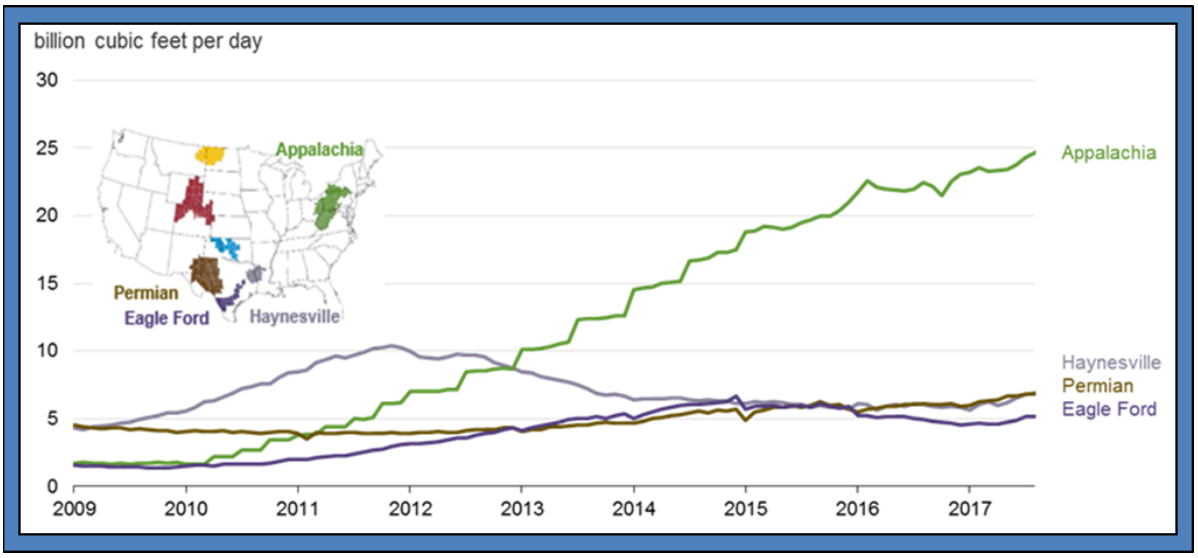
Senior Economist, U.S. Energy Information Administration

In this article, we provide an update on the fortunes of the U.S. Haynesville shale region, which is amongst the top four natural gas production areas in the U.S., as shown in Figure 1 on the next page. The Haynesville Formation is in northwest Louisiana and eastern Texas.

Mr. Faouzi Aloulou of the EIA, addressing members of the Energy Equipment and Infrastructure Alliance, in Washington, DC on September 20, 2016 regarding the response of U.S. shale gas and tight oil production to both changes in prices and the completion of drilled-but-uncompleted (DUC) wells. Ms. Danya Murali of the EIA, who assisted with this article, is in the center of the photo.

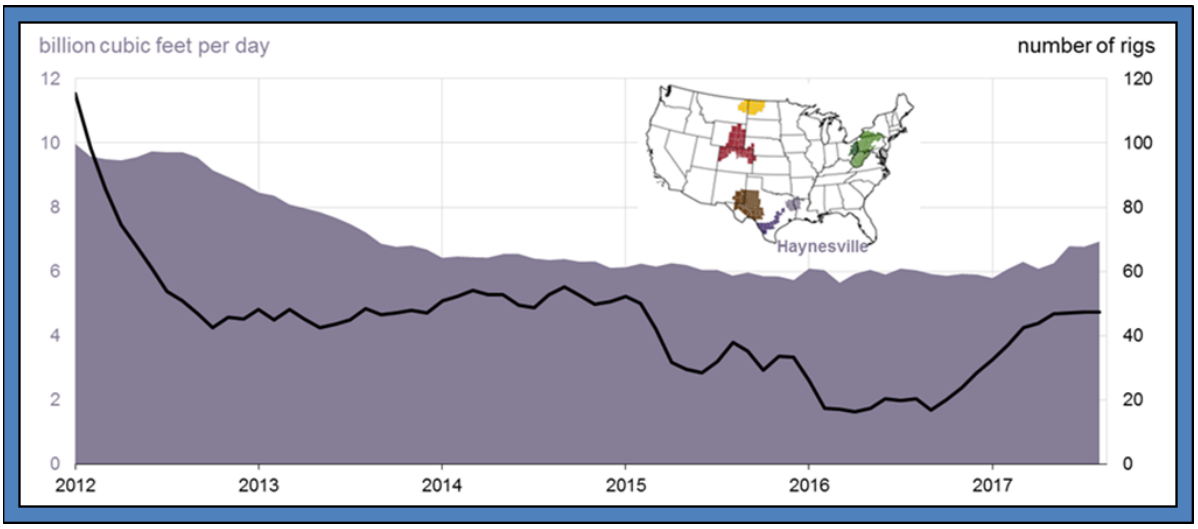
Recent increases in drilling activity and well production rates are raising natural gas production levels in the Haynesville region, according to EIA (2017a), and as shown in Figure 2 on the next page. Marketed natural gas production in Haynesville reached 6.9 billion cubic feet per day (Bcf/d) in September after remaining near 6.0 Bcf/d for the previous three years. The recent growth in Haynesville natural gas production is attributable to an increase in the number of active drilling rigs (starting late in 2016) and a trend toward higher per-well initial production rates.

Figure 1
Marketed Natural Gas Production in the Top 4 U.S. Production Regions



Source: U.S. Energy Information Administration (2017a).

Figure 2
Haynesville Marketed Natural Gas Production and Active Rig Count (January 2012 – August 2017)



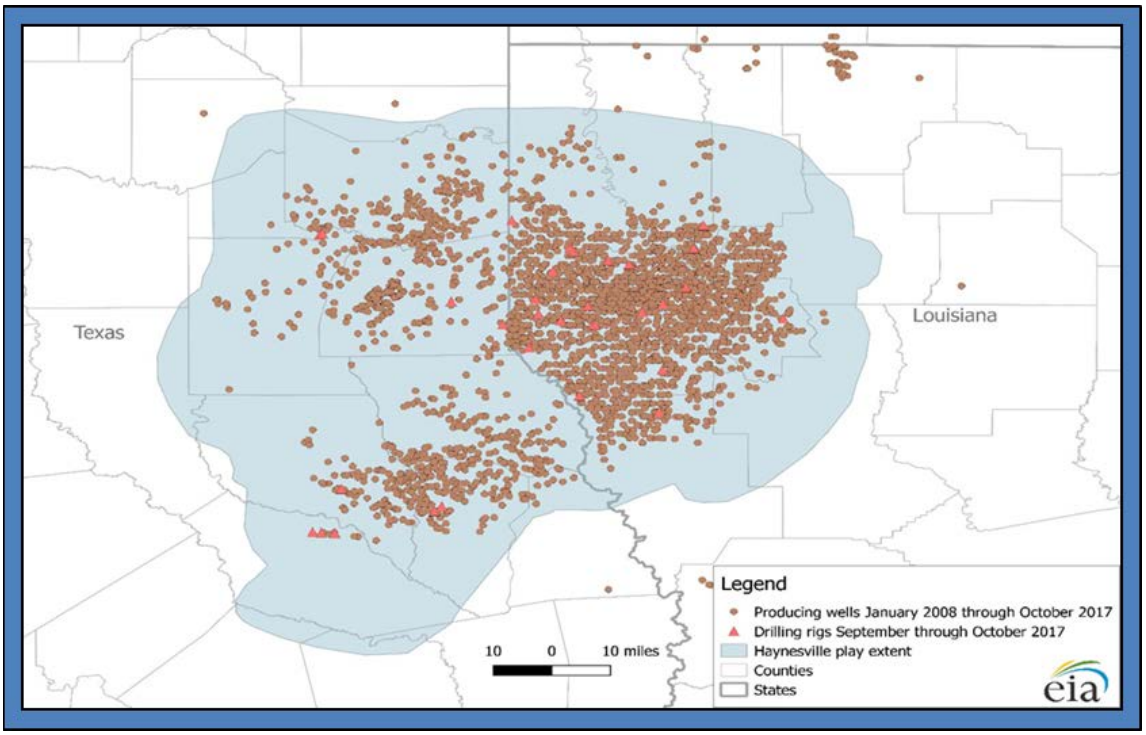
Sources: U.S. Energy Information Administration (2017a) and Baker Hughes.

In USGS (2017), the United States Geological Survey estimates that the Haynesville shale play holds 174.6 trillion cubic feet of technically recoverable shale gas resources, the second-largest level in the United States after the Appalachia region. Compared with Appalachian resources, Haynesville natural gas reservoirs are farther underground. Most Haynesville producing wells are in areas where the formations have depths ranging from 10,000 feet to 14,000 feet below sea level. In the Appalachian

region, wells are in areas where formations are 2,000 feet to 12,000 feet below sea level. Haynesville shale formation thickness is also slightly narrower, ranging from 100 feet to 350 feet, compared with Appalachia, where shale thickness ranges from 50 feet to 400 feet.

From 2009 to 2012, the Haynesville region was the largest shale gas-producing region in the country. In November 2011, Haynesville regional production reached a record high of 10.4 Bcf/d. In early 2013, however, as natural gas prices started to decrease, natural gas production in the Haynesville region was surpassed by production in the Appalachian region, which includes the Marcellus and Utica formations. By late 2015, shale gas production from relatively liquids-rich areas such as the Eagle Ford region in Texas and the Permian region, which spans parts of western Texas and eastern New Mexico, also started to surpass production from the Haynesville region, which is mapped in Figure 3.

Figure 3
Haynesville Shale Play Producing Wells and Drilling Rigs through October 2017



Source: U.S. Energy Information Administration based on data from Drillinginfo.

Drilling operators in the region have increased the lateral length of horizontal wells beyond 7,000 feet, added more fracturing stages, and significantly increased the quantity of proppant used in completion activities. In combination, these technological improvements have led to a rebound in shale gas production to the highest levels for the region since the end of 2013.

Endnote and Acknowledgement

This article is based on EIA (2017b).

The author gratefully acknowledges the contributions of Ms. Danya Murali of the EIA to this article.

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Faouzi Aloulou is a Senior Industry Economist at the Energy Information Administration (EIA) of the U.S. Department of Energy in Washington, DC. Since 2010 he has been the Project Manager of EIA's Global Shale Resources and Activities' research effort, for which he regularly authors analytical reports on shale gas and tight oil in the U.S. and the rest of the world. Mr. Aloulou initiated the monthly EIA Energy Forecasting Forum in 2002, an activity he still is responsible for organizing. Additionally, from 2014 to 2016, he was the Project Manager of EIA's Global Hydrocarbon Supply Model.

Prior to the EIA's re-organization in 2010, Mr. Aloulou was the EIA China and Middle East expert, monitoring the two regions' energy resources, supply and consumption patterns, trade, technology use and investment strategies, information provided to the World Energy Projections System (WEPS), the EIA's international energy model. In this capacity, Mr. Aloulou took the initiative to have the EIA's *International Energy Outlook* translated into Chinese and Arabic. In the period, June 2007 to June 2008, Mr. Aloulou was seconded from the U.S. Department of Energy to the Riyadh-based International Energy Forum (IEF) where he developed the early prototypes of country surveys used to extend the Joint Oil Data Initiative (JODI) to natural gas. He also compiled and edited the IEF book, From Confrontation to Dialogue, which was released at the Third Summit of OPEC Heads of State on November 13, 2007.

Prior to joining the EIA in 2001, he was a Research Associate at Cambridge Energy Research Associates (CERA), Massachusetts, where he worked with the CERA Refined Products team that produced the quarterly *World Refined Products Watch.* While at CERA he authored reports on the taxation of petroleum products, corporate strategies of the national oil companies, and Japan's activities in the Middle East oil and gas sectors. Mr. Aloulou interviewed the Prime Minister and the Finance Minister of Malaysia for the 1998 CERA book co-authored by Daniel Yergin and Joseph Stanislaw: The Commanding Heights: The Battle between Government and the Marketplace That Is Remaking the Modern World. Mr. Aloulou subsequently served as Energy Advisor at the Prime Minister's Department in Malaysia and reviewed Malaysia's investment programs and energy policies (Vision 2020) as well as working as an independent energy group consultant in Singapore.

Mr. Aloulou has a Bachelor of Arts from University of California at Berkeley and a Master's in Public Administration from the Kennedy School of Government at Harvard University. His thesis, "The European Commission Proposal on Carbon/Energy Tax and the OPEC Response," was nominated for the Kennedy School's Don K. Price award. He was granted a fellowship at the Harvard Business School where he continued his research on pricing options and derivatives for tradable permit schemes as an alternative to energy taxation while assisting in teaching courses on negotiation analysis, leadership and authority at Harvard's Kennedy School of Government.

Approaching Tides: Convergence in World Natural Gas Prices

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Mr. Colin Waugh presenting on financial technology at the 2017 China-U.K. Financial Talent Education Advanced Training Course in Guangzhou (China).

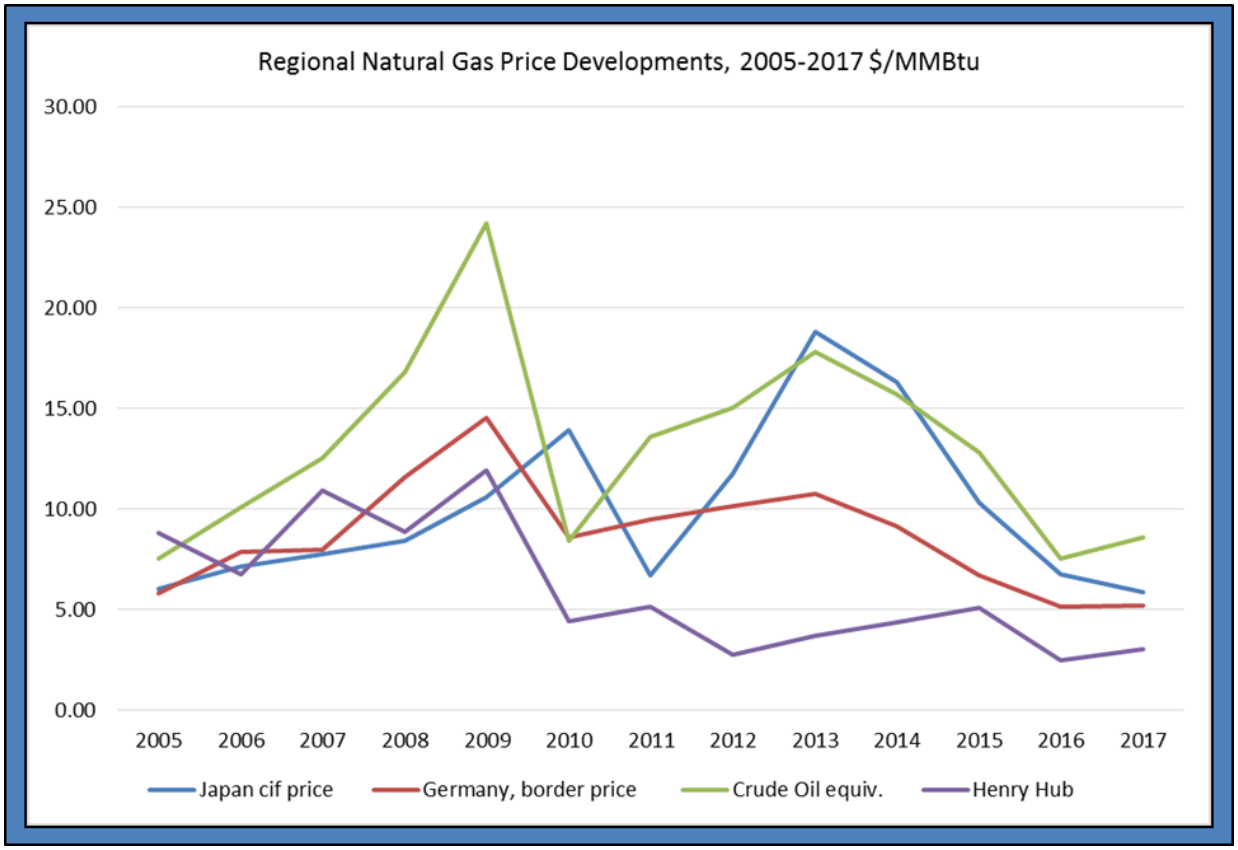
Introduction

In the past three years the global liquefied natural gas (LNG) market has seen an upward shift in supply at a time when demand has stagnated in some markets and risen less rapidly in others. Furthermore, this supply-demand imbalance has impacted different regional markets unevenly, driving the relative price of Asian LNG down in relation to levels in both Europe and the U.S., as charted on the next page in Figure 1. In addition, non-market forces may have exacerbated these price movements, as changing market structure, contractual practices, as well as environmental and geopolitical considerations have also played a role in reshaping the contours of the world natural gas market.

Following a brief overview of the current global supply and demand situation for LNG, this article examines to what degree these latter non-market forces have contributed to this narrowing of inter-regional price differentials. Against an overlay of rapid technological change that has facilitated new sources of supply, the situation in North America is contrasted with the very different forces impacting LNG prices in Europe, with its different priorities, supply options and commitment to alternative energy sources.

Finally, the article surveys the largest and most rapidly changing global market, Asia, briefly evaluating each of the most important non-supply-demand factors to have reshaped LNG trade in recent years and their impact on price movement.

Figure 1



Sources: German Federal Office of Economics and Export Control (BAFA); ICIS Heren Energy Ltd; Energy Intelligence Group, *Natural Gas Week*.

Abbreviations: Btu = British thermal units; cif = cost +insurance +freight (average prices).

The Global Liquefied Natural Gas Market

Total global trade in natural gas reached a record level of 258 million tons in 2016, including 18 countries involved in LNG exports (led by Qatar, Australia and Malaysia) and over 40 importer nations, up from

only 15 buyers of foreign LNG in 2005. Asia accounted for 72.4 percent of the total world trade (IGU, 2017). Declining Japanese imports and stagnant purchases from South Korea were more than made up for by increases in Chinese imports, up 6.9 percent, and new Indian buying, up 4.5 percent. In contrast, China, which has increasingly established itself as the key driver of global demand growth, mostly entered into the spot market for shipped LNG, focusing on pipeline-sourced rather than ocean-bound LNG supply.

At the beginning of this decade, the market consensus was that the foreseen rise in natural gas supplies from traditional as well as new, non-traditional sources would more than offset likely increases in demand, which would keep prices competitive. Supply increases from established producers and exports by emerging sellers in Asia and Africa, as well as from the U.S., would keep the market in balance, despite the secular trend of substitution away from oil and coal in favor of gas, in response to environmental factors, but increasingly also driven by cost considerations.

These forecasts were soon found to be overoptimistic, following sharp price declines in 2014-15. Supply is now forecast to increase from 450 million tons per annum (MTPA) to 677 MTPA by 2020, bolstered by a further 30 new liquefaction trains with 110 MTPA of capacity coming on stream in the next five years (Taylor, 2017). However, the advent of new emerging buyers is set to keep demand apace with supply and global natural gas prices now appearing to be bottoming, particularly in the two traditionally cheaper regions, Europe and the U.S. Recent industry estimates now envisage a new trend of moderate price increases over the period through 2021. From 2022-23 onwards however, there is a fall-off in scheduled new capacity becoming available, offering an opportunity for emerging sellers and potentially heralding a more volatile phase with higher prices globally (Bretz, 2017).

Two further factors have impacted pricing patterns over the past five years. First, the tradability of LNG internationally has improved, as buyers have multiplied and sellers have moved to a new LNG trading model offering greater flexibility in sales and delivery arrangements. Second, the entry of the U.S. into the global market, leveraging its huge shale gas reserves for export, has overturned previous LNG trade channels and boosted supply internationally.

Historically, LNG sales to North Asian buyers were based on relatively rigid, long-term offtake contracts. The latter are now becoming less common as LNG supply continues to exceed demand. Changes in contractual norms allow destination flexibility, where cargos can be diverted to buyers other than the originally contracted off-takers. This is examined in more detail later in this digest article. The newly emerging LNG exporters (mainly the U.S. and Australia) are rapidly expanding their capacities to export to Asia and elsewhere. This is a long-term supply phenomenon that is likely to keep future inter-regional price spreads far below their 2011-2014 levels when Japanese import prices ranged from $8-13 MMBtu over U.S. Henry Hub.

Technological Developments

The advent of fracking[1] technology helped make gas extraordinarily cheap in the U.S., reinforcing the status of the U.S. among lowest cost major producers worldwide. Because of the large premiums paid

by foreign LNG importers, even allowing for the significant costs of liquefying and shipping gas globally, for several years there were therefore healthy profits to be made from such wide inter-regional spreads.

The process of extraction and transformation, shipping and regasification for consumption by an overseas buyer is more complex than the extraction and marketing of crude oil. Large investments of time and money are required for the specialized liquefaction trains to achieve the conversion of gas to liquid. Specialized ships with gas auto-refrigeration are also needed for oceangoing LNG transportation; and lastly at the receiving end, LNG processing terminals are required for the retransformation of the product for consumption by the end-user.

Although further advances in liquefaction, in-transit refrigeration as well as optimizing tanker configuration may reduce the unit variable cost of gas shipped internationally, technological advances alone are unlikely to be a significant driving force in the reduction of future inter-regional price spreads (Schmidt, 2017).

Industry sources estimate that shipping and related logistical costs account for no more than 25 percent of the price differential between regions. Much of the difference is accounted for by other factors, several of which are currently in a state of flux. The following sections of this article will consider the impact of changes that have occurred or are currently underway in the political, legal, contractual and institutional arenas and the extent to which they are drivers of inter-regional LNG prices convergence.

Gas Politics and Geopolitics: Common Interests, Differing Approaches

The evolution in the growth of natural gas industries in North America and Europe over the past decade not only reflects the different domestic needs and opportunities present in the industry across the two continents. It also reflects varying priorities as to security of supply, and policy affecting who benefits and who loses from the expansion of both on and offshore gas reserve exploitation. As the U.S. has enjoyed a surge in production at lower prices, major European suppliers have begun to produce less while developing alternatives more rapidly. At the same time as Europe has found an ally with new resources to help reduce dependence on Russian supplies, prices have moderated gradually against slackening demand, but at a slower pace than in Asia.

An important clash of views across the Atlantic concerns what constitutes valid progress towards reducing carbon emissions and what is viewed as environmentally unsustainable. To the greenest of the European environmentalist parties, all fossil fuels, including natural gas, are targets for restriction and eventual elimination. By contrast, in the U.S., the switch from heavy-polluter fuels to cleaner burning natural gas helps industry achieve its carbon emissions targets via coal-to-gas switching in, for example, the U.S. power sector.

While the political climate in the U.S. has been broadly pro-gas industry, ferocious political opposition often confronts would-be gas fracking operations in Western Europe. In the latter, the perception among many activist groups as well as mainstream political parties is of an unacceptable cost to the many and a risk to the common environment – with a benefit only to the few already-wealthy energy companies.

In contrast to the U.S., rather than a cleaner alternative to polluting energy sources such as coal and oil, in Europe natural gas is now increasingly tarred with the same 'fossil fuel' brush as those legacy hydrocarbon sources – and with additional negative stigma attached to fracking as the means of its extraction.

In terms of international trade, U.S. policy towards energy exports was for a long period dominated by self-sufficiency priorities, historically influenced by the OPEC oil embargo of the 1970s. But more recently, with increasingly balanced or indeed oversupplied global markets, a continued export ban made less sense.

Indeed, the main impact of the four-decade-old export ban, which barred oil and gas shipments to countries other than Canada, was to help U.S. refiners buy cheap domestic U.S. crude oil, while selling gasoline at the global price. Till and Eagleeye (2017) cover a futures trading strategy that had benefited from the extraordinary refinery margins that resulted from this state of affairs. But finally, in December 2015, Congress passed, and President Barack Obama signed, new legislation repealing the energy export ban.

Re-gasification equipment at former LNG Gulf Coast import terminals was converted to LNG liquefaction plants, and in February 2016 Cheniere became the first company to export gas from its Sabine Pass facility, with a LNG cargo bound for Brazil. Since then, the growth in LNG export capacity from the U.S. has been exponential with Sabine Pass exports reaching a record 1.96 billion cubic feet (bcf) per day in May 2017. Another four export terminals are expected to be completed by 2021, pushing U.S. export capacity to 9.2 bcf per day (EIA, 2017).

Diverging Policies, Converging Prices

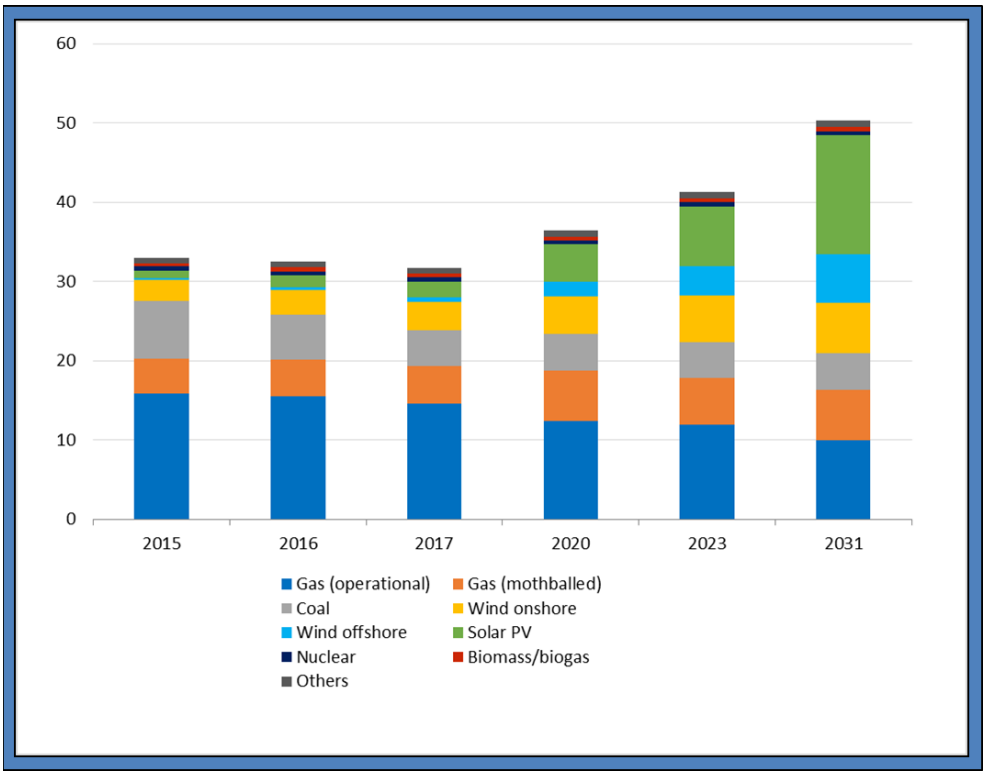
Until recently it could be said that official European policy was evenly divided between pro-and anti-natural resource exploitation camps, with the U.K., Norway and the other northern producer economies not surprisingly able to rely on mostly supportive domestic electorates. But opinion has shifted in response to events both global and domestic, forcing both governments and industry to respond.

For example, a year before he was re-elected as the U.K.'s Prime Minister, Conservative David Cameron declared in 2014 that he was 'going all out for shale' while opposing E.U. measures to limit fracking (Carrington, 2014). Today, however, the U.K.'s opposition Labour party, which is now riding high in opinion polls, has committed itself to anti-fracking legislation if elected.

Moreover, in France the government has imposed a complete ban on fracking and French industry, its consumers and financiers have been under increasing pressure to follow suit. In October 2017, BNP Paribas announced a halt to all financing for clients with businesses focusing on shale oil and gas exploitation. This is a substantial shift for the French lender, already under pressure for alleged illegal and unethical dealings in Africa, and whose business with the energy sector totaled $1.94 billion last year, down from $3.74 billion in 2014, ranking it 17th among international banks (Valentini, 2017).

Of great significance as a barometer of European sentiment is the case of the Netherlands, a major producer where opinion has spun spectacularly from supportive to restrictive in the space of a few short years. For decades the Netherlands was the E.U.'s largest gas producer and supplier to 98% of Dutch homes as well as much of northern France, Germany and Belgium. However, because of a seismic event in 2012 close to the huge Groningen field, production curbs have been put in place by the Dutch government for fear of further earthquake risk to the nearby population.

Figure 2
Netherlands Power Generating Capacity by Fuel Source 2015-2031 (in Gigawatts)



Source: *Tennet Rapport Monitoring Leveringszekerheid*, Tennet TSO B.V., 2016.

In consequence, national production has fallen from 81.5 billion cubic meters (bcm) in 2013 to 47.4 bcm in 2016. Production from the flagship Groningen field, for many decades at the heart of the Netherlands energy economy as well as a huge export earner, is now subject to a lower government-imposed cap following further recent seismic activity in the region. Extraction ramp-ups ahead of the heavy usage winter months are banned, which will force consumers to increase winter fuel imports from Russia or the Mediterranean producers, with a knock-on effect on other European buyers for whom the Netherlands was formerly a reliable supplier, rather than competitor for gas supplies.

The Netherlands is now undergoing a transformation to an economy committed to achieving majority sustainable energy supplies by the 2030s, as diagrammed in Figure 2. By that year, a combination of wind power and solar energy is expected to constitute most of the country's energy supply, according to current national strategy (Honoré, 2017).

Asian LNG Prices: Between Revolution and Reform

Asia is the fastest growing, most heterogeneous, and most expensive of the three regional LNG markets under consideration. In examining the relationships in natural gas price movement and price convergence respectively, it soon becomes clear that causal relationships that are present in North America and Europe are not present in Asia.

Although other regions offer consumers economically feasible opportunities to substitute between energy sources, in Asia coal is dominant. While switching to gas has environmental benefits, the abundance of cheap Asian coal presents significant challenges for increased gas consumption as an energy source and is likely to remain so despite other changes in the market.

China, the largest regional consumer, and India have shown a commitment to gas, and they have displayed a preference for transcontinental pipeline arrangements.[2] Their impact on the future of traded LNG markets therefore remains difficult to evaluate.

The Asian LNG market structure has recently been in flux with the confluence of several factors:

a) The trend to using alternative gas-based benchmarks instead of crude oil price indexing – by 2016 less than 35 percent of LNG was being traded in oil-linked contracts in the region compared to 90 percent in 2011. In times of higher oil prices, the oil-indexing mandate artificially supported LNG prices.

b) Japan's resumption of nuclear power generation following the post-Fukushima shutdown; the overall drop in LNG demand in Asia in 2014-15 led to buyers becoming more demanding as well as more fragmented (there will now be a projected 55 buyers in the region in 2020 versus a total of 33 in 2014).

c) Sellers have been responding with more flexible contracts. Whereas an LNG tanker used to set sail for Asia with its cargo destined for a specific buyer, today cargos may be traded and re-traded en route to their ultimate end user in the region. BP now purchases no less than 60% of its global LNG requirements on a short-to-medium-term contract basis from third-party sources (Milongo, 2017).

d) The recent rapid growth of Asian LNG futures trading. The East Asian spot LNG index Japan-Korea Marker (JKM), traded on the Intercontinental Commodity Exchange, recorded its single largest monthly volume in August of this year – the equivalent of over 21 LNG cargos – establishing the contract as a major global energy trading instrument (Terazono, 2017).

e) New producers in the Middle East, South Asia, and Africa, often with competitive production costs but in need of funding for national LNG infrastructure development. This new breed of LNG producers (e.g. Tanzania, Mozambique, and Senegal/Mauritania) often with no prior experience of selling to Asian buyers is now strongly motivated to compete for a share in Asia's growing LNG market.

These factors have all contributed directly to or facilitated the downward pressure on delivered Asian LNG prices, resulting in a situation where prices in Europe and Asia have recently been moving almost in parallel, with an inter-regional differential of under $2 MMBtu. Although some of the above changes, such as the move away from oil-indexing have only a one-time impact, other factors have more radically reshaped Asia's LNG market. In most cases, changes have improved liquidity and options for enhanced price discovery by both buyers and sellers. To that extent they have facilitated downward price movement already underway due to supply and demand shifts at a global rather than regional level.

Conclusion

The evidence suggests that changes in trade practices and new markets as well as the emergence of new sources of supply have contributed to trends underway, rather than being the primary cause of those trends themselves. Where Asian buyers have been able to exert greater market power versus sellers, they have been more willing to dictate their terms than in the past.

Undoubtedly, the LNG market has become more global and converging inter-regional price levels clearly underline that reality. In the future, when supply-demand conditions tighten, further evidence of the impact of structural changes will become available. In the meantime, a better understanding of the impact of non-market forces may assist practitioners in assessing future price trends, in conjunction with analysis based on traditional supply and demand forecasting.

Endnotes

1 The energy industry practice commonly referred to as "fracking" is a drilling technology that uses a mix of water and chemicals to dislodge natural gas from deep shale or coalbed methane (CBM) deposits. Saundry (2009) defines fracking as "the high-pressure underground injection of large amounts of water and other fluids (including chemicals) into gas bearing rock to form fractures that are propped open with sand. Once the formation is fractured, the natural gas can flow to the well where it is pumped out of the ground."

2 The largest such pipeline supplying China is from Turkmenistan, projected to provide 40 billion cubic meters per annum (bcma) with the Myanmar pipeline adding some 12bcma in the near term. Longer term potential overland suppliers under consideration could include Russia and Kazakhstan.

Acknowledgement

The author extends his thanks to Ken Rice, Business Advisor, Anadarko Petroleum Corporation, The Woodlands, Texas, for his inputs and detailed review of the text. Anadarko, in turn is a corporate member of the J.P. Morgan Center of Commodities' Advisory Council.

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Currently involved in research and investment assignments in the financial services sector in sub-Saharan Africa, Mr. Waugh was a partner in the New York firm of Galtere Ltd, a $2.5bn commodity – global macro fund, until 2008 when he joined Lombard Street Research as an Associate Director for commodities research. Mr. Waugh has also worked on the use of digital technologies to achieve wider financial inclusion in developing economies. A recent member of the Advisory Board of Columbia University's Institute of African Studies in New York and associate fellow of Chatham House in London, Mr. Waugh holds an MSc (Econ) degree from the London School of Economics, a Certificate in Financial Technology from the Massachusetts Institute of Technology, and speaks French and Portuguese. In addition to financial research and publications, he has published two non-fiction books on Africa: Paul Kagame and Rwanda (2004) and Charles Taylor and Liberia (2011). Mr. Waugh also contributed the chapter, "Collision: Investing for the New World Commodity Order," in the book, Intelligent Commodity Investing (2007).

Interview with Robert Greer

Scholar-in-Residence, J.P. Morgan Center for Commodities (JPMCC), University of Colorado Denver Business School; and Member of the JPMCC's Research Council

Mr. Robert Greer, Scholar-in-Residence at the JPMCC, presenting on commodity investing at the CFA [Chartered Financial Analyst] Society in Chicago on November 28, 2017. Mr. Greer is also an Editorial Advisory Board member of the *Global Commodities Applied Research Digest (GCARD).* (Photo courtesy of the CFA Society Chicago.)

In the Winter 2017 issue of the *GCARD*, we briefly interview Mr. Robert Greer, who is a Scholar-in-Residence at the J.P. Morgan Center for Commodities and is also an active member of both the JPMCC's Research Council and its Advisory Council. Mr. Greer is most well-known in his former role as an Executive Vice President and Real Return Product Manager at PIMCO, before his retirement.

Mr. Greer has been a stalwart supporter of the JPMCC, contributing to the Center's success in a myriad of ways. For example, he has been a featured presenter for the JPMCC's lecture series. He contributed to the inaugural issue of the *GCARD* with his article on "Portfolio Rebalancing and Commodities: The Whole is Greater than the Sum of Its Parts." And he has provided valuable business insights at the Center's prestigious Research Council meetings such as during Professor Forest Reinhardt's Harvard Business School case study on Olam International and during the Center's August 2017 international commodity symposium.

Mr. Robert Greer, who is also a Senior Advisor at CoreCommodity Management, LLC, presenting at the CFA Society in Chicago on November 28, 2017. (Photo courtesy of the CFA Society Chicago.)

In our interview, Mr. Greer explains how he became involved in the commodity markets and what led him to writing the first published article on an investable commodity index. He also touches on some of the major changes in the commodity industry, concluding with a description of the value that the JPMCC can potentially bring to the commodity industry.

Interview with Mr. Robert Greer

You have been referred to as the "Godfather of Commodity Investing." How did you first become involved in the commodity markets (either in the physical or derivatives markets)?

Like many things in life, my first involvement in commodity markets was purely coincidental; yet it has had a big influence on much of my subsequent professional activity. In the early 1970s I was working in the design of computer systems when I got a call from a fraternity brother. He wanted me to move to Dallas and lead the startup of a commodity brokerage company. When I protested that I knew nothing of commodities, he said, "That's no problem. I have plenty of connections here in Dallas to get clients, while my partner in Chicago has all the expertise we need to trade markets. All you need to do is run

the business, and since you have a Stanford MBA, I'm sure you can run any business." I was young enough and foolish enough that I agreed and accepted the offer.

In 1978, your article, "Conservative Commodities: A Key Inflation Hedge," was published by the Journal of Portfolio Management. This article introduced the idea of an investable commodity index, which was a new concept at that time. What prompted the idea of an investable commodity index, and were there any barriers to your article being accepted?

When I entered the commodity futures markets in 1973, there were not a lot of participants who had my background in economics and finance. This was also a time when inflation was starting to run out of control and when the first stock index funds had just started. In that environment I realized that commodity futures are no more volatile than individual stock prices, but they had a reputation for high risk because of the tremendous leverage that was available. What if an investor, not a "speculator," simply did not use leverage, instead fully collateralizing each position. This of course would only be possible if you held only long positions, which was OK since long exposure might protect an investor from inflation. Next, these long positions could be weighted based on how important each commodity was in global trade, leaving no room to guess which commodities would go up more than others. Adding some rules on rolling positions forward and you had a measure of the returns from passive long-only collateralized commodity futures investing—an investable index. Prior to that time commodity indexes were indexes of prices, not of investment returns.

Nobody seemed interested in such a crazy idea, even suggesting that the words "commodity" and "investment" should not be spoken in the same sentence. Fortunately Peter Bernstein, editor of the *Journal of Portfolio Management*, was intrigued by the manuscript I sent him, and he published it in 1978. It only took another 15 to 20 years for investors actually to begin using such an investment strategy. In 2012 I had fun describing these efforts (including having to work without personal computers, online databases or even the ubiquitous HP 12C calculator) in an early chapter of my book, Intelligent Commodity Indexing, which also lays out in more detail the drivers of commodity index returns and why they logically lead to the inflation hedging and diversification that investors need.

What are some of the major changes you have experienced in the commodity industry, particularly on the investing and financing sides of the business?

The first major change I remember living through was in the 1990s, when investors began to recognize commodities as a distinct asset class and started thinking about how to use this strategy in a portfolio. Forward-looking institutions like the Harvard Endowment and Ontario Teachers' Pension Plan were early adopters that began to bring attention to the benefits of inflation hedging and diversification that commodities could bring to a portfolio. More recently, say in the last 10 to 15 years, we have seen other changes. There is increased regulation of the physical markets because of environmental and other concerns, and especially since 2008, financing for commodity activities from traditional banking sources has become more difficult.

How can the JPMCC be of most benefit to the commodity industry?

The JPMCC has the opportunity to make a difference in commodity industries and markets because it uniquely covers a broad spectrum of different commodity markets and is concerned about both physical and futures markets. In that role the JPMCC can contribute to commodity industries by the training of personnel who manage commodity functions in industry (e.g. supply management and procurement); by training investment professionals who have the chance to incorporate commodity exposure in portfolios; and by educating regulators and the media about the value and benefits that commodity futures markets bring to the economy.

Thank you, Mr. Greer, for this opportunity to interview you!

ROBERT GREER
Scholar-in-Residence, J.P. Morgan Center for Commodities, University of Colorado Denver Business School

Mr. Robert Greer is the first person to define an investable commodity index and is a pioneer in explaining why commodity indexes are an asset class distinct from stocks and bonds. He developed one of the two common methods of explaining sources of commodity index returns and has spoken on this asset class on national television, at industry conferences and trade meetings globally, and at college lectures at Yale, Oxford, Columbia, Princeton and elsewhere. Mr. Greer spent eight years managing the commodity index businesses at Daiwa Securities, Chase Manhattan Bank, and J.P. Morgan before joining PIMCO in 2002 to build their inflation products business. Under his 13 years of leadership PIMCO's commodity business grew from a single pilot account to become the world's largest commodity investment management business, at one time responsible for $35 billion in accounts. During this time the other inflation strategies for which Mr. Greer had business responsibility, including inflation-linked bonds, real estate, and certain multi-asset strategies, also grew so that his lines of business included over $100 billion in assets under management.

Prior to building the commodity and inflation business for PIMCO and others, Mr. Greer spent a decade in the commercial real estate industry, and also spent many years in corporate finance and computer systems development. But for more than two decades Mr. Greer's primary interest has been the business of commodity investment; so much so that the Chicago Mercantile Exchange has referred to him as "the godfather of commodity investing." He has also published articles on the subject in *The Journal of Portfolio Management*, *The Journal of Derivatives*, *The Journal of Alternative Investments*, *Pensions & Investments*, and in the inaugural edition of the *Global Commodities Applied Research Digest*, for which he is also a member of the Editorial Advisory Board. He has consulted on the subject of commodities to the CIA, the Bank of England and the New York Fed, and participated in the CFTC's Agricultural Roundtable in April 2008. Mr. Greer wrote and edited, The Handbook of Inflation Hedging Investments, oriented to the institutional investment community, which was published by McGraw Hill in December 2005. In addition, Mr. Greer wrote the foreword to the book, Intelligent Commodity Investing, which was published by Risk Books in 2007. He also co-authored Intelligent Commodity Indexing, published by McGraw Hill in 2012. Among other interests since retiring from PIMCO, Mr. Greer serves as a scholar-in-residence at the J.P. Morgan Center for Commodities, part of the University of Colorado Denver Business School, and is a member of both the Research Council and the Advisory Council of that organization. He is also a Senior Advisor for CoreCommodity Management, LLC and provides strategic consulting for companies in the physical commodity business. Mr. Greer received a bachelor degree summa cum laude in mathematics and economics from Southern Methodist University and was in the top 5% of his MBA class at the Stanford Graduate School of Business.

GLOBAL COMMODITIES
APPLIED RESEARCH DIGEST

The *Global Commodity Applied Research Digest* is produced by the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School. The JPMCC is the first center of its kind focused on a broad range of commodities, including agriculture, energy, and mining. Established in 2012, this innovative center provides educational programs and supports research in commodities markets, regulation, trading, financial fundamentals, investing, and risk management.

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