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

GLOBAL COMMODITIES

APPLIED RESEARCH DIGEST

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UNIVERSITY OF COLORADO DENVER

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UNIVERSITY OF COLORADO DENVER BUSINESS SCHOOL

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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 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 Hilary Till, M.Sc. (Statistics), Solich Scholar at the JPMCC and member of the JPMCC's Research Council. The *GCARD's* Editorial Assistant is Katherine Farren, CAIA, and the *GCARD's* Publication Consultant is Barbara Mack, MPA.

The JPMCC is honored to have a distinguished Research Council that is responsible for shaping the applied research agenda of the Center. Accordingly, the *GCARD*, in part, draws from insightful presentations and discussions that occur at the Center's semiannual Research Council meetings. The JPMCC's Research Council members are listed on the next page.

At the inaugural April 18, 2015 JPMCC Research Council meeting, (Left-to-Right): Dr. Bluford Putnam, CME Group; Professor Vince Kaminski, Rice University; Professor Marcelle Arak, University of Colorado Denver Business School; Professor James Hamilton, University of California, San Diego; Professor Lutz Kilian, University of Michigan, Ann Arbor; Mr. Lance Titus, Guzman Energy; and Mr. Colin Fenton, Blacklight Research LLC and Co-Chair, JPMCC Advisory Council.

J.P. Morgan Center for Commodities
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* As of August 1, 2016

Rohan Christie-David, Ph.D.
Dean*
University of Colorado Denver Business School

Ajeyo Banerjee, Ph.D., CMA
Executive and Faculty Director
J.P. Morgan Center for Commodities, University of Colorado Denver Business School

Matthew Fleming
Program Manager
J.P. Morgan Center for Commodities, University of Colorado Denver Business School

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* As of August 1, 2016

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what the threshold level of coordination is for a core group of oil swing producers, which would maximize revenue, assuming that "other producers do not change their output in response." The authors observe that the required level of coordination has not occurred and perhaps is not possible, given "varying foreign policy interests and economic structures." Therefore, "the price of oil is likely to continue its slide."

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This collection of four digest articles provides answers to the following questions:

- When has OPEC spare capacity mattered for oil prices?
- What are the sources of return for CTAs and commodity indices?
- What are the risk-management lessons from high-profile commodity derivatives debacles?
- What determines whether commodity futures contacts succeed or not?

The goal with each of the four digest articles is to provide both industry participants and policy makers with useful insights on the frequently opaque, but always dynamic, commodity markets.

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Until recently, one could only gain expertise in commodity-derivatives relationships if one had worked in niche commodity-processor companies or in banks that specialized in hedging project risk for natural-resource companies. The contribution of this paper is to help fill the knowledge gap in the risk management of commodity derivatives trading. The paper emphasizes the constant challenges to a trader when attempting to navigate the very dynamic flows of both the commodity markets and the prevailing risk (Continued on next page)

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The "Research Digest Articles" section concisely covers original research on (1) metals hedging; (2) energy policy; (3) the logistical planning of a grain-trading firm; (4) commodity pricing; and (5) the development of commodity exchanges. The five research summaries were written by the Contributing Editor of the *GCARD.*

Why Do Firms Engage in Selective Hedging? Evidence From the Gold Mining Industry **69**

Summarized from article by Tim R. Adam, School of Business and Economics, Humboldt University of Berlin; Chitru S. Fernando, Michael F. Price College of Business, University of Oklahoma; and Jesus M. Salas, College of Business & Economics, Lehigh University

In this article, the authors find a counterintuitive result. While one might expect that firms with both an informational advantage and a robust financial condition to use these competitive advantages to vary their hedging programs according to their market views, the researchers, in fact, find the opposite result. This finding should be of interest to investors in gold equities, who should probably have a skeptical view regarding a firm's decision to "selectively" hedge, which the authors also refer to as speculation.

The Biofuel Connection: Impact of US Regulation of on Oil and Food Prices **72**

Summarized from article by Fernando H. Avalos, Bank for International Settlements (BIS), and Marco J. Lombardi, BIS

In this paper, the authors examine whether one might attribute at least some of the past spikes in corn prices to renewable fuel mandates in the US. The authors provide statistical evidence that corn price dynamics changed after these mandates were put into effect: namely, corn prices began having a stronger response to global demand factors that, in turn, drive demand for crude oil. This increased connection between oil prices and a food staple is an important public policy issue. Although the authors do not suggest policy innovations,
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one might conclude that when food prices spike, perhaps there should be a temporary trigger to divert corn stocks to food rather than fuel.

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Summarized from article by Nicolas Merener, Universidad Torcuato Di Tella, School of Business, Buenos Aires, Argentina; Ramiro Moyano, Grupo Los Grobo (Argentina); Nicolas Stier-Moses, Universidad Torcuato Di Tella, School of Business, Columbia University, New York, and CONICET (Argentina); and Pablo Watfi, Universidad Torcuato Di Tella, School of Business, and Universidad de Buenos Aires (Argentina)

In the paper, "Optimal Trading and Shipping of Agricultural Commodities," the authors use a case-study approach to show the benefits of jointly planning trading and logistics for a specific Argentinian grain-trading firm. Given the low profit margins of such firms, such an approach should be of interest to comparable firms in Latin America. The paper's methodology may also be applicable to large firms in other geographic locations, which are similarly involved in the trading and shipping of grain.

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Summarized from article by Marcel Prokopczuk, Leibniz Universität Hannover (Germany) and ICMA Centre, University of Reading (UK), and Yingying Wu, Xi'an Jiaotong Liverpool University (China)

In this study, the authors examine what potentially drives convenience yields. Typically, convenience yields are regarded as the benefit that a holder of commodity inventories receives for being able to avoid the cost of potential stock-outs. The authors examine to what extent commodity-specific and broad macroeconomic variables can explain the variability of convenience yields for a set of commodities. Amongst the authors' results are that convenience yields (in all cases but one commodity) "exhibit statistically significant positive relationships with" expected inflation and expected industrial production in the US. This is a helpful result for investors whom are interested in choosing futures strategies that provide exposure to key macroeconomic variables.

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Summarized from article by Sostine Ngabirano, Lecturer of Law, Uganda Christian University

In this article, the author questions to what extent a government should be "hands off" in the development of commodity exchanges. Given the scale of institutional development required for the establishment of a commodity exchange, the author is skeptical about limiting the government's role. In the Chicago model, the government's role is limited to providing the relevant legal framework and oversight functions. Instead, the author advocates an approach in which commodity exchanges are government-run. In making his case, the author compares the experience of two African countries.

Reports on the Research Council Meetings

In early 2015, the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School established a prestigious Research Council, which, in turn, consists of distinguished academics and accomplished practitioners across commodity segments. The JPMCC's Research Council has thus far met in April and December 2015, and is chaired by Professor Colin Carter, University of California, Davis and co-chaired by Dr. Margaret Slade, Professor Emeritus, Vancouver School of Economics, University of British Columbia. In this issue of the *GCARD,* we cover the agricultural panel's presentations from April 2015, which were delivered by distinguished academic and practitioner members of the Research Council. Future issues of the *GCARD* will cover academic panels on energy, metals-and-mining, and on renewable energy.

At the April 2015 J.P. Morgan Center for Commodities' (JPMCC's) Research Council meeting, Professor Brian Wright, University of California, Berkeley, discussed the puzzling behavior of grain prices during the last 10 years. Mr. Peter McCallum, Bunge Limited, moderated the session while Professor Colin Carter, University of California, Davis, and Ms. Nancy DeVore, DHF Team, LLC, discussed Wright's research from both academic and practitioner perspectives, respectively.

Professional Education Update

Undergraduate and graduate degrees in business rarely offer an in-depth exploration of commodity markets. This article argues that a supplemental professional education in the commodity markets is not only needed, but is also imperative for a well-rounded business education.

Scholar Section

This article advocates that investors take a practical and informed approach to understanding the rebalancing aspect of commodities allocations so as to be better positioned to harness the real returns of this critical (but sometimes difficult to evaluate) asset class.

Editorial Advisory Board Commentaries

This issue's "Editorial Advisory Board Commentaries" section of the *GCARD* includes articles from two accomplished members of the board. This issue's authors are (1) Jan-Hein Jesse, Founder, JOSCO Energy Finance and Strategy Consultancy, Amsterdam, and an international expert for the International Energy Agency, Paris; and (2) Richard Heckinger, Associate Editor, *Journal of Financial Market Infrastructures*, and a member of the Working Group on Financial Markets for the Federal Reserve Bank of Chicago.

This article describes the incumbent and new-entrant crude oil benchmarks at a time the oil markets are going through a period of great turbulence. The article starts with an introduction about the current state of the industry and market, including a description of benchmarks and the price discovery process in general. The next sections describe each benchmark – WTI, Brent, and Dubai in more detail. The article ends with the pending introduction of Shanghai crude oil futures contracts, which may create a new benchmark for Asian markets.

The liquidation and settlement of claims stemming from the collapse in October 2011 of the futures commission merchant and broker–dealer entities of MF Global (MFG) Group took nearly four years to settle. Various investigative initiatives have revealed evidence that customer monies were probably used at times to fund the proprietary trading of the firm in violation of law and regulation in certain jurisdictions and contrary to international principles. This paper examines the conflicting business objectives of MFG overall, its proprietary trading strategies and its eventual collapse, with some lessons learned.

Interview

In the inaugural issue of the *GCARD*, the Contributing Editor interviews Dr. Colin A. Carter, who became the Chair of the J.P. Morgan Center for Commodities' Research Council in the Fall of 2015. Dr. Carter is also a Distinguished Professor of Agricultural and Resource Economics at the University of California, Davis where he has been a researcher and educator for over 30 years. Professor Carter's research covers the grain and livestock sectors in China as well as the economics of biotechnology, global agricultural commodity markets, and biofuels policy in the United States.

Welcome Letter

Ajeyo Banerjee, Ph.D., CMA
Associate Professor of Finance and Risk Management Executive and Faculty Director
J.P. Morgan Center for Commodities (JPMCC), University of Colorado Denver Business School

Ajeyo Banerjee, Ph.D., CMA, Associate Professor of Finance and Risk Management, Executive and Faculty Director, J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School, addressing the JPMCC's Research Council in the Center's CoBank Lecture Hall on December 4, 2015.

Dear Reader,

I am happy to welcome you to the inaugural issue of the J.P. Morgan Center for Commodities' *Global Commodities Applied Research Digest (GCARD)*. This bi-annual publication is generously sponsored by the CME Group Foundation, and the purpose of this new digest is to highlight the key findings of applied research on topical commodity issues. As you read through our first issue, please consider providing feedback to the *GCARD's* Contributing Editor, Hilary Till, at hilary.till@ucdenver.edu, on how we can improve the digest to serve the needs and interests of commodity-industry professionals and policymakers.

For readers who are unfamiliar with either the University of Colorado Denver Business School or the university's J.P. Morgan Center for Commodities (JPMCC), I'd like to take this opportunity to introduce these entrepreneurial institutions to you. As a major hub for agriculture, energy, metals, minerals, and renewable energy research, Colorado is already an undisputed national leader in commodities. It is natural then for the University of Colorado Denver Business School to also become a leader in commodities education and applied research. As a result, the JPMCC was set up in 2012 and is the first of its kind covering the broad range of commodities. The Center provides research insights, student educational programs, and professional education offerings in the business of physical commodities, commodity markets, regulation, trading, risk management and policy.

The Center aims to become the focal point of highly relevant commodities thought-leadership. The *GCARD* is just one element of this strategy; other efforts include:

- The Center's Global Commodities Issues (Editor's Choice) eJournal, edited by Professor Marcelle Arak, the Center's CoBank Professor;

- The Center's prestigious Research Council, which is made up of eminent academics and successful industry professionals, who ensure the research carried out through the Center has both academic rigor and practical relevance;

- The Center's forthcoming international commodities conference, planned for Spring 2017, which will take place in Denver; and

- The recent launch of JPMCC Commodities Research Fellowship Awards.

With the *GCARD*, we had noted that commodity practitioners do not currently have an accessible source of concise information about current commodities research, either in specific fields or across industries. The *GCARD* aims to fill this marketplace gap. Accordingly, we look forward to the *GCARD* becoming the go-to place for new knowledge on commodities for the business community. We hope you will like this issue, and our subsequent issues will have the benefit of your insights and suggestions. Thank you for joining us in our latest initiative!

If you would like more information on the J.P. Morgan Center for Commodities, please feel free to contact us at commodities.center@ucdenver.edu.

Sincerely,

Ajeyo Banerjee

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*

Hilary Till, M.Sc. (Statistics), Solich Scholar, J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School, presenting on the *Global Commodities Applied Research Digest* at the JPMCC's Research Council meeting on December 4, 2015. Ms. Till is the Contributing Editor of the *GCARD*.

Dear Reader,

My colleagues and I at the University of Colorado Denver Business School's J.P. Morgan Center for Commodities are delighted to launch the inaugural issue of the *Global Commodities Applied Research Digest (GCARD).* We are grateful to the CME Group Foundation for its generous support in making this project possible.

In summary, the aim of the digest is to serve the J.P. Morgan Center'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.

At present, we would argue that for practitioners, there is not an accessible source of concise information about current research across commodity segments, so we are excited about the potential for the Center's bi-annual applied research digest.

As a result, the selection of articles is based on how relevant articles are to the concerns of professionals engaged in the business of commodities. An additional goal is to encourage dialog amongst stakeholders in the various commodity disciplines.

For our first issue, we have assembled insights from across the diverse field of commodities, including from members of both the JPMCC's prestigious Research Council and the *GCARD*'s own accomplished Editorial Advisory Board, as well as from academic content in the JPMCC's *Global Commodity Issues (Editor's Choice)* eJournal.

We have included a diverse set of topics from across commodity industry segments in order to present as comprehensive a picture of commodity research as possible. The eight main sections of the *GCARD* are as follows.

The **Research Council Corner** includes contributions from the following members of the JPMCC's Research Council: Dr. Thomas Brady, Ph.D., of the Newmont Mining Corporation; Dr. Bluford Putnam, Ph.D., of the CME Group; and Dr. Marcelle Arak, Ph.D., of the University of Colorado Denver Business School. Dr. Arak's paper is co-authored with Ms. Sheila Tschinkel, Visiting Faculty in Economics at Emory University, Atlanta. Dr. Brady discusses both the direct and *indirect* benefits of mining to host countries while Dr. Putnam provides his outlook for the oil markets in 2016. In future issues of the *GCARD*, Dr. Putnam will author a regular column entitled, "The Economist's Edge." Dr. Putnam's article is followed by a contribution from Dr. Arak and Ms. Tschinkel, whose paper concisely describes a framework for understanding the sharp drop in crude oil prices. Their framework is based on the following two factors: (1) the implications of crude oil's low short-run price elasticity of demand and (2) the present impediments to a core group of swing producers cooperating to restrict production.

Dr. Thomas Brady (middle), Newmont Mining Corporation, with Professor Ajeyo Banerjee (left), Executive and Faculty Director of the JPMCC; and Professor Graham Davis (right), Colorado School of Mines.

In the **Contributing Editor's Collection** of Digest Articles, we provide answers to the following four questions, which are of interest to commodity traders: (1) When has OPEC spare capacity mattered for oil prices? (2) What are the sources of return for CTAs and commodity indices? (3) What are the risk-management lessons from high-profile commodity derivatives debacles? (4) What determines whether commodity futures contracts succeed or not?

The **Research Digest Articles** section concisely covers academic research on (1) metals hedging; (2) energy policy; (3) the logistical planning of a grain-trading firm; (4) commodity pricing; and (5) the development of commodity exchanges in emerging markets.

The Reports on the Research Council Meetings section summarizes insightful academic and practitioner presentations that took place at the JPMCC regarding past grain price spikes. Future issues of the *GCARD* will report on the highlights of Research Council panels that have focused on metals-and-mining, energy, commodity finance, and on renewable energy.

Mr. Robert Gray, CFA, Resource Capital Funds, and member of the JPMCC's Research Council, providing feedback on an academic paper on April 18, 2015. One of Mr. Gray's insights will be covered in the Fall 2016 issue of the *GCARD*.

In the **Professional Education Update**, Andy Hecht argues that well-designed commodity education programs can potentially be of great benefit to universities, their students, and to future employers in the commodity industry. Mr. Hecht is the Chief Market Strategist for both Carden Capital and Carden Futures. He is also a Subject Matter Expert in the JPMCC's Professional Education Program.

The **Scholar Section** features a contribution from Robert Greer, who was recently appointed as a Scholar in Residence at the JPMCC and was previously an executive vice present and the real-return product manager at PIMCO. Mr. Greer discusses the "rebalancing return," which can be a substantial addition to a commodity portfolio's returns. He was the "first commentator to define the concept of an investable commodity index in an article published in the *Journal of Portfolio Management* in 1978," noted *HedgeFund Intelligence* in 2010. So we are very glad that Mr. Greer can continue his tradition of "firsts" by writing for our first issue!

Mr. Robert Greer (left), Scholar in Residence at the JPMCC, and Professor James Hamilton (right), University of California, San Diego, at the JPMCC's Research Council meeting on December 4, 2015.

In the **Editorial Advisory Board Commentaries** section, we are pleased that two board members have contributed their expertise on the following two opaque subjects that, nonetheless, underpin successful commodity trading: Jan-Hein Jesse explains the interplay of existing and emerging oil benchmarks in determining global oil price discovery; and Richard Heckinger explains the complex lessons from the failure of the futures broker, MF Global. Mr. Jesse is the founder of JOSCO Energy Finance and Strategy Consultancy, Amsterdam, and is also an international expert for the International Energy Agency, Paris while Mr. Heckinger is an Associate Editor of the *Journal of Financial Market Infrastructures*, in addition to serving as a member of the Working Group on Financial Markets for the Federal Reserve Bank of Chicago.

This issue's concluding article is an **Interview with a Thought Leader in Commodities**. In this article, we have the privilege of briefly discussing with Professor Colin A. Carter, University of California, Davis, what encouraged him to become the Chair of the JPMCC's Research Council along with what his current research interests are across the agricultural commodity arena.

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On a personal note, I have always enjoyed the commodity markets as an active participant. These markets are like a big tent that comfortably encompasses a wide variety of talented professionals and includes, for example, global-macro strategists, street-smart practitioners, careful fiduciaries as well as brilliant quants, many of whom I have worked with in the past. In creating the first issue of the *GCARD*, I have been delighted to stretch the boundaries of this big tent even further to include influential policy advisors and distinguished academics. I hope to include you, our readers, in this project: I welcome your suggestions on how we can best provide highly relevant insights to commodity practitioners and policymakers in this extremely dynamic field!

Best Regards,

Hilary.Till@ucdenver.edu

Introduction to Research Council Corner

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

In 2015, the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School established its Research Council. The Council consists of eminent academic researchers and successful professionals of practice, whom are interested in a shared platform for relevant academic commodities research and its dissemination to the wider commodities community. The goal for the Research Council is for it to help shape and validate the research agenda of the Center, according to Ajeyo Banerjee, Ph.D., who leads the JPMCC as its Executive and Faculty Director.

In the "Research Council Corner" section of the *Global Commodities Applied Research Digest (GCARD)*, we are pleased to include articles from the following three distinguished members of the Research Council: Thomas Brady, Ph.D., of the Newmont Mining Corporation; Bluford Putnam, Ph.D., of the CME Group; and Marcelle Arak, Ph.D., of the University of Colorado Denver Business School. Dr. Arak's article is co-authored with Sheila Tschinkel, Visiting Faculty in Economics at Emory University.

Dr. Brady's paper clarifies what the benefits from mining are to host countries. Dr. Brady advocates that host countries evaluate the holistic benefits of this activity and not just the direct monetary benefits derived from taxes and royalties. Dr. Putnam's article then discusses what the main drivers have been for the price of crude oil and what this key commodity's prospects are in 2016 based on *fundamental* factors. In future issues of the *GCARD*, Dr. Putnam will be contributing a regular column entitled, "The Economist's Edge." Dr. Arak's and Ms. Tschinkel's paper, in turn, explains why the price of crude oil has declined as much as it has by focusing on the consequences of the low short-run price elasticity of demand for crude oil in the face of a substantial surplus in oil production (relative to demand.) They also note what the threshold amount of cooperation by core swing producers is that would halt the decline in the price of crude oil; this particular condition was proven *mathematically* by Dr. Arak in previous academic work. Finally, the authors note the present impediments, which have prevented core producers (as of the end of January 2016) from agreeing to the required level of cooperation that would arrest the drop in the price of oil.

The next two pages further summarize this section's highly relevant papers on mining and energy issues. The mining article is quite helpful in public policy debates while the two energy papers are quite useful for petroleum project planning.

The Distribution of Economic Benefits from Mining by Thomas Brady, Ph.D.

Prevalent in the literature concerning economic contributions of mining is the view that royalty rates and taxes which governments levy on mineral extraction are the primary sources of benefits a host-country receives from a typical mining operation. However, more holistic perspectives are needed as significantly more economic value is generated by the spending of mining companies on their supply chains and on employee wages. Governments that ignore these wider benefits are at risk of limiting the returns generated by mining activities within their borders as these typically result in reduced mine lives and lower incentives to invest. As a result, this article recommends a careful analysis of the holistic benefits of mining by host countries.

Oil Market Dynamics and 2016 Outlook by Bluford Putnam, Ph.D.

This article's forward looking analysis of the long-term trends in the crude oil market, including sluggish global growth, continued advances in transportation fuel efficiency, and extraction technology improvements, suggest that the era of relatively low prices could last for many years. In hindsight, what seems remarkable is that oil prices stayed as high as they did for as long as they did, before breaking down in the second half of 2014. Back in the second half of 2014, the oil market experienced a powerful downward price adjustment, which was sustained throughout 2015.

There are several long-term supply and demand forces in play as well as some shorter-term response factors that make for a very difficult mix to analyze going forward. On the supply side, there are the technology-driven improvements in extraction techniques that ignited a production boom in the United States commencing back in 2006. On the demand side, there is the huge shift in the global growth environment, from an emerging market boom period in the early 2000s to a sluggish growth period after the 2008-2009 Great Recession. Also, on the demand side, technology has been steadily at work making transportation considerably more fuel efficient. Shorter-term factors include the time-lagged feedback loops and the behavioral responses as producers have adjusted to a lower oil price environment, as well as policy responses such as the lifting of the US ban on crude oil exports.

This all adds up to a very long and prolonged period of low oil prices as our base case, which would apply so long as economic conditions are the key driver for the price of oil. That said, there are always small probability events, such as further conflict in the Middle East, which could lead to upside price risks, in which case economic conditions would definitely not be the predominant price driver.

Why Do Oil Prices Keep Going Down?
By Marcelle Arak, Ph.D. and Sheila Tschinkel

This article is a practitioner-oriented paper that is based on the insights of Arak and Tschinkel (2016), which, in turn, is an academic paper that is available on SSRN. The present article focuses on the low price elasticity of demand for crude oil in the short run as well as the implications of this observation. For those readers unfamiliar with this economic concept, the definition of price elasticity of demand is the [change in demand in %] / [change in price in %]. With a low price elasticity of demand, a given change in demand requires a correspondingly much greater change in price. Drawing from an example in Hamilton (2008, p. 9), if say the global production of crude oil became 90% of the amount of the previous year, a price increase of 100% would be required to force a 10% drop in demand if the short-run demand price elasticity is -.10, a quite low level. (Hamilton (2008, p. 15) cites past research with even lower levels of short-run elasticities for crude oil.) Given that various studies have shown that crude oil demand is relatively price inelastic in the short run, one can note that any given supply cut should have a magnified impact on the price of crude oil. But how much of a supply cut would be in the best interest of a core group of oil swing producers, who would want to maximize revenue, assuming that "other producers do not change their output in response"? (This assumption is noted in Arak and Tschinkel (2016, p. 2).) Dr. Arak has shown mathematically that a coordinated group of producers with a market "share greater than the elasticity of demand, weighted by … [their] profit margin, could benefit by curbing supply to increase profits". This proof can be found in Arak and Tschinkel (2016, pp. 4-5), and this mathematical result is cited in the present paper. The threshold level of coordination, though, has not happened. Why is the case? This "kind of cooperation is much less likely [now], as oil-producing countries don't appear interested or even able to work together to raise prices – let alone do so unilaterally. They have varying foreign policy interests and economic structures," concludes the present paper, and therefore, "the price of oil is likely to continue its slide."

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Arak, M. and S. Tshinkel, 2016, "The Direction of Crude Oil Prices: The Role of Market Structure," February 15. Available at SSRN: http://ssrn.com/abstract=2732918.

Hamilton, J., 2008, "Understanding Crude Oil Prices," National Bureau of Economic Research Working Paper 14492, November. [J. Hamilton is also a member of the Research Council of the J.P. Morgan Center for Commodities at the University of Colorado Denver Business School.]

The Distribution of Economic Benefits from Mining

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

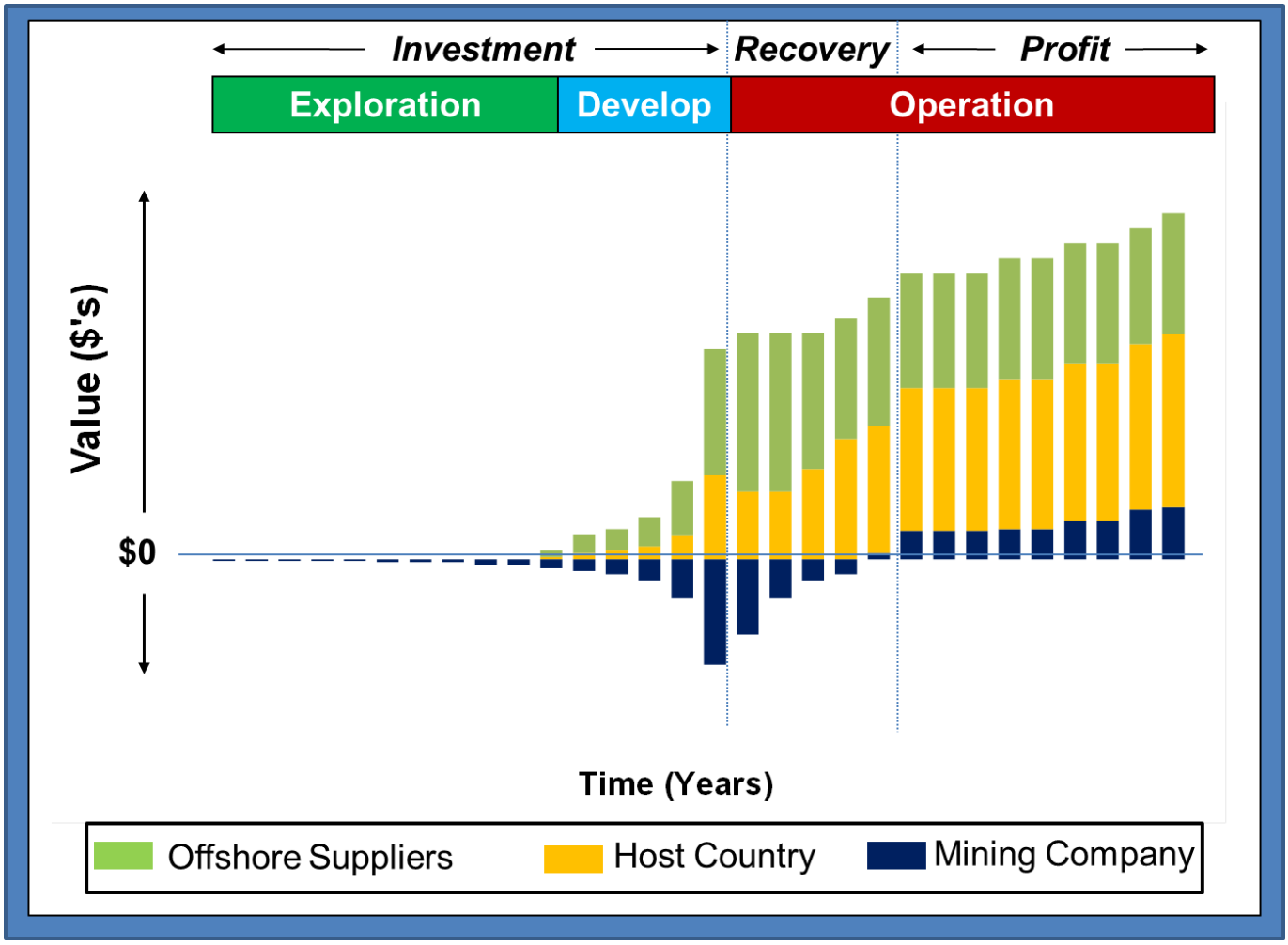
Dr. Thomas Brady (with microphone), Chief Economist at the Newmont Mining Corporation, participating in the J.P. Morgan Center for Commodities' (JPMCC's) Research Council meeting in the Center's CoBank Lecture Hall on December 4, 2015. Mr. Robert Greer, Scholar in Residence at the JPMCC, is on Dr. Brady's left.

Literature on the economic contribution of mining to host countries tends to focus on the royalties and taxes that governments levy on mineral extraction as the primary sources of benefits a country receives from a typical mining operation. Less understood, however, are the other, and significantly larger, sources of economic value including supply chain expenditures, employment and other economic benefits that host-country communities and governments receive as the result of mining activities. Governments that ignore these wider, holistic benefits are at risk of limiting the economic returns generated by mining activities within their borders.

The Mining Life Cycle

Critical to understanding the distribution of economic benefits from a mining operation are the time and capital requirements to discover, develop and profitably operate a mine. Figure 1 displays the life cycle of an example mine and associated cash flows (or economic value generated).

Figure 1
Example Mine Life Cycle and Economic Value Timing



Source: Newmont Mining, "Ghana Chamber of Mines Addendum to Response to IMF Questions," 2010.

As shown, upon receipt of necessary government approvals, the exploration phase of a potential mine begins as the mining company (blue bars) invests in drilling and other exploration activities and resource modeling to determine the economic viability of a potential mine.[1] This phase may last 10 or more years. If an opportunity is estimated to be profitable under expected metal prices, expected production, capital and operating cost and cash flow assumptions, the company may decide to advance the project to a construction and development phase, which typically requires an additional two to five years, depending on the complexity of the project. It is during this phase where a company invests significant

financial resources. For example, Newmont Mining is currently developing a gold mine in Suriname where development costs are expected to approach $1B; however, larger and more complex projects can require many multiples of this level of investment.[2]

Upon the decision to develop a mine, host countries and offshore service providers begin to receive immediate revenues (yellow and green bars.) For host countries these include not only payments to a government (in the form of import duties, employment, corporate and other taxes received from both on- and offshore service providers, contracted by the mining company.) The split of economic value retained by on- and offshore contracted suppliers reflects the reality of mining. In most host countries, a significant portion of the equipment and input commodities (steel, fuel, etc.) need to be imported to conduct construction and mining activities.[3]

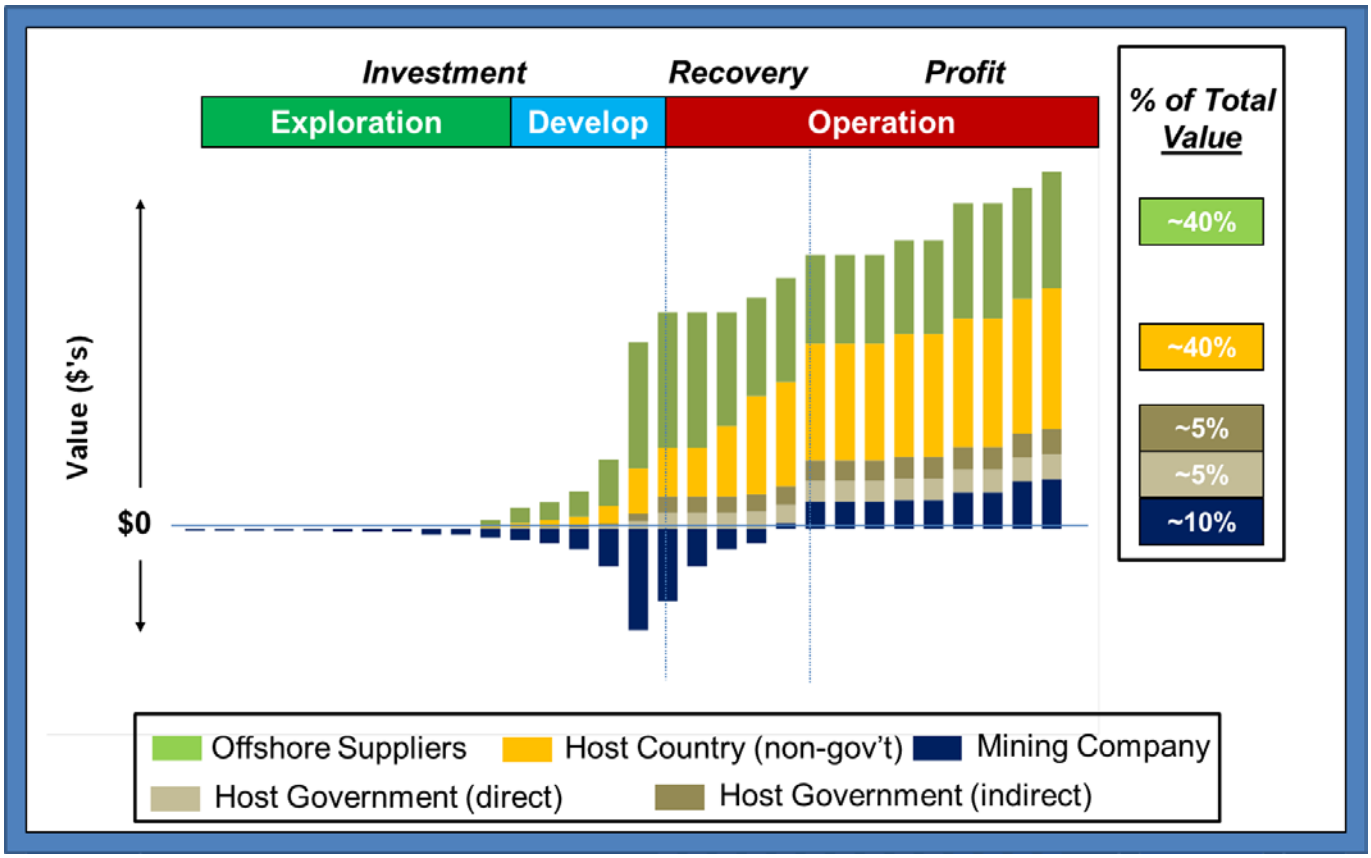
Depending on the deposit geological characteristics, the operational phase of a mine may extend for many decades (note, however, current gold mining projects typically have much shorter mine lives, averaging only 10 to 15 years.) The first revenues received by the company during the operational phase are used to recover the capital investments incurred during the exploration and development periods and/or to fund additional development of the mine if projected to be economically viable. As such it may take many years until a mining company actually makes a profit. Host countries, on the other hand, receive employment taxes as well as production taxes and royalties and other payments immediately and these payments last throughout the operational life of a mine. Importantly, the economic values generated by on- and offshore service providers also continue as replacement parts and input commodities are required (fuel, electricity, etc.) Once all economically viable ore has been extracted, a mine will enter a decommissioning and closure phase.

Distribution of Economic Benefits

Literature related to the economic value received from mining typically highlights that royalties and taxation are the principal sources for host government. However, by far, the most significant means by which value flows from mining firms to host countries is through payments to suppliers and contractors and wages paid for employees (in other words more value is generated from the activities of mining firms rather than through royalties and direct taxation). Figure 2 expands on the previous figure displaying the approximate sources of economic value over the life of a typical mine, including the breakout of direct and indirect benefits received by host country governments.

As shown, on- and offshore contracted firms of the mining company retain the vast majority of economic value (evenly split at approximately 40% each.) These firms provide the necessary capital and operating inputs required to build and operate a mine and include costs for steel and electricity required to build and operate mining and processing facilities, haul trucks and other mining equipment as well as fuel and other inputs. Direct payments to governments by mining firms, in the form of employment and corporate taxes and applicable dividend and royalty payments approach 5% of total value. Governments typically receive an additional approximate 5% of value indirectly as contracting firms pay their own employment and corporate taxes.

Figure 2
Approximate Revenue Breakdown from Gold Mines in Ghana



Source: Newport Mining, "Ghana Chamber of Mines Addendum to Response to IMF Questions," 2010 and ICMM, "Mining in Ghana – What Future Can We Expect," 2015.

Surprising to many is that profits received by mining companies typically represent only ~10% of the total value generated by a mine. As mentioned earlier, these profits are used to repay funds expended during the exploration and development phases of the mine. In addition, mining firms generally allocate nearly 1% of value to local community and social investment programs. Overall, mining companies and host-country governments tend to retain equivalent value from a mine.

Other Sources of Economic Value

Mining, unlike many manufacturing businesses, typically occurs in rural, less economically developed regions where job creation is scarce and poverty-level subsistence living is widespread. A recent study on mining in Ghana estimates that the approximately 7,000 citizens directly employed by mining companies in the country, there are nearly 110,000 additional jobs in the wider economy, including individuals employed at local firms used throughout the supply chain (approximately 70,000) as well as the induced positions resulting from re-spending of salaries (nearly 40,000). Direct, indirect and induced job creation result in an employment multiple of approximately 15 to 1.[4]

In addition to job creation, the benefits of mining include training and community development. Overall, mining companies generally allocate ~5% of payroll expenses toward training activities, targeted toward health and safety and technical skills to both direct and indirect (contractor) personnel. These skills result in increased productivity and are eventually transferable to other segments of an economy.[5] Creating and maintaining the social acceptance to operate with local communities is critical for the success of any mining operation. Community investments in education, health, housing and other infrastructure projects help address social issues in local areas. The World Gold Council estimates that on average, mining companies spend approximately 1% of total revenues on community investments. The economic value of any mining opportunity can only be realized if the social and political environments enable production.

Conclusions

Both host country governments and non-governmental organizations have tended to focus on royalties and tax payments as the primary methods of extracting economic value from mining operations. However, a more holistic perspective is required as significantly more value is generated due to expenditures by mining companies in their supply chains and on employee wages. Approximately 80% of the value generated by a mining operation flows evenly toward the on- and offshore suppliers that are contracted by the mining company. By contrast, production royalties, employment and corporate taxes and other payments to governments approach only 10% of the overall value from a typical mine. Following the exploration and development phases of a mine, the mining company eventually realizes the remaining 10% of value, from which prior investments are recovered and future investments can made.

Governments attempting to extract higher royalties and taxes are at risk of:

- Decreasing the minable reserves at existing mining operations and thus shortening the life of an existing or potential mine. This is turn, results in reduced employment and supply-chain spending, the larger sources of economic value; and

- Reducing the incentive for mining companies to invest in exploration opportunities within the country.

Overall, given the magnitude of capital investment and length of time required to explore and develop an operation, mining companies require stable legislative environments: uncertainty reduces the incentive to invest and thus halts economic values that can be realized. As a result, this article recommends a careful analysis of the holistic benefits of mining by host countries.

Endnotes

1 Estimates do vary, however, within the gold sector, in general less than 1% of prospecting exploration prospects eventually meet economic thresholds to become a viable mining operation.

2 Importantly, these investments are funded through the cash flow from a company's current operations or via the capital markets (debt, equity and/or other financings).

3 For example, it is not practical to assume that large-scale mining equipment can be purchased through local (or onshore) providers as these industries generally do not exist within a country. As a result, this equipment is purchased from large, global companies such as Caterpillar and/or Komatsu and then imported into the host country, from which governments receive duties and other payments.

4 ICMM, "Mining in Ghana – What Future Can We Expect," 2015.

5 World Gold Council, "The Social and Economic Impacts of Gold Mining," 2015.

Author Biography

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

Thomas (Tom) Brady is currently the Chief Economist at Newmont Mining Corporation and is responsible for generating the company's assumptions of key metal and energy commodity, foreign exchange and cost escalation rates. 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.

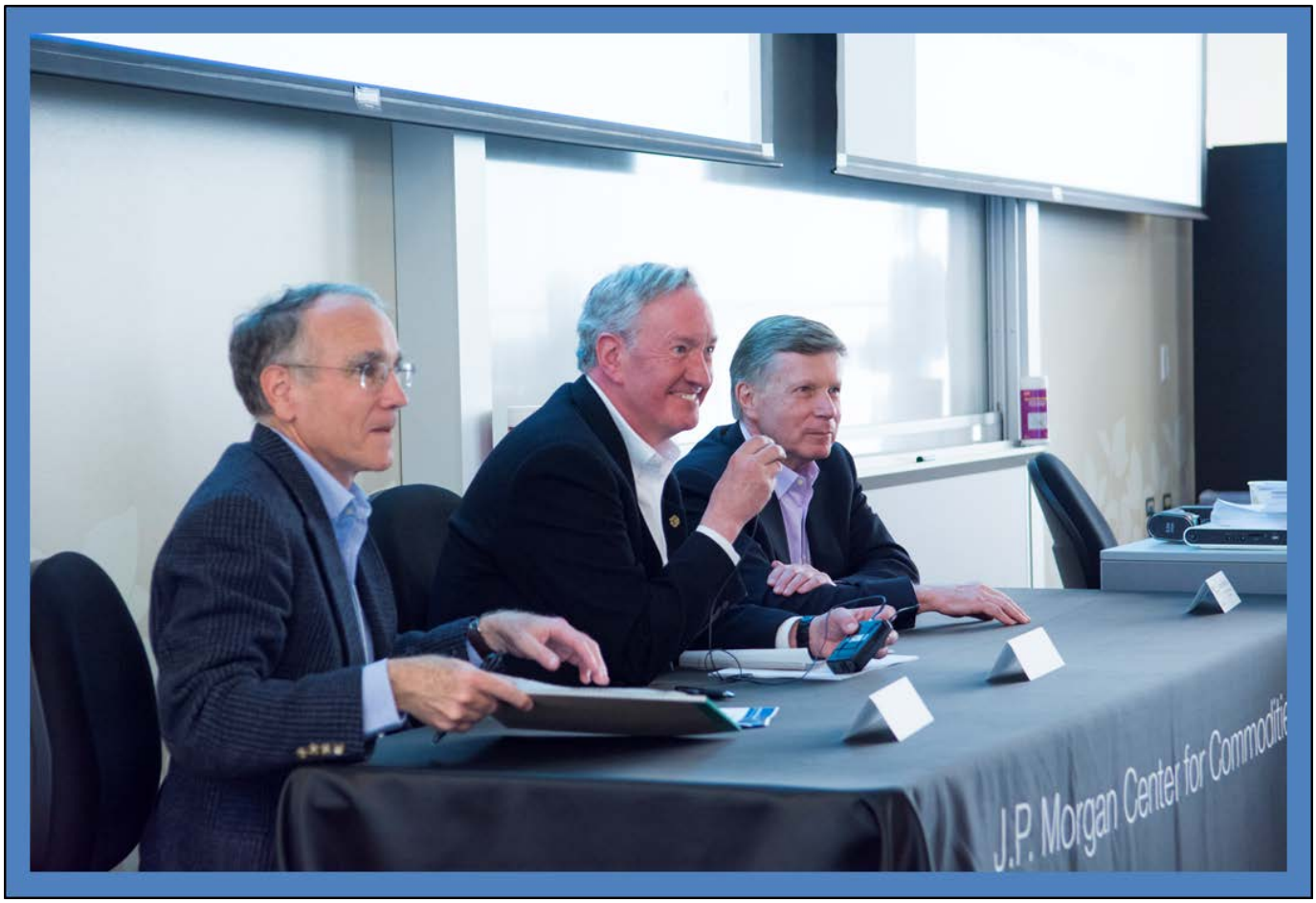
Previously Dr. Brady was a Senior Manager at Risk Capital Management, a consultancy that advised energy and natural resource companies on financial risk, valuation and commodity hedging. Dr. Brady has also worked with CQG, Inc. where he developed a suite of automated trading systems for commodity futures 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, Dr. Brady holds a Master's degree in mathematics, also from the Colorado School of Mines.

Dr. Brady is also a member of the J.P. Morgan Center for Commodities' Research Council at the University of Colorado Denver Business School.

Oil Market Dynamics and 2016 Outlook

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



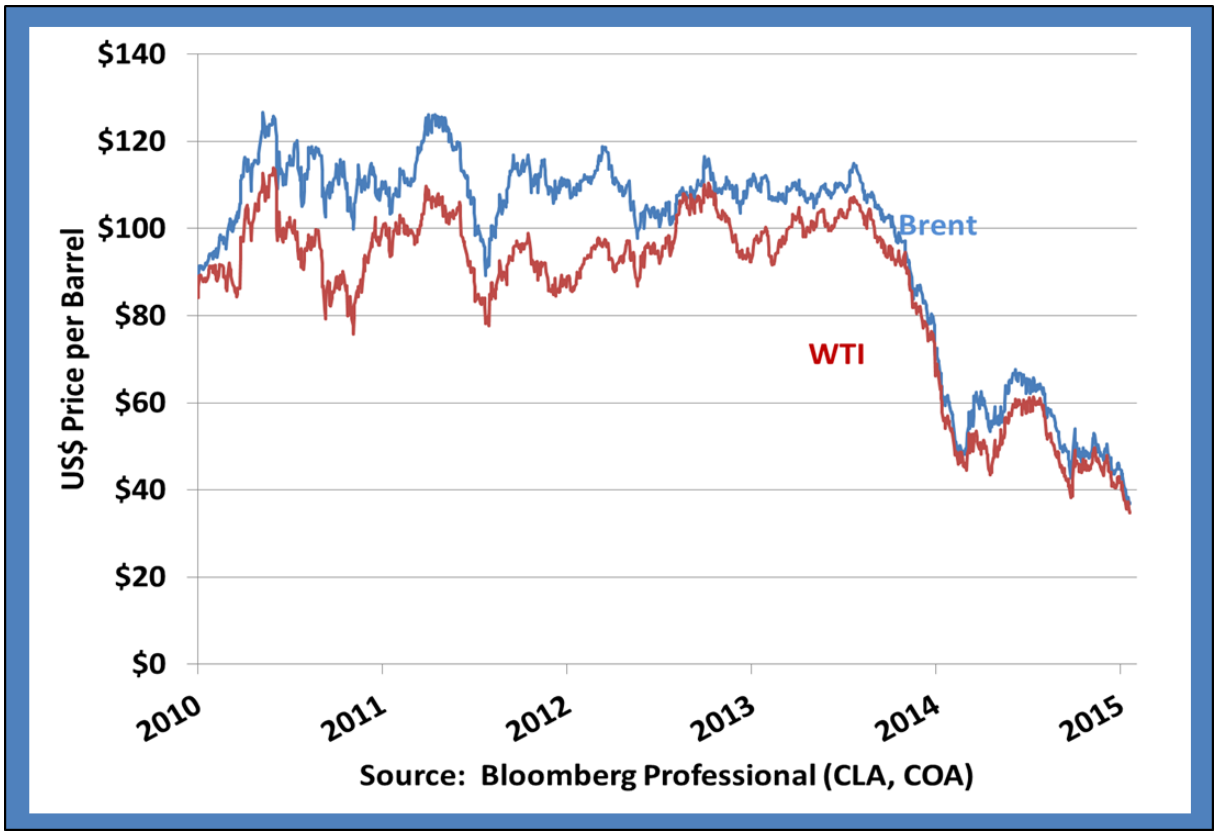
Dr. Bluford Putnam (center), Chief Economist at the CME Group, moderating the Energy Panel at the J.P. Morgan Center for Commodities' (JPMCC's) Research Council meeting in the Center's CoBank Lecture Hall on April 18, 2015. He is flanked (left) by Professor James Hamilton, University of California, San Diego; and (right) by Professor Vince Kaminski, Rice University.

Introduction

In the second half of 2014, the oil market experienced a powerful downward price adjustment, which was sustained throughout 2015; please see Figure 1 on the next page. There are several long-term supply and demand forces in play as well as some shorter-term response factors that make for a very difficult mix to analyze going forward. On the supply side, there are the technology-driven improvements in extraction techniques that ignited a production boom in the United States commencing back in 2006. On the demand side, there is the huge shift in the global growth environment from an emerging market boom period in the early 2000s to a sluggish growth period after

the 2008-2009 Great Recession. Also, on the demand side, technology has been steadily at work making transportation considerably more fuel-efficient. Shorter-term factors include the time-lagged feedback loops and the behavioral responses as producers have adjusted to a lower oil price environment, as well as policy responses, such as the lifting of the US ban on crude oil exports.

Figure 1
WTI and Brent Crude Oil Prices



Our forward looking analysis of the long-term trends in the crude oil market, including sluggish global growth, continued advances in transportation fuel efficiency, and extraction technology improvements, suggest that the era of relatively low prices could last for many years. In hindsight, what seems remarkable is that oil prices stayed as high as they did for as long as they did before breaking down in the second half of 2014.

This research report starts with a brief review of the three key long-term trends we perceive are the main drivers of crude oil prices, and we assess the probabilities of any shifts in these trends. Second, we take a look back at the perceived catalyst that "broke the camel's back" – namely the OPEC decision in November 2014 to keep producing at high levels even as oil prices were falling – and see what lessons can be learned about the behavior of suppliers in a low price environment. That is, there are short-term and long-term feedback loops from prices to production decisions that are quite complex, and that worked to reinforce lower oil prices, at least in 2015.

Finally, we cover an important change in market structure – namely the lifting of the US ban on crude oil exports – to appreciate some of the dynamic shifts involving relative price spreads inside the workings of the broader global oil market. As suggested above, both our long-term and short-term analyses place a high probability on the base case that the low crude oil price environment has many years to run. There are, however, a number of very low probability scenarios that could cause a return to higher prices, which deserve at least some passing consideration.

Critical Long-Term Trends Argue for a Sustained Low Price Environment

As noted in the summary, the oil market faces both demand and supply trends arguing for the continuation of low prices. The two persistent demand trends are (1) slow global growth and (2) continued advances in transportation fuel efficiency. The long-term supply trend is grounded in the pace of technology improvements related to continued reductions in extraction costs. None of these factors seem likely to change course over the next several years and some may be accelerating in intensity.

Slow Global Growth

China is decelerating. Brazil is in recession. Russia is in recession. Most emerging market countries are struggling to grow. In the mature, industrial countries, among the US, Europe, and Japan, about the best that can be expected is 2% real GDP growth, and even that low bar may tough to achieve in 2016. In essence, the era of strong commodity demand in the early 2000s that was supported by 10% real GDP growth in China and strong growth in many emerging market countries is long gone with little prospect of returning. And, in the post-2008 environment, the mature, industrial economies are struggling to produce anything better than lackluster growth. The implications of this growth outlook are for very sluggish growth in energy demand, and especially for crude oil. And, it is not clear what could change the growth prospects.

China's growth deceleration is based on four key factors. First, the country grew rapidly as it invested in infrastructure at an impressive pace in the decades from 1980-2010, but with modernization has come the reality of diminishing returns from new spending on nation-building projects.

Second, the aging demographic pattern is making a transition to a more domestic-demand driven growth model extremely difficult. The over-65 age group will make up more than 20% of the economy in the 2020s, and retirees spend considerably less per person than working age individuals. Rolling back the one-child policy, as was done in 2015, may help ease the demographic challenges by 2050, but not over the next decade or two. It takes thirty years to make a thirty year-old and materially impact the growth of the labor force.

Third, China has benefited from a large rural-to-urban migration that has supported growth for several decades. As the percent of the rural population declines in the 2020s, though, this source of growth for the economy will diminish as well. Finally, we note that China is still an export-dependent country. With its major trading partners no longer posting solid growth, exports have stagnated.

Importantly, none of these four key factors pointing to a slower growth rate are reversible by short-term government policy adjustments. Indeed, China is experiencing both a natural process of reduced long-term growth potential as a result of the success of its modernization programs while also dealing with slow-moving demographic patterns and lackluster global growth. Policies such as devaluing the currency are not likely to help much on the growth front in the short-run, even if a depreciating exchange rate against its trading partners is the most likely scenario for the currency going forward. We are not forecasting a hard-landing for China, but just a very bumpy road to a 3% real GDP trend growth rate in the 2020s, which is neither supportive of higher commodity prices in general or oil prices specifically.

There is a secondary effect related to China's impact on many commodities beyond oil. China's shadow banking system has depended heavily on using commodities as collateral for lending. During the China super-growth period, the use of commodities as collateral meant that commodity demand was accelerated beyond that associated with rapid economic growth.[1]

The reverse is true, too. As China has decelerated and commodity prices have fallen, some collateral has been released into the market and the demand for new commodity collateral for lending has fallen, making the China impact on commodity prices even more pronounced than the economic deceleration might suggest.

The US, Europe, and Japan have all tried every manner of expansionary monetary policy to pump up growth since the 2008-2009 recession to no avail. The lack of success of monetary policy to create superior growth is because it cannot address the fundamental reasons for slow growth.[2] The first and largest challenge to growth potential in these mature industrial countries is the demographic pattern. Populations are not growing and are aging while labor force growth is next to zero. On the demand side, as already noted for the case of China, per capita consumption spending declines for the retired demographic, and this is the faster growing segment of the population. With respect to potential GDP growth, if there is little to no labor force growth then it takes above average increases in labor productivity to create superior growth rates.

While this is possible with technological gains and outsized capital investments, it is highly unlikely in mature economies. Indeed, without major tax and labor market structural reforms that are only remote possibilities, it seems unlikely that sustained, above-average labor productivity gains are possible. Low short-term interest rates and central bank asset purchases (i.e., quantitative easing) can raise asset prices above what they might have otherwise been, but there is little to no evidence that they can raise labor productivity.

Recessions or slow growth in most of the emerging market countries are not so easily grouped into one cause. Commodity producing countries are naturally suffering in a slow demand world. But political risks are high and rising in a number of countries from Brazil to Turkey. And, in the Asian countries close to China, it is the deceleration of their big neighbor that dominates growth prospects. Regardless of the cause, it seems hard to project resurgence in emerging market country growth without either stronger growth in China or in the mature industrial countries, and neither is in the cards for 2016.

Fuel Efficiency

Also on the demand side, and not always given its proper due, is the continued progress in transportation fuel efficiency. Crude oil is 70% to 75% a transportation fuel in terms of the uses of refined petroleum product. The relentless march toward greater fuel efficiency is both impressive and a continued drag on crude oil demand growth. The elasticity of demand for crude oil with respect to real GDP growth is a on a long-run declining path. Indeed, there appears to be considerable gains still possible in the fuel efficiencies of internal combustion engine vehicles, including the ability to use lighter materials such as aluminum in pick-up truck frames.

Natural gas is starting to make inroads into transportation in bus fleets, in long-haul truck transport, and in railroad engines. Electrical-driven vehicles are still a minute portion of the transportation system, but longer-term advances in battery technology could change that, especially if batteries can be made both lighter as well as more efficient. And, the promise of clean-burning hydrogen, with H2O coming out the exhaust pipe, remains a long-term dream attracting considerable research and development funding.

Risk Factors

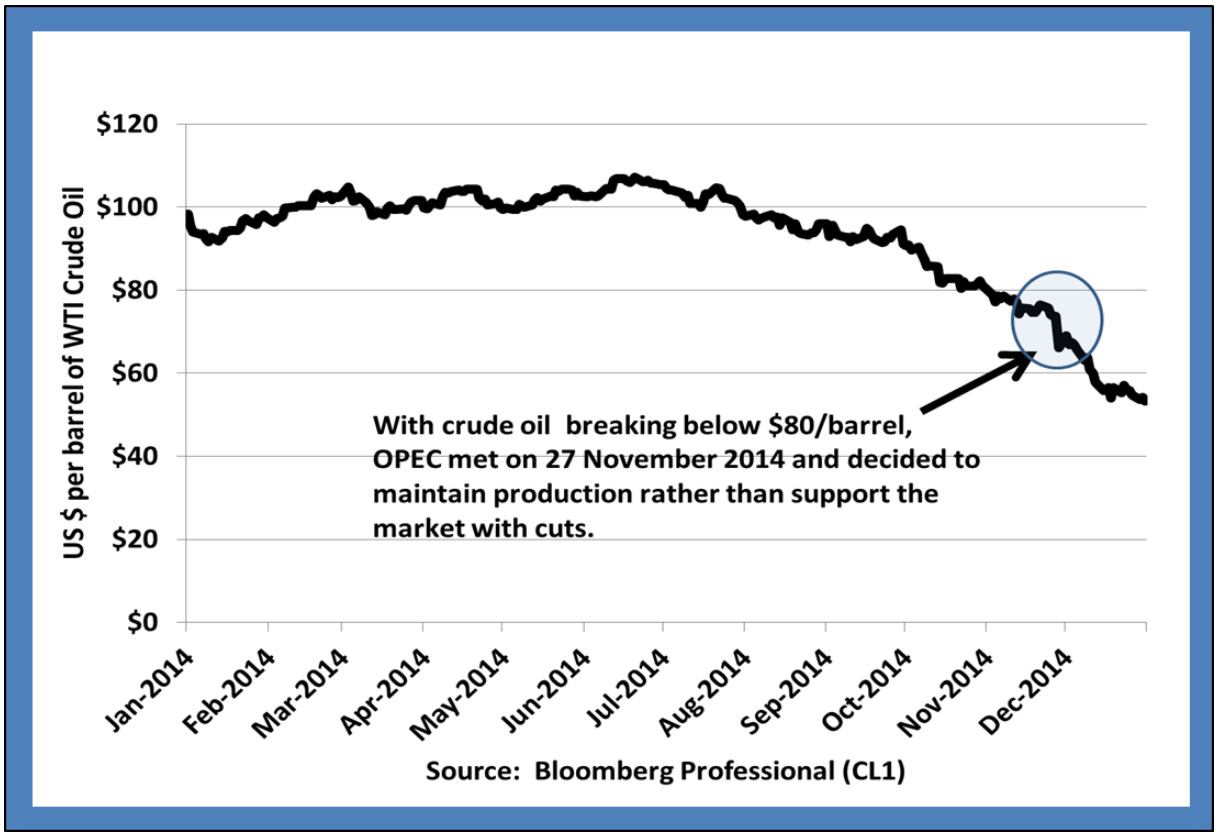
While the base case of slow global growth has a very high probability associated with it, there are risks. First, global growth could be even slower, almost stagnant, if China's deceleration turns into a hard landing. We give this possibility a meaningful 25% probability, and it would most likely point to a temporarily lower level of global crude oil prices. Second, supply disruptions are possible depending on how tensions in the Middle East, particularly relationships developments among Saudi Arabia, Iran, and Iraq. At the present time we place the probability of military action that would impair global supply as very small, less than 10%; nevertheless this possibility is worthy of close monitoring as this low probability event would come with huge price action potential to the upside.

Appreciating the Catalyst for the Price Break

When long-term supply and demand forces are in play, it can take markets many years to realize their full impact. Often there is a catalyst for a price break, which can be incorrectly interpreted just because of its association in timing with the critical event that may have been building for years. We argue that this was the case in the fall of 2014.

Crude oil prices had been bouncing around $100/barrel all through the first half of the year 2014. Prices started drifting down in July 2014, and broke below $90/barrel in October 2014. In mid-November, prices broke below $80/barrel. On November 27th, 2014, the Organization of Petroleum Exporting Countries (OPEC) met in Vienna and decided to maintain production rather than cutback and try to support the market. Please see Figure 2 on the next page.

Figure 2
NYMEX WTI Crude Oil: 2014



"Recording its concern over the rapid decline in oil prices in recent months, the Conference concurred that stable oil prices – at a level which did not affect global economic growth but which, at the same time, allowed producers to receive a decent income and to invest to meet future demand – were vital for world economic wellbeing. Accordingly, in the interest of restoring market equilibrium, the Conference decided to maintain the production level of 30.0 mb/d, as was agreed in December 2011.[3]

The OPEC statement, emphasizing the need for oil producing countries to keep producing to maintain their incomes, fueled concerns that oil prices would fall further, and fall they did.

During 2015, much has been made by many analysts about the Saudi Arabian strategy to increase production to squeeze out high marginal cost producers. We would argue that this is much more *rationale* than *strategy*. That is, the key problem for Saudi Arabia, not to mention virtually every other OPEC member, is that their government spending programs were built on assumptions of crude oil prices staying above $80 per barrel (or perhaps a little higher) for as far as the eye could see. $40 per barrel oil puts tremendous domestic political risk into the equation for the governing authorities, as it makes it nearly impossible to continue with planned spending and subsidy programs without material adjustments.

Indeed, Saudi Arabia has gone to the debt markets for new money as well as cutback government spending and subsidies. By increasing production, they were able in some small way to keep the cash flowing. As we analyze the behavioral response and feedback loops to lower prices in the crude oil market, we will again come back to the theme that long-term spending and liability commitments work to keep production strong, even with low prices, at least for an extended period of time, which creates complex lags in the price to production response cycles.

Behavioral Feedbacks and Policy Responses Impact Crude Oil Spreads

US Production Dynamics

When crude oil prices collapsed by half in the fourth quarter of 2014, many analysts expected a relatively quick supply response based on models taught in every Economics 101 class. Unfortunately, the basic economics version of supply and demand knows nothing about debt, time, and cash flow, among many other things. Many wells in the United States were shut down in 2015 as predicted, but a focus on getting more oil from the most efficient wells kept production higher than most analysts expected.[4] There were a couple of reasons for this common miscalculation.

One has to appreciate the difference between cash flow and accounting reports. Oil producers, just like mom and pop convenience stores, know that cash is king. It is very easy to include non-cash items, such as depreciation, as well as certain investment or capital costs, into the calculation of how much money is required to produce the next barrel of oil. What really matters to the oil producer, though, is the actual cash costs of the next barrel of oil, and these cash costs can be substantially lower than the costs as measured by accounting principles and purported to represent the dollar cost per barrel.[5] What this means is that on a going-forward cash basis, production that looked unprofitable on an accounting basis was still net cash flow positive or only small cash losers. So the producer kept on pumping – oil and cash.

Debt matters, too, because many oil producers have a lot of it. If they were to shut their production down, there would not only be no flow of oil, but also no cash flow; and the cash is needed to pay their debts. Pumping oil at a loss makes sense if one can stay in the game for the long run and avoid bankruptcy.

And then there are the advances in technology. Producers in the US using hydraulic fracturing methods and horizontal drilling have been increasingly improving their ability to finish wells faster and get to the new wells sooner at lower costs. "Finishing faster" simply means sharply increased production in the first months of a well's life, allowing the producer to close the well sooner and move to the next location. Rigs are now available that can "walk" (albeit very slowly) to the next drill site. Enhanced fracturing techniques can improve extraction results. It all added up in 2015 to an ability by US producers to cut rig count and still maintain strong production.

What may change in 2016 is the lagged impact of sharply reduced capital investment in 2015. That is, while producers were using technological improvements to get more oil from fewer rigs, they were not investing in new capabilities. Virtually every capital investment project that could reasonably be delayed

in 2015 was, indeed, delayed or postponed indefinitely, while oil producers assessed their economic future in a lower price environment. By the second half of 2015, most producers had come to realize that that they were in for a very long period of lower prices, and the process of downsizing and consolidation began in earnest.

We draw two conclusions from the mix of improved extraction technology and lack of new capital investment. First, when oil prices rise, at some threshold price, probably north of $50 per barrel yet well below $80 per barrel, new production will again be profitable and will come on line faster than in the past. Second, the lack of capital investment in 2015, and likely lack of investment in 2016, will start to hit production, such that US production in 2016 and beyond may show material declines from 2015 and 2014 levels so long as oil prices are below $50 per barrel. This capital investment impact may be much larger for higher cost production areas such as the North Sea, which has seen declining production of oil for over a decade and has higher ongoing maintenance and marginal costs.

From a global supply picture, the reduced production from the US and the North Sea, and probably Alberta as well, in 2016, is not likely to impact prices since it may be more or less offset by rising production entering the world market from Iran. It is unclear how the balance will tilt, but the overall impact on prices may be more to cause short-term volatility within a wide price range rather than to push prices back onto a sustained rising trend.

US Lifts Oil Export Ban

The US crude oil export ban was lifted in December 2015 as part of the legislation to fund the Government through September 2016. The export ban was imposed back in 1975 under the administration of President Gerald Ford, in the midst of public anxiety over (a) the rising power of OPEC, (b) reduced US influence over global economic conditions, and (c) fears of slow growth and high inflation – then known as stagflation. In fact, through Presidential actions over the years and other rule changes, the ban was quite leaky, so to speak.

As a result, the short-term impact on oil prices of lifting the export ban is likely to be relatively small in terms of prices and not an important driver for production. Nevertheless, anytime frictions and barriers to free trade are removed the market price discovery process is made more robust and capital allocation more efficient. Hence, the lifting of the export ban is a positive factor for the role of US oil (West Texas Intermediate, aka WTI) as a global benchmark. Here we provide our perspective on some of the key questions being asked.

1. What Has Really Changed?

Under the old law, US refined product was allowed for export. Crude oil exports required licenses. Effectively, US crude oil could be exported to Canada and Mexico by permits, which were virtually automatically granted, as were re-exports of foreign-sourced oil, and some crude oil exports from California and Alaska. Moreover, the definition of refined product had been weakened in the last several years to include some lightly altered crude products (i.e., lighter condensate products). With the lifting of the crude oil ban, US producers now can export freely; however, do not expect much of a rise in

exports of crude oil any time soon. Indeed, the sum of crude oil plus refined product exports is likely to remain more or less on its current trend for 2016-2017.

2. Will Lifting the Crude Oil Export Ban Result in Greater US Production?

No. The low price environment for crude oil globally that commenced in Q4/2014 is still with us, and the longer-term expectation for price is the key driver of future production. As noted earlier, China is still decelerating. Growth in emerging markets is slow. Europe, the US, Japan, all may grow 1% to 2% in real GDP terms. No major demand surges here. And as discussed in the technology trends section, oil is largely a transportation fuel. Transportation is becoming steadily more energy efficient. In short, as we have argued, the demand situation does not support a return to a higher price environment whether the US exports oil or not. Nevertheless, the lifting of the US crude oil export ban will mean some small benefits to US producers based on the tighter Bakken-WTI spreads, because Bakken and other domestic sweet crudes will now have new export markets that will bring higher revenue overall.

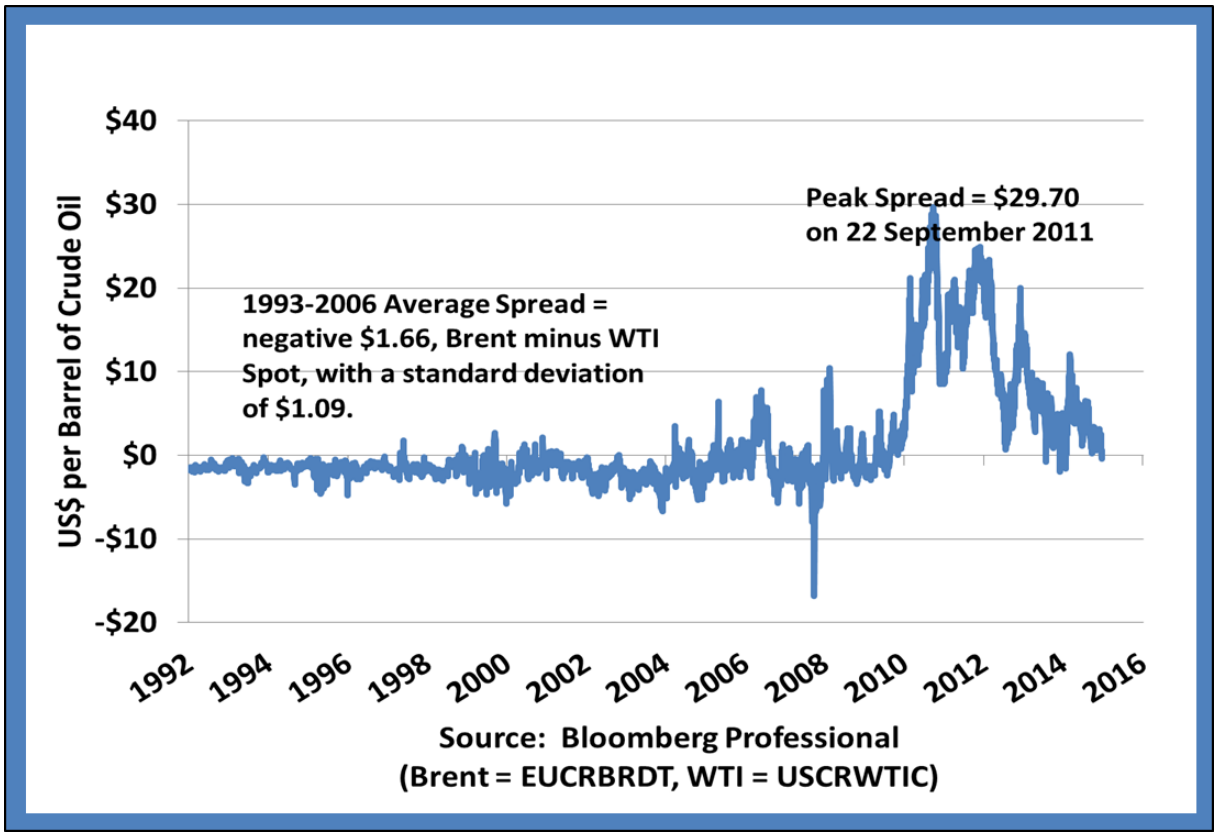
3. What is the Likely Impact on Brent-WTI and Other Crude Oil Price Spreads?

Our view is that any policy change that removes market frictions and makes the connection among different sources of oil around the world more efficient will assist the robustness of the global oil price discovery process. Thus, the lifting of the US crude oil export ban could make an incremental difference in narrowing the spread between North Sea Brent and US West Texas Intermediate (WTI). Figure 3 on the next page shows the history of this spread since 1992.

Indeed, in early December 2015, with news that the crude oil export ban might be lifted, there were some changes in the price spreads between different grades of crude. The WTI-Brent spread narrowed slightly in both spot and longer-dated futures. Also, the Bakken-WTI spread tightened. In addition, in the US Gulf Coast, WTI and LLS (Louisiana Light Sweet Crude) went up in price relative to the sour crude grades (e.g., Mars). The export ban artificially depressed sweet crude in the U.S. Gulf Coast market relative to sour crude. So, there was a perceptible change in the sweet-sour spread in the US Gulf Coast market in the weeks prior to the lifting of the crude oil export ban.

Prior to 2006 and the emerging US oil production boom, WTI and Brent met, in a competitive sense, at the refineries in the northeast part of the US. From 1993-2006, the Brent-WTI spot price spread was typically extremely narrow and not very volatile. With the production boom, higher US oil production eventually overwhelmed the capacity to deliver oil where prices were higher, and refined product exports had not yet taken off.

Figure 3
Brent minus WTI Spot Price Spread



During 2011-2012, Brent was consistently priced $20 above WTI, with a peak of $29.70 in September 2011 with these two markets, in effect, temporarily separated. In 2013 and 2014, the oil delivery and storage infrastructure in the US largely caught up with greater production, and the spread has narrowed materially. Since lifting the crude oil ban incrementally improves the competition among all sources of oil, this suggests that the spread between Brent and WTI will average next to nothing over the coming years; however, it can still be quite volatile around the average given the potential for weather and maintenance supply disruptions in the North Sea.

4. What are the Implications for Refined Product?

Another implication of lifting the ban is that oil exports from the US will go where the combination of lower transport costs and refinery demand coincide. This probably means some increase over time in US oil exports to Asia. Remember though, crude oil is not so much exported to a country as to a refiner that happens to be in another country. So, the direction of crude oil exports from the US will depend on developments in refining capacity in the US and around the world as well as on transport costs between competing sources of crude oil.

US refineries are extremely cost efficient. They are more than capable of competing effectively around the world – again putting increased emphasis on transport and storage costs. Also, in virtually all

countries around the world, it is difficult to get the permits to build new refineries – not impossible, just hard. So, to build a new refinery, one needs billions of dollars, a steady source of foreseeable demand, and reasonable transport costs to get the crude oil from the source to the new refinery. Put another way, changes in the global environment for refineries will drive some shift in exports over the coming years, but not quickly, meaning US refined product exports will probably hold up quite well even as there may be incremental increases in crude oil exports.

Long-term, as the competitive landscape for refineries adjusts, there may be some incremental narrowing of refined product price spreads relative to crude oil since the crude oil market will be just a little more efficient. This will take time and may turn out to be relatively small impact.

5. What is the State of the US infrastructure for Exporting Crude Oil?

The lifting of the export ban will have the biggest impact in the U.S. Gulf Coast, and to a lesser extent on the West Coast and Alaska. The infrastructure for WTI exports in the U.S. Gulf Coast is already completed, and the U.S. is actively exporting some crude oil and lighter condensate products, not to mention all the Natural Gas Liquids (NGLs) such as propane (which use the same export terminals.) At this time, there is adequate capacity to handle any increases in export flow. Indeed, in January 2016 the first boat loaded with US crude was leaving Texas for Europe.

Conclusion

Our analysis points to a base case for a long period of low crude oil prices. The China-driven boom in emerging market demand is over. Slow growth due to aging demographic challenges will keep real GDP growth very slow in the mature industrial countries. Technological advances in fuel efficiency in transportation mean the elasticity of demand for crude oil with respect to economic growth is diminishing. And on the supply-side, further technological improvements in oil extraction are reducing costs, allowing more production from fewer oilrigs. This all adds up to a very long and prolonged period of low oil prices as our base case. The price risks to the downside for oil prices come mostly from the possibility of a hard landing in the Chinese economy leading to a global recession – not likely but worth considering. The price risks to the upside come from conflict in the Middle East, possibility involving Saudi Arabia and Iran, leading to major supply disruptions – again, this is a small probability event with a huge impact, so monitoring is required.

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.

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Prior to joining CME Group, Dr. Putnam gained more than 35 years of 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 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. He has authored five books on international finance, as well as many articles that have been published in academic journals and business publications.

Dr. Putnam is also a member of the J.P. Morgan Center for Commodities' Research Council at the University of Colorado Denver Business School.

Why Do Oil Prices Keep Going Down?

Marcelle Arak, Ph.D.
CoBank Professor of Commodities at University of Colorado Denver Business School; and Editor of "Global Commodity Issues [Editor's Choice]"

Sheila Tschinkel
Visiting Faculty in Economics at Emory University, Atlanta

Professor Marcelle Arak, University of Colorado Denver Business School, presenting to the J.P. Morgan Center for Commodities' (JPMCC's) Research Council on April 18, 2015. Mr. Matthew Fleming, Program Coordinator of the JPMCC, is seated in the left foreground.

Global stock markets have been in a tailspin[1]. And the sinking price of oil received at least some of the blame. The cost of a barrel of crude has reached[2] a 12-year-low of US$27, down from more than $100[3] a little more than year ago. And that may not be the end of it,[4] according to some in the industry. Plummeting oil prices have raised fears of a worldwide recession, even though countries are still reporting growth in jobs and income. Are there other factors driving oil prices globally? If prices are going down, suggesting flat or falling demand, why do producers keep adding supply to the market?

They should be curtailing production, according to economics 101. But the oil market doesn't always seem to follow the rules.

Swelling Supply

In fact, even as prices have fallen, the amount of oil being pumped has actually increased. And supply is poised to rise even further, thanks to the lifting of sanctions against Iran, leading the International Energy Agency (IEA) to warn[5] that markets could "drown in oversupply." Global oil supply averaged[6] 96.9 million barrels a day in the fourth quarter of 2015, up from 95.4 million a year earlier. Demand, meanwhile, was almost 2 million barrels lower at 95.1 million and is expected to decline in the current quarter, even as supply is likely to increase, according to the IEA.

It's this glut of crude oil in the global economy that has led to the sharp declines in oil prices. The additional supplies have ended up in storage tanks, because consumption has barely budged. And oil revenues of producing countries have consequently dropped very sharply,[7] in tandem with price. This leads to two more questions: if prices have fallen so much, why doesn't demand increase? And if demand and revenues are down, why don't producers just turn down the taps?

Inelasticity of Demand

It's actually not a surprise that demand hasn't changed much, because oil use in the short run is determined by factors that cannot be changed quickly. Economists look at the responsiveness of demand to price changes in relative terms and refer to this as the elasticity of demand. If a price decline of one percent, for example, leads to an increase in the volume sold of less than one percent, it means demand is not elastic. This is the case with oil consumption. In other words, the demand for oil in the short run is not that affected by changes in price. A consumer driving a gas-guzzling SUV in excellent condition will not trade it in right away just because prices rose. Or if you are a manufacturer and your equipment is still in good condition, you cannot adjust it to use less energy or buy different machines quickly.

The inelasticity of demand also means that the total revenue the seller receives will not rise when prices fall. On the other hand, if a one percent price decline were to lead to a more than one percent increase in the volume sold, then total revenue would rise as a result of the price cut. When prices are rising, inelasticity of demand works in the favor of the seller. An increase in price leads to a lower volume of sales but higher revenue. That is, the relative decline in volume is less than the rise in price, resulting in more money taken in by the seller.

Thus, the current situation reflects a highly competitive market and a weak response from customers in the short run. The current global rate of economic growth, the state of technology and things like the weather determine the demand for energy more than price. At the same time, producers and individual nations keep trying to increase revenue by producing and selling even more oil. With demand inelastic, the price decline does not generate enough of an increase in sales volume to raise revenue for any seller.

Fiddling with the Taps

This brings us to the other question: why don't producers pump less oil?

If demand is inelastic in the short run, would withholding supply in the hope that prices will rise lead to more revenue? It turns out that this depends on the share of global output the supplier controls: if a major player or cooperating group of sellers account for a share of total sales greater than the elasticity of demand, weighted by the group's operating margin, then cutting back on supply can improve its current revenue, even if sales volume declines. This is because the cutback is able to generate a price increase that is large enough.

Of course, this cutback generates even larger benefits or a "free ride" for other sellers who do not cut back. Other suppliers happily sell at the higher price. This may be one reason it is hard to get cooperation to raise the price. Right now oil producers are not cooperating with each other as much as they have in the past, such as in the 1970s. Back then, the Organization of Petroleum Exporting Countries (OPEC) controlled more than half of the global supply of crude. When they cut production, prices rose and all its members benefited.

Today, that kind of cooperation is much less likely, as oil-producing countries don't appear interested or even able to work together to raise prices – let alone do so unilaterally. They have varying foreign policy interests and economic structures. The biggest producer, Saudi Arabia, is even accused[8] of purposely trying to keep prices low to run upstart American producers out of business. And those U.S. producers, which ramped up production in recent years in large part because oil prices were above $100, still haven't backed down,[9] perhaps encouraged by the move by Congress to allow U.S. oil exports[10] for the first time in four decades.

What's Next

Still, the relationship between demand elasticity and percentage of market share implies that all it would take is two or three major suppliers working together to restrict supply sufficiently to raise prices by enough to increase their total revenue. For example, Saudi Arabia and the Russian Federation each control[11] about 10 percent of supply. If they both agreed to cut back, it would probably stop the skid in prices and improve their total revenue. It would also improve revenues of countries and producers who did not cut back. While this would work in the current environment, producers may be thinking long-term and waiting out the lower prices in hopes of either pushing U.S. marginal suppliers into bankruptcy[12] or reversing the trend toward fuel efficiency.

But these trends work both ways. For example, the OPEC-generated price increases in the 1970s caused changes in the energy efficiency of capital equipment in the years that followed. All sectors of the economy bought more fuel-efficient machinery and insulated structures. And this reduced demand for oil. That is, in the long run, the price elasticity of demand is higher because consumers are more responsive to price changes. If prices go up, consumers and businesses eventually find ways to cut back. If prices are low, demand will eventually rise commensurate with the reduced cost.

Meanwhile, as long as supply continues to rise and demand remains inelastic or unresponsive, the price of oil is likely to continue its slide.

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A version of this article was originally published at http://theconversation.com on January 21, 2016.

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Sheila Tschinkel served as Resident U.S. Treasury Economic Advisor in several Eastern European and Central Asian countries. She worked with Prime Ministers, Finance Ministers and central bank Governors on macroeconomic policy issues and cash and debt management. Her abilities to facilitate discussion were instrumental in obtaining agreement to divide the assets and liabilities of the former Yugoslavia among the five countries that succeeded it.

Before work abroad, Ms. Tschinkel served as Senior Vice President and Director of Research at the Federal Reserve Bank of Atlanta and was a member of the bank's Management Committee. In this capacity, she regularly attended meetings of the Federal Open Market Committee (FOMC), the Federal Reserve Bank's monetary policy setting group. Under Ms. Tschinkel, the Atlanta Bank became the first Fed research department to specialize in finance as well as macroeconomic and regional issues.

Earlier, Ms. Tschinkel was an official of the Federal Reserve Bank of New York. There, she had administrative responsibility for the open market "trading desk," where monetary policy is implemented. In the private sector she was Vice President and Director of Global Asset Management at Chase Bank N.A., where she ran the bank's multi-billion dollar investment portfolio and oversaw the global management of loan assets.

Ms. Tschinkel completed the Advanced Management Program at Harvard. She did graduate work in economics at Yale University and received an undergraduate degree from Hunter College, City University of New York; she is a member of the Hunter College Hall of Fame.

Ms Tschinkel serves on the Dean's Council of the Rollins School of Public Health and the Advisory Board of the Oglethorpe University Museum, and is a past member of the Emory University Board of Visitors and its Executive Committee.

Contributing Editor's Collection

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

This collection of four separate digest articles provides answers to the following questions:

- When has OPEC spare capacity mattered for oil prices?
- What are the sources of return for CTAs and commodity indices?
- What are the risk-management lessons from high-profile commodity derivatives debacles?
- What determines whether commodity futures contacts succeed or not?

Each article takes a different approach in answering these questions, as noted on the next page.

Hilary Till, M.Sc. (Statistics), Solich Scholar, J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School, posing a question at the JPMCC's Research Council meeting on December 4, 2015. She is flanked (left) by Dr. Sueann Ambron, Former Dean of the Business School and Senior Advisor, JPMCC; and (right) by Dr. Thomas Brady, Chief Economist at Newmont Mining Corporation; and (immediate foreground) by Dr. Margaret Slade, Professor Emeritus, Vancouver School of Economics, University of British Columbia and Co-Chair of the JPMCC Research Council.

Original Empirical Analysis

The first article on OPEC spare capacity and oil prices examines historical data and finds that at least in the past, OPEC spare capacity has only mattered when (U.S.) crude oil inventories have been low. The article does raise the question on whether a focus on OPEC behavior will continue to be relevant if America's shale industry has replaced OPEC as the oil market's "swing producer."

Survey of Empirical Research

The second article on Commodity Trading Advisors (CTAs) and commodity indices surveys empirical research on the long-term drivers of return for futures programs. From this survey, one can find strong evidence that there are persistent returns in futures programs due to momentum, roll yield, and also due to rebalancing. Further, a CTA investor may also require that a program's dynamic trading strategies produce returns that have options-like payoff profiles; and institutional investors expect commodity index programs to provide diversification for their balanced equity-and-bond portfolios.

Industry Case Studies

The third article on commodity derivatives debacles uses case studies to infer key risk-management lessons. Each of the case studies did not involve complex mathematical issues; instead, they can each be summarized as fundamental control problems. Large commodity derivatives trading companies must emphasize (1) compliance with regulatory rules and laws; (2) the valuation of derivatives instruments by third parties independent of front-office personnel; and (3) the imposition of position limits in all electronic trading systems.

A Complex System Modeled as a Competitive Game

The fourth article on futures contract successes and failures treats the futures markets as a competitive game. Specifically, futures trading can be seen as a game where the competing players, the hedgers and speculators, each have sufficient economic reasons to participate. The referee of this game, the government authorities, has the power to stop the game, if there is not a convincing economic rationale for a futures contract's existence. Therefore, a futures contract can only succeed if it responds to a hedging need, and if speculators are able to manage the risk of taking on hedger positions. In addition, if one cannot make a convincing case that a contract serves an economic purpose, then the contract is at risk to either being banned or being heavily curtailed.

Common Theme

The goal with each of the four digest articles that follows is to provide both industry participants and policymakers with useful insights on the frequently opaque, but always dynamic, commodity markets.

When Has OPEC Spare Capacity Mattered for Oil Prices?

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Forthcoming in ***Argo: New Frontiers in Practical Risk Management***
Available at SSRN: **http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2682694**

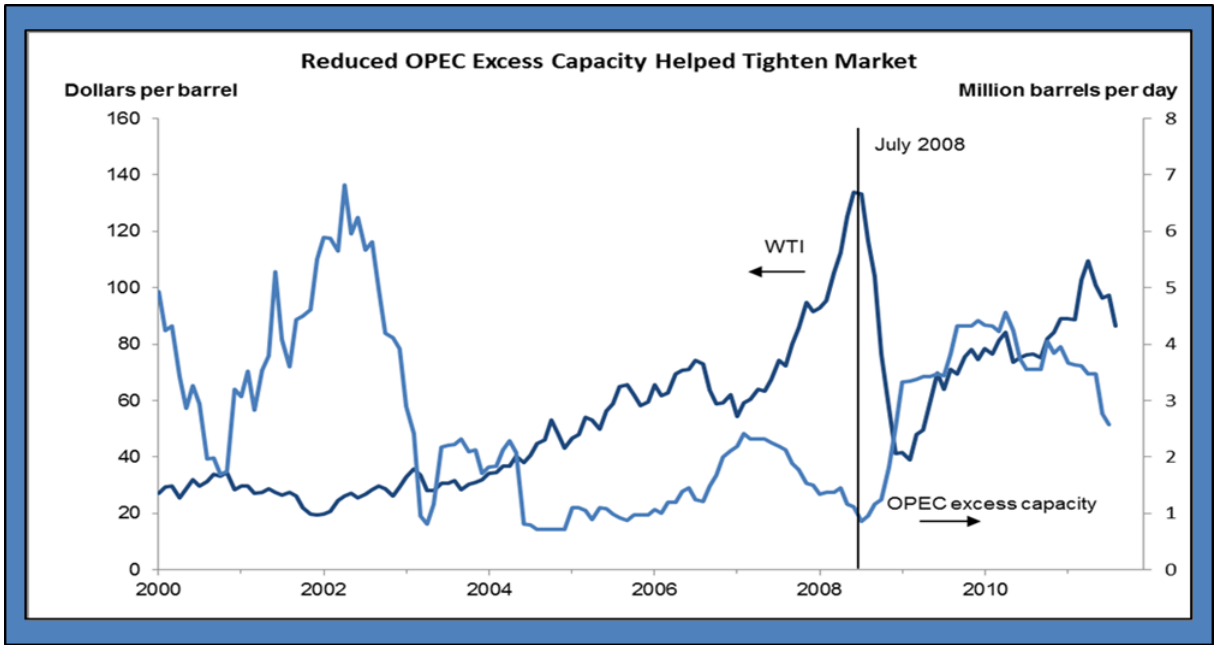
Oil prices are usually influenced by a number of factors. But there have arguably been times when OPEC spare capacity has been the most important factor for driving oil prices. This paper discusses the circumstances when this has likely been the case in the past.

In order to motivate why the spare capacity situation might be quite important to the behavior of crude oil prices, one can review the circumstances of 2008. The events of that year showed what can happen if the oil excess-capacity cushion becomes quite small. At the time, the role of the spot price of oil was arguably to find a level that would bring about sufficient demand destruction, after which the spot price of oil spectacularly dropped.

2008: A Clear Relationship

Figure 1 illustrates that when OPEC excess capacity levels reached pinch-point levels in 2008, the price of crude oil responded by exploding.

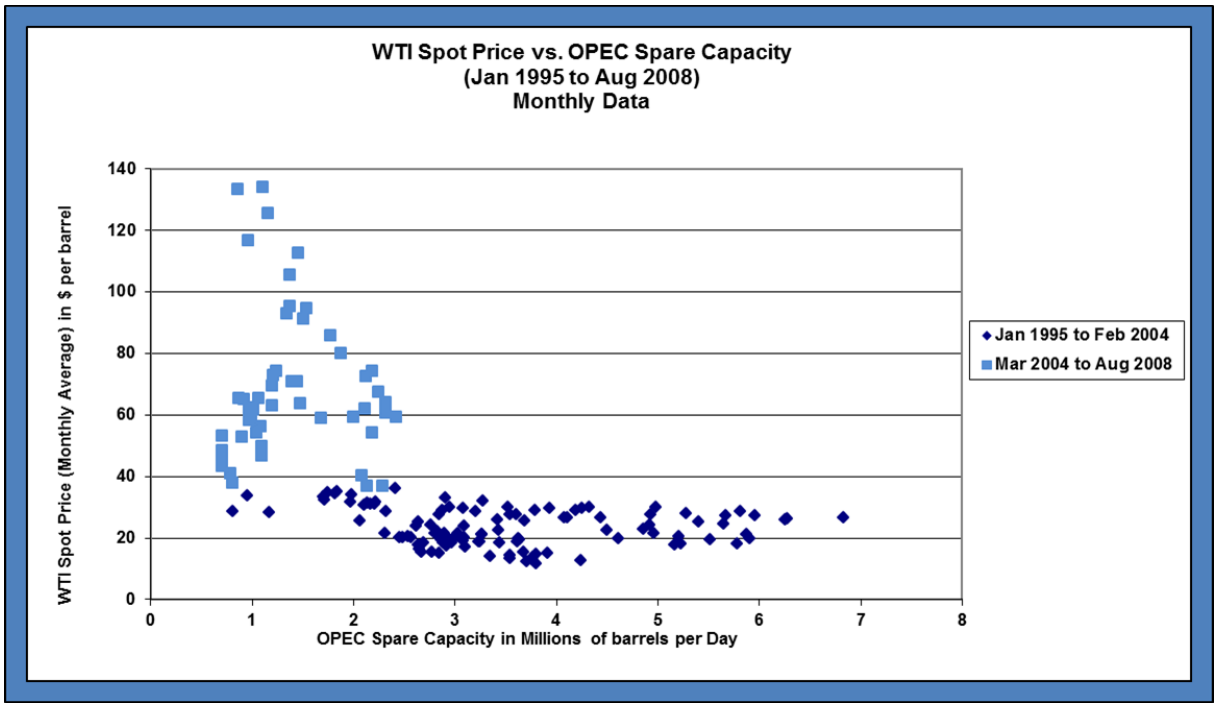
Figure 1



Source: Plante and Yücel (2011), Chart 2. [The dark blue line is WTI prices while the light blue line is OPEC excess capacity.] Authors' Notes: Oil prices are monthly averages. Sources of Data: U.S. Energy Information Administration (EIA) and the *Wall Street Journal*.

Figure 2 provides another way of illustrating what happened to the price of crude oil as OPEC spare capacity collapsed in mid-2008.

Figure 2



Source: Till (2014), Slide 19.

Sources of Data:
The WTI Spot Price is the "Bloomberg West Texas Intermediate Cushing Crude Oil Spot Price," accessible from the Bloomberg using the following ticker: "USCRWTIC <index>".
The following Bloomberg formula was used to create a monthly data set from daily prices:
bdh("USCRWTIC Index","px last","1/1/1995","8/31/2008","per=cm","quote=g")

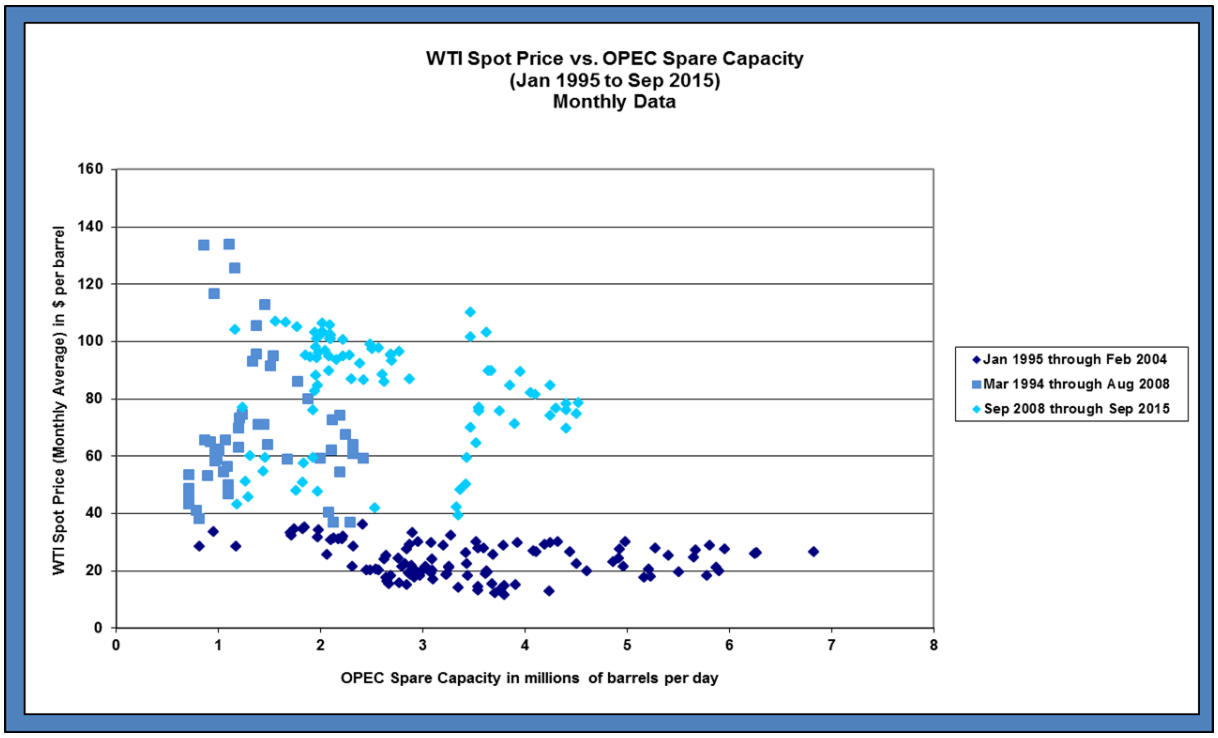
The OPEC Spare Capacity data is from the U.S. Energy Information Administration's website, which was accessed on 8/30/14.

Presenting data in this fashion is based on Büyükşahin *et al.* (2008), Figure 10, which has a similar, but not identical, graph. Their graph, instead, shows "Non-Saudi crude oil spare production capacity" on the x-axis.

Post-2008: An Unclear Relationship

After 2008, the relationship illustrated in Figure 2 structurally changed. This is illustrated in Figure 3 with the addition of data from September 2008 through September 2015. Using data through September 2015, it is not clear what the relationship between WTI oil prices and OPEC spare capacity is, if any.

Figure 3



Sources of Data:
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The following Bloomberg formula was used to create a monthly data set from daily prices:
bdh("USCRWTIC Index","px last","1/1/1995","9/30/2015","per=cm","quote=g")

The OPEC Spare Capacity data is from the U.S. Energy Information Administration's website, which was accessed on 8/30/14 (for the 1995 data) and on 10/24/15 (for the 1996 through September 2015 data.)

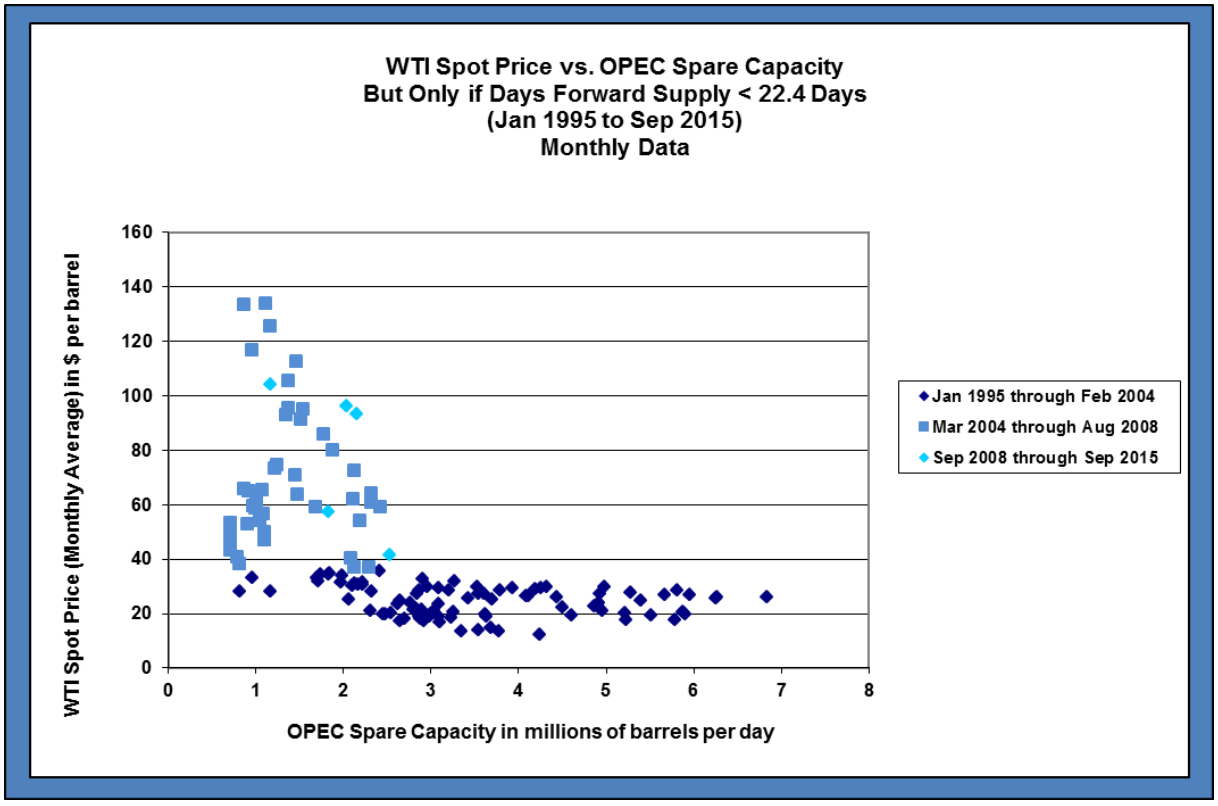
Presenting data in this fashion is based on Büyükşahin *et al*. (2008) and Büyükşahin (2011).

A Clear Relationship Re-emerges

It may only be in a certain state-of-the-world that OPEC spare capacity matters. But what precisely describes that particular state-of-the-world? Ori (2015) essentially provides the answer: *OPEC spare capacity should only matter if one is in a state of low inventories.*

Figure 3 can be re-examined based on Ori (2015)'s insight. The relationship between WTI oil prices and OPEC spare capacity from January 1995 through September 2015 is examined, *but only when crude oil inventories are low.* This particular conditional examination is illustrated in Figure 4. At least over the period, January 1995 through September 2015, it is apparent that tight levels of OPEC spare capacity had only mattered when (U.S.) oil inventories were low. Here, the low levels of inventories are defined as being under 22.4 days-of-forward-supply-of-crude-oil in the U.S.

Figure 4



Sources of Data:
The WTI Spot Price is the "Bloomberg West Texas Intermediate Cushing Crude Oil Spot Price," accessible from the Bloomberg using the following ticker: "USCRWTIC <index>".
The following Bloomberg formula was used to create a monthly data set from daily prices:
bdh("USCRWTIC Index","px last","1/1/1995","9/30/2015","per=cm","quote=g")

The OPEC Spare Capacity data is from the U.S. Energy Information Administration's website, which was accessed on 8/30/14 (for the 1995 data) and on 10/24/15 (for the 1996 through September 2015 data.)

"Days Forward Supply" refers to the U.S. Department of Energy's U.S. Days-of-Supply-for-Crude-Oil, accessible from the Bloomberg using the following ticker: "DSUPCRUD <index>".
The following Bloomberg formula was used to create a monthly data set from weekly data:
bdh("DSUPCRUD Index","px last","1/1/1995","9/30/2015","per=cm","quote=g")

Presenting data in this fashion is based on Büyükşahin *et al.* (2008) and Büyükşahin (2011).

A Debate on Practical Relevance

The data set in this paper is largely during the period when OPEC, and specifically Saudi Arabia, had been considered the swing producer for the oil market, and who traditionally attempted to prevent a free fall in the price oil. When there was sufficient spare capacity, these producers, in effect, underwrote an (implicit) put on the price of oil, as explained in Till (2015). It was only when there had been insufficient OPEC spare capacity that oil prices spiked.

Perhaps going forward, U.S. shale producers will instead be considered the swing producers, but in their case, their actions would cap the price of oil. These producers would, in effect, be underwriting an (implicit) call on the price of oil, as argued in Citi Research (2015). The price spikes illustrated in the survey paper would thereby not be expected to occur in the future.

On the other hand, Coy (2015) has argued against the view that "America's shale oil industry has supplanted OPEC as the so-called 'swing' producer," noting that "a true swing producer has freedom of action." Explained Coy (2015): A swing producer "has a large market share, spare capacity, and very low production costs, and it is capable of acting strategically—alone or in a cartel—to raise and lower production to affect the price. Saudi Arabia fits that description; America's shale producers don't."

Continued Coy (2015): "The shale players are too small to move prices on their own, and they don't act in concert. Shale producers have essentially no spare capacity because they're always producing as much as they profitably can. Production costs are also far higher than those of the Saudis or Kuwaitis. In the language of economics, U.S. shale producers are price takers, not price setters." Under Coy (2015)'s framework, the survey paper's results *would* continue to have practical relevance.

Conclusion

Based on an examination of data over the past 20 years, OPEC spare capacity has only dramatically mattered for oil prices when (U.S.) crude oil inventories have been below a threshold level. That said, the survey paper's practical relevance depends on whether the U.S. shale industry supplants OPEC as the world's true swing producer.

Endnote

The title of the SSRN version of this article is "OPEC Spare Capacity and Oil Prices."

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Keywords

Crude oil prices, OPEC spare capacity

What Are the Sources of Return for CTAs and Commodity Indices? A Brief Survey of Relevant Research

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Abstract Available at SSRN: **http://ssrn.com/abstract=2676161**

This survey paper discusses the (potential) structural sources of return for both CTAs and commodity indices based on a review of empirical research from both academics and practitioners. The paper specifically covers (a) the long-term return sources for both managed futures programs and for commodity indices; (b) the investor expectations and the portfolio context for futures strategies; and (c) how to benchmark these strategies.

This digest article will mainly draw from the survey paper's summary of return sources for futures programs. Accordingly, one can find strong evidence – historically at least – for there being persistent returns in futures programs due to momentum, roll yield, and also due to rebalancing. This is the case across asset classes, including in commodity futures programs.

Return Sources

Momentum

A 2012 AQR Capital Management white paper discussed how persistent momentum profits have been across time and across asset classes. This assertion is illustrated in Figure 1 on the next page. The AQR authors theorized that "price trends exist in part due to longstanding behavioral biases exhibited by investors, such as anchoring and herding, as well as the trading activity of non-profit seeking participants, such as central banks and corporate hedging programs."

Figure 1

Hypothetical Performance of Time Series Momentum

Strategy performance after simulated transaction costs both gross and net of hypothetical 2-and-20 fees.

Time Period	Gross of Fee Returns (Annualized)	Net of 2/20 Fee Returns (Annualized)	Realized Volatility (Annualized)	Sharpe Ratio, Net of Fees	Correlation to S&P 500 Returns	Correlation to US 10-year Bond Returns
Full Sample:						
Jan 1903 - June 2012	20.0%	14.3%	9.9%	1.00	-0.05	-0.05
By Decade:						
Jan 1903 - Dec 1912	18.8%	13.4%	10.1%	0.84	-0.30	-0.59
Jan 1913 - Dec 1922	17.1%	11.9%	10.4%	0.70	-0.12	-0.11
Jan 1923 - Dec 1932	17.1%	11.9%	9.7%	0.92	-0.07	0.10
Jan 1933 - Dec 1942	9.7%	6.0%	9.2%	0.66	0.00	0.55
Jan 1943 - Dec 1952	19.4%	13.7%	11.7%	1.08	0.21	0.22
Jan 1953 - Dec 1962	24.8%	18.4%	10.0%	1.51	0.21	-0.18
Jan 1963 - Dec 1972	26.9%	19.6%	9.2%	1.42	-0.14	-0.35
Jan 1973 - Dec 1982	40.3%	30.3%	9.2%	1.89	-0.19	-0.40
Jan 1983 - Dec 1992	17.8%	12.5%	9.4%	0.53	0.15	0.13
Jan 1993 - Dec 2002	19.3%	13.6%	8.4%	1.04	-0.21	0.32
Jan 2003 - June 2012	11.4%	7.5%	9.7%	0.61	-0.22	0.20

Source: Hurst *et al.* (2012), Exhibit 1.

Roll Yield

In addition to momentum, the empirical literature also documents that "roll yield" can be considered a structural source of return, at least over long periods of time. A 2014 Campbell & Company white paper attempted to demystify "roll yield." According to the white paper, futures returns "and spot returns on the same underlying asset often diverge, and the magnitude of this divergence is known as the futures 'roll yield.'"

Excerpting further from the Campbell & Company white paper: "The cumulative impact of roll yield can be quite significant, in some cases being similar in magnitude to the entire gain or loss an investor experiences over the lifetime of a trade." In summary, "the roll yield represents the net benefit or cost of owning the underlying asset beyond moves in the spot price itself." "[T]he spot return and roll yield together comprise the total return experienced by an investor (net of financing costs.)" Figure 2 on the next page shows the "benefits and costs relevant to selected asset classes." For each asset class, the roll yield can be arrived at by deducting the cost of holding the asset from its benefit.

This net benefit or net cost shows up in an asset class' futures curve. If there is a net benefit to holding the commodity, then a futures contract will be priced at a discount to the asset class' spot price, reflecting this benefit. Correspondingly, if there is a net cost to holding the commodity, then a futures contract will be priced at a premium to the asset class' spot price, reflecting this cost.

Returning to the table in Figure 2, which shows the benefits and costs of holding selected asset classes, "[f]or financial assets, these represent actual cash flows, while other assets may have non-cash flow costs and benefits [such as] the convenience yield in the case of commodities." The "convenience yield [in turn] reflects the benefits to holding a physical commodity, which tends to be more valuable when inventories are low or shortages are expected."

Figure 2

Benefits and Costs of Holding Selected Asset Classes

Asset Class	Benefits	Costs
Bonds	Current Yield (Bond Coupon) [1]	Financing Rate
Currencies	Foreign Deposit Rate	Local Deposit Rate
Stocks	Dividend Yield	Financing Rate
Volatility	Hedging Against Increases in Volatility*	Insurance Premium*
Commodities	Convenience Yield*	Storage; Transport; Insurance; Financing Rate

**Non-cash flow terms*

[1] "In fixed income markets, there is an additional component to returns called the yield curve 'rolldown' (unrelated to futures roll yield) which occurs over time as the bond cash flows experience different points along the yield curve."

Source: Campbell & Company, (2014), Exhibit 3.

For commodity traders, grasping the importance of the convenience yield is quite important. Roll yield can be referred to as the net convenience yield; i.e., the benefit of holding the commodity netted against its costs. Paying attention to the net convenience yield, or roll yield, is useful over short horizons and separately, over long horizons.

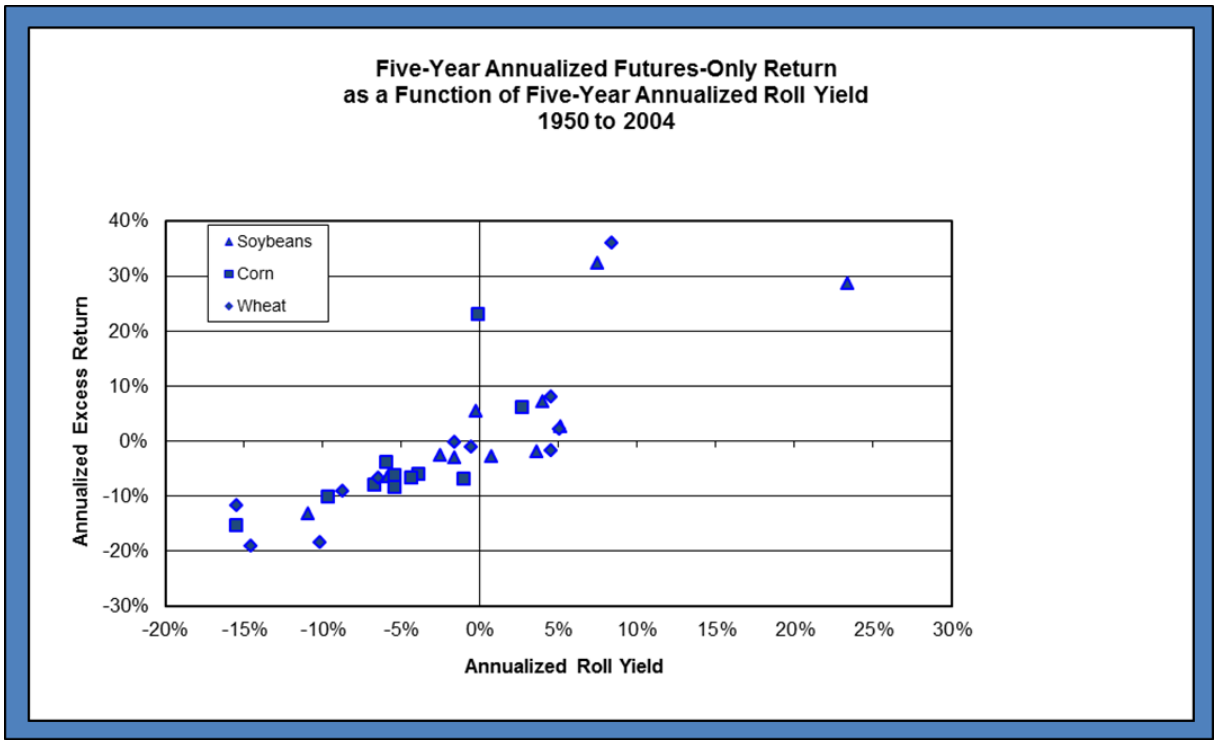
Over short horizons, given that the roll yield increases during times of shortage, this factor provides a useful price proxy for fundamental data that can be used as a timing indicator for positions in a particular commodity market. That is, one would only go long a particular commodity futures contract, if one has an indication of scarcity.

Over long horizons, the roll yield is also important for commodity futures contracts. This is because of another structural feature of commodity markets: mean reversion. If a commodity has a tendency over long enough timeframes to mean-revert, then by construction, (real) returns cannot be due to a long-term appreciation (or depreciation) in spot prices. In that case, over a sufficient timeframe, the futures-only (real) return for a futures contract would have to basically collapse to its roll yield. This can be observed historically in the commodity futures markets.

Feldman and Till (2006) examined three agricultural futures markets from which one could obtain price data since 1949. In the 2006 paper, the authors found that over a 50-year-plus timeframe, the returns

of three agricultural futures contracts were linearly related to roll yield *across time,* but this result *only* became apparent at five-year intervals, given how volatile spot prices are. This result is illustrated in Figure 3.

Figure 3



Graph based on research undertaken during the work that led to the article by Feldman and Till (2006).

Rebalancing Return

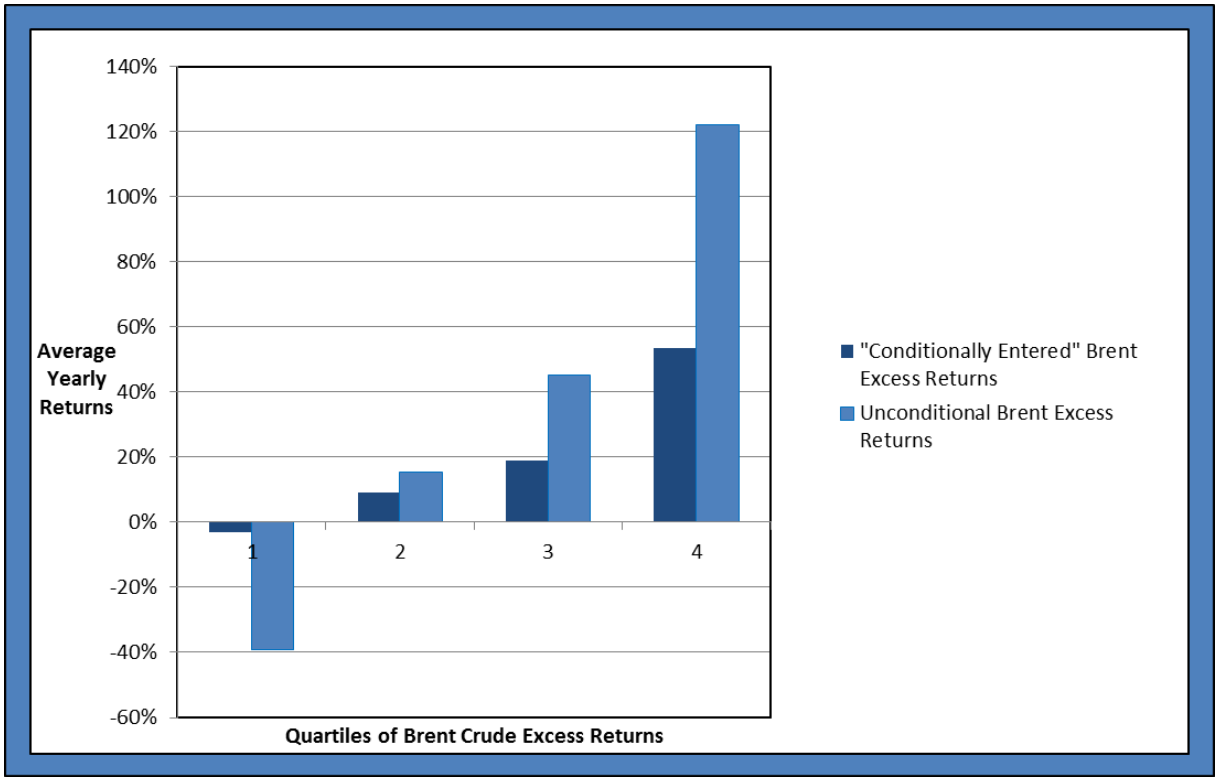
Erb and Harvey (2006) discussed how there can be meaningful returns from rebalancing a portfolio of lowly-correlated, high-variance instruments. "Commodity futures contracts happen to display … [these] characteristics …," noted Sanders and Irwin (2012).

The rebalancing effect was explained in Greer *et al.* (2014), as follows: "[A] 'rebalancing return' … can naturally accrue from periodically resetting a portfolio of assets back to its strategic weights, causing the investor to sell assets that have gone up in value and buy assets that have declined." Erb and Harvey (2006) concluded, in turn, that the returns from rebalancing are the one "reasonably reliable source of return" from owning (and rolling) a basket of commodity futures contracts. The issue, yet again, like roll yield, is that the rebalancing effect will not be apparent over short horizons.

Investor Expectations and Portfolio Context

A CTA investor may also require that a program's dynamic trading strategies produce returns that have options-like payoff profiles. Figure 4, for example, provides an example of a market-timing model for crude oil futures contracts that historically produced an option-collar-like profile across states of the crude oil market. The strategy underperforms oil in up markets, but outperforms oil during down markets. This type of analysis is drawn from Fung and Hsieh (1999).

Figure 4
"Conditionally Entered" vs. "Unconditionally Entered" Brent Crude Oil Futures (Excess) Returns
End-January 1999 through End-December 2014



Source: Till (2015), which was based on joint work with Joseph Eagleeye of Premia Research LLC.

Regarding commodity indices, institutional investors expect this investment to provide diversification for their balanced equity-and-bond portfolios. According to Fenton (2015), an updated efficient-frontier analysis for adding commodities to a standard U.S. 60/40 portfolio shows that the optimal long-run allocation over the period, March 1988 through June 2015, would have been 10%.

Conclusion

The survey paper notes that there may be structural returns in futures strategies as a result of momentum, roll yield, and rebalancing. One caveat is that an investor's holding period may have to be quite long term in order for these return effects to become apparent. But even structurally positive

returns may be insufficient to motivate investors to consider futures products. Investors may have additional requirements such as that a strategy provides exposure to an asset class while limiting its losses and also that the strategy diversifies a balanced stock-and-bond portfolio.

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Keywords

CTA, sources of return, managed futures, commodity indices, commodity futures contracts

Case Studies from Commodity Derivatives Debacles

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Available at SSRN: **http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2617705**

Until recently, one could only gain expertise in commodity-derivatives relationships if one had worked in niche commodity-processor companies or in banks that specialized in hedging project risk for natural-resource companies. The contribution of this paper is to help fill the knowledge gap in the risk management of commodity derivatives trading. The paper emphasizes the constant challenges to a trader when attempting to navigate the very dynamic flows of both the commodity markets and the prevailing risk environment. The paper also emphasizes that operational controls are paramount in an age of increasing legal and regulatory risk, particularly for firms involved in large-scale commodity derivatives trading.

This digest article focuses on the risk-management lapses at three large institutions involved in commodity derivatives trading, including an international oil company, a Canadian bank, and a Futures Commissions Merchant.

International Oil Company

In 2007, an International Oil Company in the Chicago suburbs ran afoul of market-conduct laws and rules, as enforced by the Commodity Futures Trading Commission and by the U.S. Department of Justice, for trading activities of the previous five years.

There is a strict body of law prohibiting market manipulation by commodity traders, especially when retail customers are put at risk. The International Oil Company had attempted to corner the market in physical propane and senior management had consented to the strategy. For example, in the CFTC complaint, the compliance manager at the company's business unit responsible for propane trading is quoted as approving the propane-purchasing strategy.

The total monetary sanction against the company was approximately $303-million, "the largest manipulation settlement in the CFTC history," according to CFTC (2007), which included both civil and criminal penalties. The civil and criminal fines *far* exceeded the market risk of the activities, illustrating where the risk-management priorities need to be for large participants in the commodity markets.

The key risk-management lesson from this debacle is to establish clear-cut compliance and ethics programs, not just for the trading staff but also for senior management. Also, prospective traders entering into large-scale derivatives trading operations need to be as (or more) knowledgeable about regulatory rules and laws, as they are with sophisticated market risk-management techniques.

Canadian Bank

At the end of April 2007, a Canadian bank announced trading losses of $350 to $400 million Canadian dollars. These losses were later revised upwards to $680-million Canadian dollars, which was higher than the bank's revenue from trading during the previous year. Unfortunately, the bank's auditors had found that the bank's over-the-counter natural-gas book had been seriously mismarked. The auditors reported that they had never seen such a large discrepancy between the marks that were used, and market value.

Another way of framing the significance of the bank's natural-gas trading loss was that in its filings with the U.S. Securities and Exchange Commission (SEC), the bank had stated that its average one-day Value-at-Risk in its commodity book was only C$8.8-million during the quarter that ended on January 31st, 2007, according to BMO (2007). We have to conclude that for large-scale commodity-trading efforts, the complexity may not be in market-risk monitoring, but in relatively simply described operational controls, which must be rigorously applied throughout a large organization.

Futures Commissions Merchant

On February 28th, 2008, a large Futures Commissions Merchant (FCM) revealed an unexpectedly large $141.5-million loss from a wheat-futures trading position taken by one of its registered representatives in Memphis, Tennessee for the representative's proprietary (own) account. The representative had amassed more than 15,000 futures contracts covering 75 million bushels of wheat on the Chicago Board of Trade, between midnight and 6 a.m. on February 27th. Apparently, the clearing firm did not have automatic limits in the sizing of futures trades executed electronically, when the operator was a registered representative of the firm.

As a consequence of the wheat loss, the FCM's CEO stated that "the company would introduce limits on positions taken by all customers and traders," reported Cameron and Lucchetti (2008). The FCM also took other remedial actions to restore customer and shareholder confidence in its risk-management infrastructure. The lessons from this trading mishap are to impose strict position limits in all electronic trading systems and to restore customer confidence by taking immediate action.

Summary of Risk Management Lessons for Large Institutions

None of these three examples involve complex mathematical issues; they can each be summarized briefly and simply as fundamental control problems. That said, this statement is admittedly not fair to individuals at large organizations. Employees at large companies operate in *extremely* complex social environments. Frequently, for individuals working at large companies, one can liken employment to a sumo-wrestling match. From the outside, it does not look like anything much is getting done, but just staying in the ring is actually the accomplishment.

The real conclusion from these case studies might be an insight from a textbook, which is not considered a risk-management primer: Good to Great. In the main, a large organization can only do well when it implements a handful of simple concepts, which it consistently applies in scale, and across time, by individuals who all share common business values. In the case of large commodity derivatives trading companies, an emphasis on:

(1) complying with regulatory rules and laws;

(2) valuing instruments based on pricing sources genuinely independent of the trading team; and

(3) imposing strict position limits in all electronic trading systems

are clearly core principles that all stakeholders in institutionally-sized commodity trading firms should embrace.

Conclusion

The perhaps surprising conclusion of this article is that the risk-management lapses at three large institutions were due to simply described operational control problems. After learning the risk-management lessons from these debacles, readers will hopefully be helped in avoiding such mishaps in their own careers.

Endnote and Acknowledgement

Some of the concepts in this article were previously discussed in Till (2008). In addition, the comprehensive article benefitted from comments from Hendrik Schwarz.

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Keywords

Risk management, commodity derivatives, trading, regulatory, hedge fund

Brief Case Studies on Futures Contract Successes and Failures

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Forthcoming in the ***Journal of Alternative Investments***
Abstract Available at SSRN: **http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2573894**

Why do some futures contracts succeed and others fail? Although the U.S. futures markets have evolved in a trial-and-error fashion, a survey of relevant research suggests key elements have determined whether particular futures contracts succeeded or failed. This knowledge could be useful for new financial centers as they build successful futures markets. This paper shows that there are three elements that determine whether a futures contract succeeds or not:

1. *There must be a commercial need for hedging;*
2. *A pool of speculators must be attracted to a market; and*
3. *Public policy should not be too adverse to futures trading.*

A Commercial Hedging Need

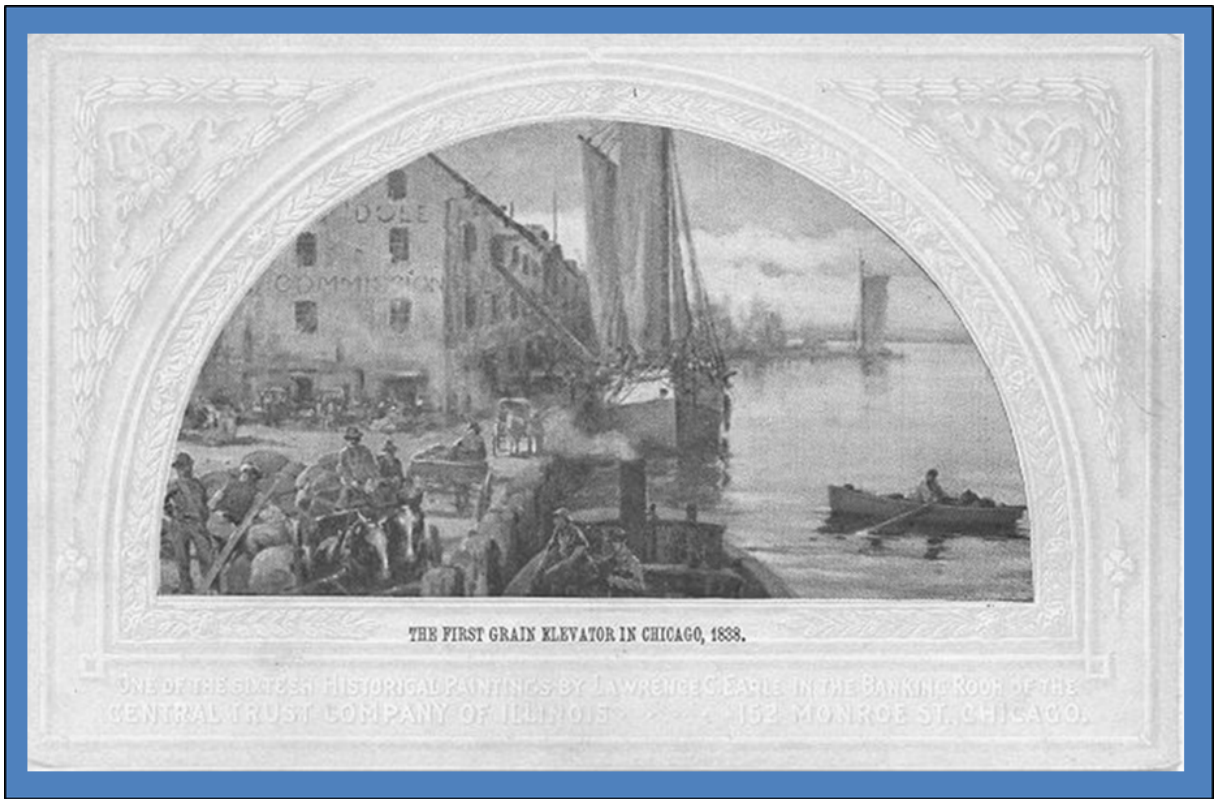
Successes

New futures contracts have succeeded when there has been a need for a hedging instrument to hedge new kinds of risks. The earliest (modern) example is the establishment of the Chicago Board of Trade to manage the price risk of accumulating grain inventories in the 19th Century. Figure 1 on the next page illustrates the first-ever grain elevator in Chicago.

Much later and surprisingly at the time, the price-risk-management approach for grain inventories turned out to be well-suited for financial instruments and for energy products. Namely, the collapse of the Bretton Woods Agreement in the 1970s created a need to hedge currency risk; and the change in the structure of the oil industry, also in the 1970s, produced an economic need for hedging volatile spot oil price risk.

New futures contracts have also succeeded when the market was looking for new *ways* to hedge *existing* risks. Examples include futures contracts in the soybean complex, live cattle, and the creation of the Chicago Board Options Exchange.

Figure 1
"The First Grain Elevator in Chicago, 1838"
Postcard of a 1902 Painting By Lawrence C. Earle



Source of Image: http://www.lcearle.com/works/CH-grainelevator-1838.jpg, retrieved on December 20, 2015.

Note: This 1902 painting is "one of 16 historical paintings by Lawrence C. Earle, [which were] originally located in the banking room of the Central Trust Company of Illinois, 152 Monroe Street, Chicago;" the paintings are "now stored within the Collection Services Department at the Chicago History Museum," according to http://www.earlychicago.com, also retrieved on December 20, 2015. This website, in turn, is based on Danckers and Meredith (1999).

Failures

Contracts fail when the risks are not sufficiently material. This was the case with currency futures launched pre-Bretton Woods, CPI futures and some redundant U.S. Interest Rate futures contracts in the 1970's and 1980's. Figure 2 on the next page illustrates how 64% of financial futures contracts launched between 1975 and 1982 failed.

Additional reasons for failure are when existing contracts or exchanges already serve to adequately manage risk and when technology and government policies change in ways that reduce risk or make past ways of hedging no longer effective.

Figure 2
Financial Futures Contract Launches Between 1975 and 1982

Financial Futures Innovations: 1975-1982					
Contract	*Exchange*	*Date of Innovation*	*Average Daily Volume*	*Wall Street Journal Listing*	*Traded in 1985*
GNMA-CDR[1]	CBT	10/20/75	1995	Yes	Yes
Treasury bills (90-day)	CME	1/6/76	1610	Yes	Yes
Treasury bonds	CBT	8/22/77	7954	Yes	Yes
Commercial paper (90-day)	CBT	9/26/77	99	No	No
Treasury bills (1-year)	CME	9/11/78	63	No	No
GNMA-CD[2]	CBT	9/12/78	180	No	No
GNMA-CD[2]	ACE[3]	9/12/78	180	No	No
Commercial paper (30-day)	CBT	5/14/79	12	No	No
Treasury notes (4-6 - year)	CBT	6/25/79	88	No	No
Treasury bills (90-day)	ACE[3]	6/26/79	52	No	No
Treasury notes (4-year)	CME	7/10/79	93	No	No
Treasury bills (90-day)	COMEX	10/2/79	286	No	No
GNMA-CD[2]	COMEX	11/13/79	47	No	No
Treasury bonds	ACE[3]	11/14/79	130	No	No
Treasury bonds	NYFE	8/7/80	867	Yes	No
Treasury bills (90-day)	NYFE	8/14/80	188	No	No
Treasury notes (2-year)	COMEX	12/2/80	290	No	No
CD (90-day)	NYFE	7/9/81	914	No	No
CD (90-day)	CBT	7/22/81	895	No	No
CD (90-day)	CME	7/29/81	5103	Yes	Yes
Eurodollar (3 month)	CME	12/9/81	2012	Yes	Yes
Value Line Index	KCBT	2/24/82	2683	Yes	Yes
S&P 500 Index	CME	4/21/82	24156	Yes	Yes
Treasury notes (6 1/2 - 10-year)	CBT	5/3/82	4228	Yes	Yes
NYSE Composite index	NYFE	5/6/82	11656	Yes	Yes

Notes: CBT = Chicago Board of Trade; CME = Chicago Mercantile Exchange; ACE = Amex Commodity Exchanges; COMEX = Commodity Exchange; NYFE = New York Futures Exchange; and KCBT = Kansas City Board of Trade.
1. GNMA-CDR = Collateralized Depository Receipt GNMA contract.
2. GNMA-CD = Certificate Deposit GNMA contract.
3. No longer in existence.

Source: Black (1985), as reproduced in Silber (1985), Table 2.2.

Pool of Speculators Must Be Attracted to a Market

Not only must a futures contract respond to a commercial need for hedging, but the contract must also attract a pool of speculators. Arguably, there are three aspects to attracting speculators: (1) A futures exchange must already have a community of risk-takers; (2) There must be a level playing field for speculators; and (3) A speculator must have the ability to actually manage the price risk of taking on the other side of a commercial hedger's position.

Community of Risk-Takers

Two central features of speculators have historically been their practical approach and their willingness to risk failure. Both traditions have continued in present-day Chicago. In a 2013 *Opalesque* Round Table on Chicago, Paul MacGregor of FFastFill noted in his interview with Melin (2013): "Chicago is … the only town in the world … where you can walk into a large proprietary firm [and] what you see is literally three

guys: The trader, the technology guy and the manager, and that's it. And then you look at the kind of volumes they are trading and you are just staggered. You don't see that … anywhere else in the world."

Level Playing Field for Speculators

Another key aspect to attracting speculators to a futures market is that commercial hedgers cannot have an undue advantage in predicting prices, as demonstrated with two examples below.

Grains

With the highly successful soybean, corn, and wheat futures contracts, the primary uncertainty is the outcome of supply. Therefore, speculators and hedgers are on a level playing field. Hedgers would not have an informational edge over speculators. In contrast, with agricultural contracts where the primary uncertainty is demand, and where this demand is concentrated amongst large commercials, a speculator could be at an informational disadvantage.

Equities

A similar consideration applies to equities, regarding the need for informational symmetry. "One of the problems inherent in market making with specific equities is the risk that a buyer or seller has information that will affect the specific price of a stock. The trade is then information based rather than liquidity motivated," wrote Silber (1985). "A dealer will make a better market for a package of equities rather than one or two individual stocks because it is then less concerned about inside information. Such buy or sell programs for groups of large blocks of stock are ideally hedged in the stock index futures markets," contributing to the success of equity index futures contracts, according to Silber.

The Ability to Actually Manage Risk

In order to participate, speculators must also be able to manage the risk of taking on the other side of a commercial hedger's position. There are actually a number of ways in which professional speculators provide risk-bearing services. A speculator may be an expert in the term structure of a futures curve and would spread the position taken on from the commercial hedger against a futures contract in another maturity of the futures curve. Or the speculator may spread the position against a related commodity. Alternatively, a speculator may detect trends resulting from the impact of a commercial's hedging activity, and be able to manage taking on an outright position from a commercial because the speculator has created a large portfolio of unrelated trades. In this example, the speculator's risk-bearing specialization comes from the astute application of portfolio theory.

Public Policy Should Not Be Too Adverse

Besides a contract serving a commercial hedging need and being able to attract a pool of speculators, a third factor determining the success of a futures contract relies on public policy not being too adverse. Historically, there have been four relevant factors: (1) A contract must have a convincing economic rationale; (2) It is helpful if contracts are viewed as being in the national interest; (3) Regulatory imbalances across jurisdictions should be avoided; and (4) Regulatory interventions should not be too draconian.

Conclusion

In a sense, futures trading can be seen as a game where the competing players, the hedgers and the speculators, each have sufficient economic reasons to participate. The referee of this game, the government authorities, has the power to stop the game, if there is not a convincing economic rationale for a futures contract's existence. Therefore, a futures contract can succeed only if it responds to a commercial hedging need, *and* if speculators are able to manage the risk of taking on the hedger's positions. In addition, a convincing case must be made that the contract serves an economic purpose; otherwise the contract is at risk to either being banned or heavily curtailed.

Endnotes and Acknowledgement

The title of the SSRN version of this article is "Why Some Commodity (and Financial) Futures Contracts Succeed and Others Fail: A Survey of Relevant Research." The comprehensive version of this article was excerpted from a seminar in Chicago that was prepared by the author for staff from the Shanghai Futures Exchange. In addition, the comprehensive article benefitted from insightful comments and inferences from Joseph Bast.

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Keywords

Commodities, futures market, commodity regulation, policy

Introduction to Research Digest Articles

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In selecting research articles for the inaugural issue of the *GCARD*, our goal has been to provide commodity industry practitioners with new academic insights from across the commodity complex. Our intent is to do so in a brief, accessible format. To our knowledge, no other commodity publication has a similar scope.

In this issue, we concisely cover research on (1) metals hedging; (2) energy policy; (3) the logistical planning of a grain-trading firm; (4) commodity pricing; and (5) the development of commodity exchanges. Each of these articles is summarized below.

Metals Hedging

In the article, "Why Do Firms Engage in Selecting Hedging? Evidence from the Gold Mining Industry," the authors find a counterintuitive result. While one might expect that firms with both an informational advantage and a robust financial condition to use these competitive advantages to vary their hedging programs according to their market views, the researchers, in fact, find the opposite result. This finding should be of interest to investors in gold equities, who should probably have a skeptical view regarding a firm's decision to "selectively" hedge, which the authors also refer to as speculation.

Energy Policy

In the article, "The Biofuel Connection: Impact of US Regulation on Oil and Food Prices," the authors examine whether one might attribute at least some of the past spikes in corn prices to renewable fuel mandates in the US. The authors provide statistical evidence that corn price dynamics changed after these mandates were put into effect: namely, corn prices began having a stronger response to global demand factors that, in turn, drive demand for crude oil than had been the case previously. This increased connection between oil prices and a food staple is an important public policy issue. Although the authors do not suggest policy innovations, one might conclude that when food prices spike, perhaps there should be a temporary trigger to divert corn stocks to food rather than fuel.

The Logistical Planning of a Grain Trading Firm

In the paper, "Optimal Trading and Shipping of Agricultural Commodities," the authors use a case-study approach to show the benefits of jointly planning trading and logistics for a specific Argentinian grain-trading firm. Given the low profit margins of such firms, such an approach should be of interest to comparable firms in Latin America. The paper's methodology may also be applicable to large firms in other geographic locations, which are similarly involved in the trading and shipping of grain.

Commodity Pricing

In the paper, "The Determinants of Convenience Yields," the authors examine what potentially drives this commodity pricing factor. Convenience yields are typically regarded as the benefit that a holder of commodity inventories receives for being able to avoid the cost of potential stock-outs. The authors examine to what extent commodity-specific and broad macroeconomic variables can explain the variability of convenience yields for a set of commodities. Amongst the authors' results are that convenience yields (in all cases but one commodity) "exhibit statistically significant positive relationships with" expected inflation and expected industrial production in the US. This is a helpful result for investors whom are interested in choosing futures strategies that provide exposure to key macroeconomic variables.

The Development of Commodity Exchanges

In the article, "Development of Commodity Exchange Markets as an Avenue to Foster Economic Development in Africa," the author questions to what extent a government should be "hands off" in the development of commodity exchanges. Given the scale of institutional development required for the establishment of a commodity exchange, the author is skeptical about limiting the government's role. In the Chicago model, the government's role is limited to providing the relevant legal framework and oversight functions. Instead, the author advocates an approach in which commodity exchanges are government-run. In making his case, the author compares the experience of two African countries.

Future Issues

As one can see from the breadth of topics covered in our first issue, the global commodities arena is a fertile one full of useful research. We welcome readers' recommendations regarding novel, and highly relevant, international research for us to distill in future issues of the *GCARD*!

Why Do Firms Engage in Selective Hedging? Evidence from the Gold Mining Industry

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Available at SSRN:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2613920

"The widespread practice of managers speculating by incorporating their market views into firms' hedging programs ('selective hedging') remains a puzzle. Using a 10-year sample of North American gold mining firms, we find no evidence that selective hedging is more prevalent among firms that are believed to possess an information advantage. In contrast, we find strong evidence that selective hedging is more prevalent among financially constrained firms ..."

Introduction

The main thrust of this research paper is to provide insights into what kinds of firms "selectively hedge." The paper distinguishes between *passive hedging* and *selective hedging*. Passive hedging is where a company passively matches its commodity exposures with derivatives. In contrast, selective hedging is deemed to occur when the size and timing of the company's hedging varies through time. In the language of derivatives, a firm can be termed a selective hedger if its commodity "hedge ratio" surpasses a threshold amount of variability compared to a peer-group of fellow commodity hedgers. The hedge ratio, in turn, is the percentage of a firm's commodity exposure that has been hedged with derivatives.

What are the characteristics of firms that selectively hedge? The paper examines this question with a set of data uniquely available in the gold-mining industry. The authors provide useful, but preliminary, answers to the question of what types of firms selectively hedge. The reason we might term the results as preliminary is because the study is limited to the gold industry; it is an open question regarding how generalizable the results are across industries. But even so, one would expect such a study to be quite valuable to investors in gold equities.

Why the Paper's Research Question is Important

The authors note that selective hedging can also be referred to as speculative activity. They note that previous work using a similar data set to the one in their current paper found that "speculation does not create value for shareholders." Then what sort of firm would engage in such an activity? The answer to this question should be of interest to investors, and perhaps regulators as well, given that selective hedging likely is not a value-maximizing activity for shareholders.

Data Description

The authors use 10 years of quarterly data, collected by Ted Reeve of Scotia Capital. This data includes the "derivatives usage of a sample of 92 North American gold mining firms between 1989 and 1999." Mr. Reeve's data collection ended in 1999.

They further note that to their "knowledge[,] the gold mining industry is the only industry where data is available in sufficient detail at quarterly intervals to enable a systematic study of corporate speculation with derivatives."

The researchers also use financial data from Compustat "or from a manual search of firms' financial statements if a firm is not covered by Compustat. Stock prices are obtained from CRSP." CRSP, in turn, is the University of Chicago's Center for Research in Security Prices at the Booth School of Business.

Description of Investigation

One can summarize the paper's main investigation as follows.

Dependent Variable

The dependent variable, selective hedging, can be proxied as the yearly variability of a firm's hedge program. And what is the metric for a firm hedge's program? Uniquely, with the benefit of the Scotia Capital data, the researchers can calculate over quarterly timeframes, the fraction of each gold mining company's production that had been hedged forward over a period of three years. This is a firm's total hedge ratio with respect to production.

The researchers also calculate an alternative hedge ratio: the fraction of each company's gold reserves that had been hedged forward over a period of three years, referencing the reserve estimates from each firm's financial statements.

Of note, the paper uses additional sophisticated measures of speculation beyond just the year-by-year standard deviation of quarterly hedge ratios, but the results were robust across speculation metrics.

Independent Variables

Which characteristics does the paper specifically examine to see if they can explain selective-hedging behavior? The researchers examine the following two characteristics of each firm: (1) a propensity to have an informational advantage, and (2) the ability to withstand market volatility.

The paper uses various measures of size in the gold marketplace to proxy for the level of informational advantage that a firm might be expected to have. In addition, the paper uses two probability-of-financial-distress metrics to proxy for whether a firm is in a particularly precarious situation to be engaged in attempting to outsmart the market.

Results

Using a sophisticated regression technique, the authors find that it is actually the smaller firms (those presumed to have the least informational advantage), as well as the firms that are likely in the most distress, that tend to selectively hedge. This is the case whether the hedge metric is based on the fraction of gold production hedged, or the fraction of gold reserves hedged.

In an unreported analysis, the authors additionally note that they were able to obtain a different data set from the period, 2002 through 2011, "from surveys collected by the VM Group for Fortis Bank Nederland." Similar to the 1989-1999 study, "[l]arger firms speculate[d] less and more constrained firms speculate[d] more."

Conclusion

The paper's empirical results point to the following conclusion: the gold-mining firms that have selectively hedged (or speculated) are the firms that had the least economic motive to do so. For investors in such companies, such activity should be flagged as not confidence-inspiring, to say the least.

Keywords

Corporate risk management, selective hedging, speculation, financial distress, corporate governance, managerial compensation.

The Biofuel Connection: Impact of US Regulation on Oil and Food Prices

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Available at SSRN:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2564242

"Biofuel policies are frequently mentioned in the policy and academic debates because of their potential impact on food prices. In 2005, the United States authorities passed legislation under which corn-based ethanol became in practice the only available gasoline additive. Some studies have then argued that ethanol and biodiesel subsidies in advanced economies may have strengthened the link between the prices of oil and those of some food commodities.

This paper tests whether the response of food commodity prices to global demand shocks and to oil-specific demand shocks has changed following the introduction of this legislation. Our results show that corn prices exhibit a stronger response to global demand shocks after 2006. Some short-lived but statistically significant response to oil-specific demand shocks is also documented. …"

Introduction

In 2005, the US Energy Policy Act (EPAct) "introduced new quantitative methods for the amount of motor fuel coming from renewable sources," recount the researchers. In practice, only ethanol, produced from corn, could meet these standards. "The impact of the legislation on demand for corn was … remarkable: in 2008, only about 5% of US corn production (the world's largest) was used for ethanol production. … By 2010, more than 35% of US corn production was used to produce ethanol," note the authors of the research paper.

Corn prices have periodically spiked since 2007, as shown in Figure 1 on the next page. Might these price spikes be at least partly attributed to U.S. biofuel mandates? This is main research question of the paper, and the authors use sophisticated statistical techniques to provide an answer.

Why the Paper's Research Question is Important

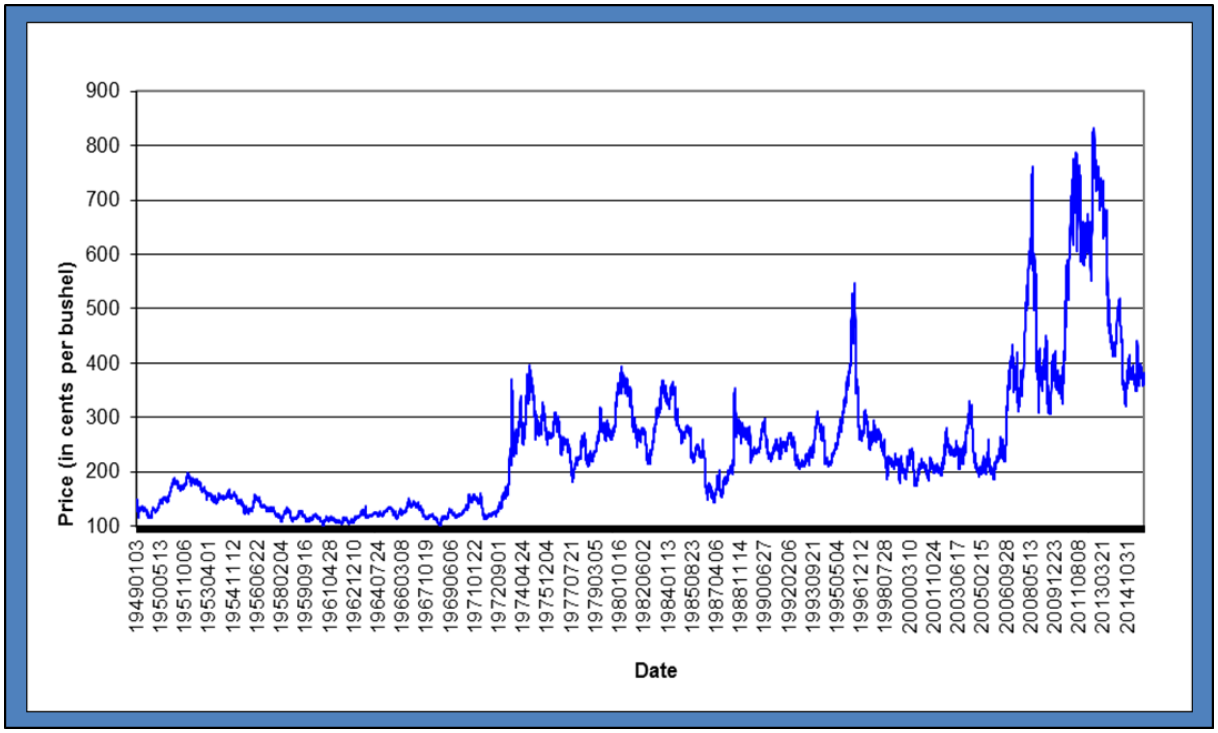
Food price spikes have quite damaging consequences for low-income countries, including significantly increasing the incidence of intra-state conflicts, according to Arezki and Brückner (2010). Even though the research paper does not cover the policy debate on how to potentially lessen future food price spikes, the paper is very useful in this debate. If one understands what actually contributed to the price spikes in the past, presumably one would be better equipped in designing smart policy, regarding dampening food price volatility in the future.

Data Description

The "authors collect data from January 1974 up to May 2013. … [They] use monthly averages of daily oil prices from Datastream, and for corn …, USDA national monthly price averages. All nominal price data have been deflated by the US Consumer Price Index. Data on crude production was obtained from the US Department of Energy."

The authors create their own measure of global economic activity, which is a function of industrial production indices and purchasing managers' indices "for the United States, United Kingdom, Germany, France, Japan, Korea, Mexico, Brazil, India, and China" combined with Kilian (2009)'s measure of real economic activity that, in turn, relies on "representative dry cargo single-voyage freight rates."

Figure 1
Rolling Corn Front-Month Futures Prices (Daily Data)
January 3, 1949 through December 28, 2015



Source: Updated from Till (2007).

Sources of Data: Commodity Systems Incorporated (CSI), the Commodity Research Bureau (CRB), and Bloomberg.

Description of Investigation

The paper largely relies on an econometric model that "capture[s] the evolution of, and the interdependencies between, multiple time series," as explained in Maggetti *et al.* (2013, p. 103). "The procedure … involves the application of 'simulated shocks' to a variable of interest in order to detect its

influence on the value of other variables …", continues Maggetti *et al.* (2013, p. 104). The paper specifically builds off of the advanced modeling work in Kilian (2009), which analyzed the drivers of historical oil price changes, including "global oil demand, oil supply, and oil-specific demand factors." The authors examine the "response of food price changes to … these shocks" after adding "individual food commodity prices to the [Kilian] model."

Results

When the authors use the full data set from January 1974 through May 2013, they find that "[c]orn prices show a weak connection with the other variables" that have been found to be important in driving changes to the price of oil. The response of corn prices "to positive shocks to oil supply or oil-specific demand shocks are statistically non-significant."

According to the authors, "Avalos (2014) argue[d] that the adoption of EPAct 2005 strengthened the connection between corn and oil markets by making corn-based ethanol the only viable additive to comply with the new renewable fuels standards." Therefore based on the work in Avalos (2014), the authors choose to examine the subsample of data from May 2006 through May 2013 and redo the analysis that had been performed over the full sample of data.

When using the subsample of data, the authors find "a stronger positive response [by corn prices] to a positive shock to the global demand factors that drive the demand for industrial commodities [including oil], which is significant … and [which] vanishes after about 20 months. Also, there is a significant positive response [by corn prices] to a positive oil-specific demand shock, but it [is] … short-lived."

Conclusion

"The question of the actual role played by biofuels in the apparently increased connection between oil prices and food prices is of significant policy relevance," note the researchers. After the "quantitative standard for the use of corn-based ethanol in gasoline ... became applicable", one can detect a statistically significant response of corn prices to the fundamental factors that drive the demand for oil.

Given this relationship, one might conclude that there is a need for creative policy responses when biofuel mandates, combined with periods of strong demand for oil, drive food (and specifically corn) prices to quite high levels. The authors stop short of naming specific policy prescriptions, but one logical idea, for example, is from a former policy advisor for Oxfam UK: developed countries might consider introducing "a price trigger so that when food prices are high, … [one would] divert … stocks of grains from fuel to food."

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Keywords

Oil price, corn price, food prices, ethanol, biofuel, VAR

Optimal Trading and Shipping of Agricultural Commodities

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Forthcoming in the ***Journal of the Operational Research Society***
Available at SSRN: **http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2535463**

"We develop and implement a model for a profit maximizing firm that provides an intermediation service between commodity producers and commodity end-users. We are motivated by the grain intermediation business at Los Grobo — one of the largest commodity-trading firms in South America. Producers and end-users are distributed over a realistic spatial network and trade with the firm through contracts for delivery of grain during the marketing season.

The firm owns spatially distributed storage facilities, and begins the marketing season with a portfolio of prearranged purchase and sale contracts with upstream and downstream counterparts. The firm aims to maximize profits while satisfying all previous commitments, possibly through the execution of new transactions. Under realistic constraints for capacities, network structure and shipping costs, we identify the optimal trading, storing and shipping policy for the firm as the solution of a profit-maximizing optimization problem, encoded as a minimum cost flow problem in a time-expanded network that captures both geography and time. We perform extensive numerical examples and show significant efficiency gains derived from the joint planning of logistics and trading."

Introduction

The authors describe the "study [of] the interface between grain trading and logistics" in the business activities of Grupo Los Grobo, "a large agricultural commodity firm in South America." They "develop and implement an optimization model for a commodity-trading firm that purchases a bulk commodity over time in different geographic locations and sells it to downstream users also in different geographic locations," summarize the paper's authors.

Logistical planning is key in Argentina's soybean businesses. "Domestically-produced soybeans and its byproducts, such as soybean meal and soybean oil, are produced almost exclusively for the international markets and exported mainly to Europe and Asia. … [T]he agribusiness logistic chain requires transporting grain from geographically distributed farms to ports or crushing mills with up to 600 km of transportation by land," explain the researchers. "Moreover, if the end points of the chain are saturated or if purchase and sale contracts differ in their timing, grains can be stored at the source using silobags, at a storage facility, or at the port," add the authors. Essentially, Grupo Los Grobo "provides an intermediation service between inland farmers and waterfront-based exporters, mills and crushing

factories," sum up the researchers. In practice, continue the authors, this firm "faces a logistical and a financial problem, as it must ship grains across space and time in the most efficient manner and it must sign new contracts to make the whole plan feasible."

The main point of the paper is to advocate that a commodity trading firm's trading and logistics should be coordinated under a single framework that maximizes the overall profitability of the firm. They propose that a firm should do so via a linear programming framework. They specifically provide a case study on how such a framework could have increased the profit margin of their example company during a past marketing season in Argentina. A linear programming problem, in turn, "consists of a linear function to be maximized or minimized subject to certain constraints in the form of linear equations or inequalities," explains Kahlig (2014).

Why the Paper's Research Question is Important

The authors point out that Argentinian grain intermediation firms likely do not yet have "computerized systems that can value the[ir] commercial position at any given point in time while simultaneously considering the logistics." Their paper assists Argentinian trading firms in making the case for such systems, which would thereby potentially increase the profitability of their business operations. Given the low profit margins of Argentinian grain intermediaries, such a development could be expected to be a welcome innovation for these firms.

Data Description

The paper's data is sourced from the business operations of Grupo Los Grobo. The authors note that this company trades "over a million tonnes of grain per year. The firm trades dynamically over a marketing season and executes its logistics by hiring haulage services and utilizing a proprietary network of storage facilities over the growing season." The authors' case study is based on the soybean marketing season of March-to-August 2012. In addition, the authors "geocoded all relevant locations and computed distances … between any two locations using actual roads and a GIS system. Distances were converted into transportations costs using … a widely accepted price list published by the trucking industry of Argentina."

Description of Investigation

Fundamentally, the main tasks of the article are two-fold, as noted below.

(1) The authors initially specify the trading firm's profit equation, which is to be maximized, along with identifying numerous realistic constraints. These constraints include the relevant limitations during the buying, financing, selling, drying, storing, processing, and transporting and shipping of soybeans in Argentina.

(2) The authors then solve this problem using linear programming.

Five further clarifications and conditions are that:

(1) The buying and selling of soybeans can be done in the spot market and also through forward contracts (including contracts in which the price determination occurs during a future timeframe);

(2) Each cash flow needs to be discounted at the proper interest rate, which matches up to the timing of a particular cash payment or receipt;

(3) In order to be feasible, the firm will need to sign (purchase and sale) contracts in addition to the ones that already exist;

(4) The authors choose to limit the allowable number of additional contracts in order to preserve the model's realism; and

(5) The model assumes that there is no chance of failure in all contractual matters.

Results

The paper solves for the "globally optimal logistical and financial solution" for Los Grobo's soybean intermediation business of 2012. Their model's solution specifically includes "the detailed routing of trucks in space and time [and] the precise nature of new transactions that the sales force should aim to achieve," write the researchers.

Table 1 on the next page compares the optimal solution versus a representation of the firm's actual decision-making. The table shows the aggregated transactions and fees, as well as the physical volumes, across time for both solutions. The optimal solution could have improved the firm's profit by 4.56%.

"ARS means Argentinean Pesos. In the second half of 2013, one Argentine peso was roughly equivalent to 0.20 US dollars," according to the research paper.

Given how variable Argentinian interest rates are, the optimal solution will change depending on the model's particular interest-rate assumptions.

Table 1
Comparison of Model's Optimal Solution versus
A Model of Los Grobo's In-House Solution (Based on "Heuristics")

Transactions (in ARS)	Heuristics	Model	% Change
Prearranged purchases	-833,670,645	-833,670,646	0.00%
Forward purchases at origins	-107,194,906	-23,907,818	-77.70%
Spot purchases at destinations	0	-75,932,792	N/A
Prearranged sales	610,429,550	610,429,550	0.00%
Forward and spot sales at destinations	408,964,582	397,361,351	-2.84%
Storage costs at origins and destinations	-6,262,070	-6,068,385	-3.09%
Loading costs at processing plants	24,557	42,444	72.84%
Storage costs at processing plants	-1,237,561	-1,194,399	-3.49%
Processing costs	84,888	84,888	0.00%
Shipping fees paid by farmers	81,950,287	81,950,288	0.00%
Real shipping fees	-85,957,382	-78,900,226	-8.21%
Profit	**67,131,302**	**70,194,256**	**4.56%**
Total sales	**1,019,394,132**	**1,007,790,901**	**-1.14%**
Profit/Total sales	**6.59%**	**6.97%**	**5.76%**
Tonnage	**Heuristics**	**Model**	**% Change**
Prearranged purchases	506,719	506,719	0.00%
Forward purchases at origins	65,969	15,211	-76.94%
Spot purchases at destinations	0	43,423	N/A
Prearranged sales	371,712	371,712	0.00%
Forward and spot sales at destinations	200,035	192,700	-3.67%

Source: Table 4 of research paper.

Conclusion

The paper applies a linear-programming approach to solving for the best logistics-and-trading solution for the business operations of a large Argentinian grain trader during a particular marketing season. This solution could have improved the firm's profitability by an economically significant margin. This result suggests that comparable firms should strongly consider investing in the implementation of such models for their firms. In addition, one would expect that the paper's methodology would also be applicable to large firms in other geographic locations, which are similarly involved in the trading and shipping of grain. That said, one would need to await further case studies to understand what the economic impact would be for such modeling in other geographic locations such as in North America.

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Keywords

Agriculture, commodities, logistics, finance, network flow problems

The Determinants of Convenience Yields

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Available at SSRN:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2372838

In this study, we investigate the determinants of convenience yields across a broad range of commodities. We find that the convenience yields of commodities are exposed to both commodity-specific and systematic factors, but to a different extent. The difference in explanatory power of these factors for each commodity sheds light on the heterogeneity of commodity markets. One main difference between commodity sectors lies in their different sensitivities towards the state of the economy.

Introduction

Quite simply, the price level of a futures contract is equal to the value of the underlying asset, plus the cost of the asset, minus the benefit of the asset. For example, a futures contract on a basket of equities will have a price that is equal to the value of the equities, plus the cost of financing the purchase of the basket, minus the benefit of all the equity holdings' dividends. If the price of the futures contract diverges from this formula then there would be a riskless arbitrage. Therefore, under "no arbitrage" conditions, we would say that this relationship holds.

Interestingly, with commodity futures contracts, there is a complication with this "no arbitrage" condition. At times for some commodity futures contracts, the futures contract's price level will be below what it would cost to finance, store, and insure the spot commodity. This is because there can be an industrial benefit to holding commodities so that a commercial entity can avoid the disruption to its business operations from a potential stock-out. We call this benefit the "convenience yield," and this is a concept that was formalized in Kaldor (1939).

For commodity futures contracts, then, the futures price level is equal to the value of the spot commodity, plus the cost of holding the commodity, minus its convenience yield. The convenience yield is unobservable and we infer it from the futures contract price. In effect, it is a "plug factor" in the typical cost-of-carry formula, but it is also a logical, economically sound factor, nonetheless.

The research paper at hand uses a number of sophisticated mathematical techniques to examine to what extent convenience yields across commodities are driven by (a) commodity-specific factors such as inventories and hedging pressure, and to what extent convenience yields are driven by (b) macroeconomic factors such as inflation and industrial production.

Why the Paper's Research Question is Important

The authors explain that "convenience yield dynamics … play a crucial role in commodity derivatives pricing." In addition, as noted in Till (2016), commodity traders regard convenience yields as quite important in both short-horizon trading strategies and in long-horizon investment strategies. Understanding what may drive convenience yields across commodities would be helpful in both enterprises.

Data Description

The study includes "18 commodities … which can be categorized into 5 subgroups, namely grains, softs, animals and woods, precious metals and energy. … The sample period dates back to April 1990 and ends in December 2011," write the researchers. Table 1 on the next page summarizes the paper's data sources.

Description of Investigation

The authors use Schwartz (1997)'s three-factor model to represent all futures curve shapes, across time and across commodities, from which they extract a representation of each commodity futures contract's convenience yield through time. The researchers note that Schwartz's model has "been studied in detail and has been found to do a good job in pricing [commodity] futures contracts." The authors then use a set of sophisticated mathematical techniques to solve for their representation of convenience yields for each commodity through time.

Once the researchers have created time series for each commodity's convenience yields, they then proceed to examining how much of the variability of each commodity's convenience yields can be explained (a) by commodity-specific fundamental variables and (b) by broad macroeconomic variables. They do so via regressions.

Table 1
Research Paper's Data Sources

Data	Source
Commodity Futures Prices	Commodity Research Bureau
Interest Rates	Thomson Reuters Datastream's *US Treasury Constant Maturity Yield*
Agricultural Inventories	United States Department of Agriculture
Energy Inventories	U.S. Energy Information Administration
Cotton, Cocoa, and Cocoa Inventories	Intercontinental Exchange (ICE) warehouse data on The Bloomberg
Gold and Silver Inventories	COMEX warehouse data on The Bloomberg
Platinum Inventories	NYMEX warehouse data on The Bloomberg
Hedging Pressure ("[R]elevant net positions taken by commercial traders")	U.S. Commodity Futures Trading Commission's Commitments of Traders Report
Expected U.S. Industrial Production	*Blue Chip Economic Indicators*
Expected Consumer Price Index	*Blue Chip Economic Indicators*
10-Year / 2-Year Term Spread, "a measure of future economic activity."	Thomson Reuters Datastream

Results

The paper's noteworthy empirical results are as follows, quoting the authors:

- "Significant positive correlations between the convenience yields and the spot prices are observed across all commodities."

- "[For] 13 out of 18 commodities[,] ... the convenience yield is [more often] … below the level of storage costs [which shows] … that markets have sufficient supply most of the time, and inventory holders benefit little from owning the underlying good."

- "On the other end, … soybean meal, feeder cattle, … platinum and crude oil often exhibit … convenience yields" greater than storage costs.

- "[T]he convenience yields of most commodities show only relatively low correlations with each other."

- "Considering inventory …, we … observe that 15 out of 18 commodities exhibit a negative relationship [with convenience yields], with 10 of them being [statistically] significant ..." This is as generally as expected, given the theory covering convenience yields.

- "The explanatory power of inventory levels varies substantially across commodities. It is highest for silver [at] 27% …"

- Regarding hedging pressure, the authors "observe negative coefficients of the *net* long positions of commercial traders for 15 commodities … [with] 12 of them [statistically] significant. This result shows that a higher number of long commercial traders' positions (typically consumers) implies lower convenience yields." [Italics added.]

- Except for one commodity, the expected Consumer Price Index (CPI) and expected industrial production factors "exhibit significantly positive relationships with the convenience yields."

- "The term spread … is only significant for precious metals."

- "[T]he convenience yields of grains are less exposed to economic expectations than other sectors."

- Whereas the results above used only one explanatory variable at a time, the researchers also examined "all explanatory variables at once by conducting multiple regressions." The results "generally match those from simple regressions."

- "[T]he overall explanatory ability of the [authors'] variables … [is] strongest for metals and energy commodities."

Conclusion

The authors emphasize the usefulness of modeling convenience yields for derivatives pricing applications. But their paper is also useful for holders of long-term positions in commodity futures contracts.

Till (2016) discusses how the realized convenience yield for a commodity can be quite significant for the long-run returns of a commodity futures contract. Therefore, an understanding of what drives convenience yields is potentially useful to long-term holders of commodity futures contracts so that these investors can wisely choose which commodities to include (and which commodities to exclude) in their futures basket.

Erb and Harvey (2006, p. 83) find that "the efficacy of an individual commodity futures contract in hedging unexpected inflation has historically been correlated with its roll return," (which, in turn, is linearly related to the commodity's convenience yield, according to Lewis (2005).) This digest article's research paper provides additional evidence that convenience yields have statistically significant

relationships with key macroeconomic variables. If an investor is choosing a strategy based on its potential exposure to key macroeconomic variables, then this paper's results will be useful to this class of investors as well.

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Keywords

Commodity futures, convenience yield

Development of Commodity Exchange Markets as an Avenue to Foster Economic Development in Africa

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Available at SSRN:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2660948

This paper argues that meaningful economic development in Africa could be achieved through the establishment of commodity exchange markets. Further the paper makes a moral case for such institutions since they would be expected to reduce the informational disadvantage besetting poor rural farmers. The paper discusses the relevance of the establishment of the Chicago Board of Trade in mid-nineteenth century frontier America, but also notes the limitations of using this example for African countries. Instead, the author argues that the Ethiopian model for commodity exchange development may be most relevant for other African (and developing) countries, particularly in Uganda.

Introduction

African economies underwent a series of economic reforms in the 1980s. These reforms were intended to correct the inefficiencies of the centrally planned economy and bring about an efficient system where prices would be determined by the market forces. The result of this was the liberalization of almost all sectors of the economy. It was generally agreed that agricultural marketing systems should be liberalized to allow the private sector to unleash the power of the market, gain efficiency in the sector, and stimulate higher production volumes and standards. Unfortunately, the market system, as implemented, has exposed farmers to intense market risks and has failed to address informational asymmetries. The purpose of the paper is to explore the potential of commodity exchange markets to correct such problems and to analyze under what conditions a commodity exchange can actually work in Africa.

Case Studies

The paper explores the historical development of the Chicago Board of Trade, but also notes the limited applicability of this example for contemporary Africa. The paper then notes how the Ethiopian commodity market may be a more relevant model for other African countries, particularly in Uganda.

Chicago Board of Trade (CBOT)

A number of the factors that led to the creation of the CBOT in 1848 are similar to what is currently occurring in many African countries. The agricultural regions of 1840s America faced:

- Bumper harvests that led to a collapse in prices,
- Poor storage facilities, and
- Market risks that were beyond the ability of individual merchants to manage.

Arguably, this is not only the case in Africa, but it is perhaps worse than what was prevalent in frontier America.

The Chicago markets *evolved* over a century-and-a-half to not only resolve the problems of transaction costs and risks faced by farmers, but also to coordinate the exchange of agricultural goods across participants, locations, and time. State regulation increased in scope as the market grew; importantly, regulation *followed* market developments rather than occurring in advance.

The evolutionary nature of the Chicago futures markets is also emphasized in the *Global Commodities Applied Research Digest* article, "Brief Case Studies on Futures Contract Successes and Failures," in the *Contributing Editor's Collection*. That article discusses how futures markets and contracts were developed in a trial-and-error fashion with numerous failures accompanying periodic success.

In contrast, the author of "Development of Commodity Exchange Markets as an Avenue to Foster Economic Development in Africa" notes that whereas the Chicago markets were *demand-driven* and established by its users, the emerging exchanges in Africa have been *donor-driven.*

The author further notes how ambitious it is to establish commodity exchange markets from scratch. There are many interrelated, core institutions that must be established for commodity exchange markets to properly function. These institutions include a market information system, a warehouse receipts system, a system of product grading and certification, a regulatory framework and appropriate legislation, an arbitration mechanism, and producer and trade associations. In addition, a commodity exchange's success relies on other sectors such as banking, insurance, transport, information technology services, and inspections services.

Given the scale of the required institutional development, the author advocates a strong role for government in the formation and coordination of these necessary institutions. Of note, this is the opposite of the historical Chicago experience. But as the author asserts, and as summarized below, the varying fortunes of the Ugandan versus Ethiopian commodity exchanges can be largely explained by the level of government engagement in each project.

Uganda Commodity Exchange

Uganda is a primarily rural country, with the majority of the population living in villages. For many households, selling commodities produced on their farm is their only source of cash income. Therefore improvements in the operations of markets may have the potential to have a positive impact on the lives of the rural poor.

The Uganda Commodity Exchange was established in 1998. The exchange carries out its commodity futures trading and commodity options trading transactions on the basis of an open and free market system. The system was originally funded with a grant from the European Commission of 1.3 million euros. A further 1.13 million euros were given for technical assistance. Unfortunately, many of the original objectives of the scheme have not materialized or have been considerably delayed. Funding for

the commodity exchange has now ended, and it is not certain whether the system will receive further funding, as of the writing of the article.

Ethiopian Commodity Exchange

The Ethiopian system developed very differently from the system in Uganda: namely, the Ethiopian system is government-run. The government decided that the new exchange should include the country's most important export commodity, coffee. And rather than leave the trading fraternity to decide whether it would use the new system, the government mandated the use of the exchange by coffee exporters. The major traders and exporters have bought seats on the exchange and have developed a system of dealing with each other to establish prices for various coffee grades. The existing coffee industry infrastructure of warehouses, testing centers and weighing stations has been marshaled in service to the program. The Ethiopian government has also considered expanding the system and including other crops.

Conclusion

Based on Uganda's experience, the author questions whether African commodity exchanges can succeed when the government's role is limited to providing the relevant legal framework and oversight functions (which is the Chicago model.) Instead, the author highlights the relevance of the Ethiopian *government-run* commodity exchange. That said, the author recognizes that the new African exchanges represent something of an experiment, so it is too early to note whether the Ethiopian model will have widespread applicability for other developing countries.

Reference

Till, H., 2016, "Contributing Editor's Collection of Digest Articles," *Global Commodities Applied Research Digest*, Vol. 1, No. 1, Spring.

Keywords

Commodity market development and regulation

Introduction to Research Council Report

Hilary Till
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The J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School established a prestigious Research Council in early 2015. The Council is a selection of academics and practitioners, and its members are balanced across commodity segments. The group has met in April and December 2015, and is chaired by Professor Colin Carter, University of California, Davis, and is co-chaired by Dr. Margaret Slade, Professor Emeritus, Vancouver School of Economics, University of British Columbia.

Opening remarks by Dr. Sueann Ambron, Former Dean of the Business School and Senior Advisor, JPMCC and Ajeyo Banerjee, Ph.D., CMA, Associate Professor of Finance and Risk Management, Executive and Faculty Director, JPMCC, at the inaugural Research Council meeting on April 18, 2015.

Mission of the Research Council

Excerpting from Casey (2015), the goal of the Council is "to encourage robust dialogue between researchers and practitioners as well as to drive research into wide-scope commodities issues, such as supply chain management, risk management and regulatory matters, said Ajeyo Banerjee, Ph.D., Center director. 'There is really no organized research activity on commodities as a whole,' Banerjee said. He noted that plenty of research is directed at various sectors — agriculture, metals and minerals, and energy — but 'there is no organized group that looks across all commodities.'"

"That's where the Research Council comes in. Twenty-six experts, a mix of renowned academics and business leaders from across the nation, met … at the CU Denver Business School in April [2015]. Three sessions each involved an academic presentation of a study followed by discussion about the research by both academics and practitioners," recounted Casey (2015).

Recognition of Support

During the April inaugural meeting, Banerjee recognized Colin Fenton, who has been a leader of the JPMCC's Advisory Council since its inception. Fenton and the Center's principal sponsor, J.P. Morgan, have supported and encouraged the idea of a Research Council, which Banerjee and Professor Marcelle Arak, Research Director of the JPMCC, brought to fruition in early 2015.

Colin Fenton, Managing Partner and Head of Research at Blacklight Research LLC and Fellow, Columbia University, Center on Global Energy Policy; and Ajeyo Banerjee, Ph.D., Executive and Faculty Director of the JPMCC, at the Research Council meeting of April 18, 2015.

The Value of the Research Council

The Value to Industry

During the April 2015 Research Council meeting, Professor Vince Kaminski, Rice University, and member of the JPMCC's Research Council, provided a conceptual framework for the commodity markets. He compared the interaction between various parts of the commodity complex to a Rubik's cube. One dimension is the physical layer, the second dimension is the financial layer, and the third dimension is the geopolitical and social layer, with shocks in one layer propagating through other layers in an unpredictable fashion.

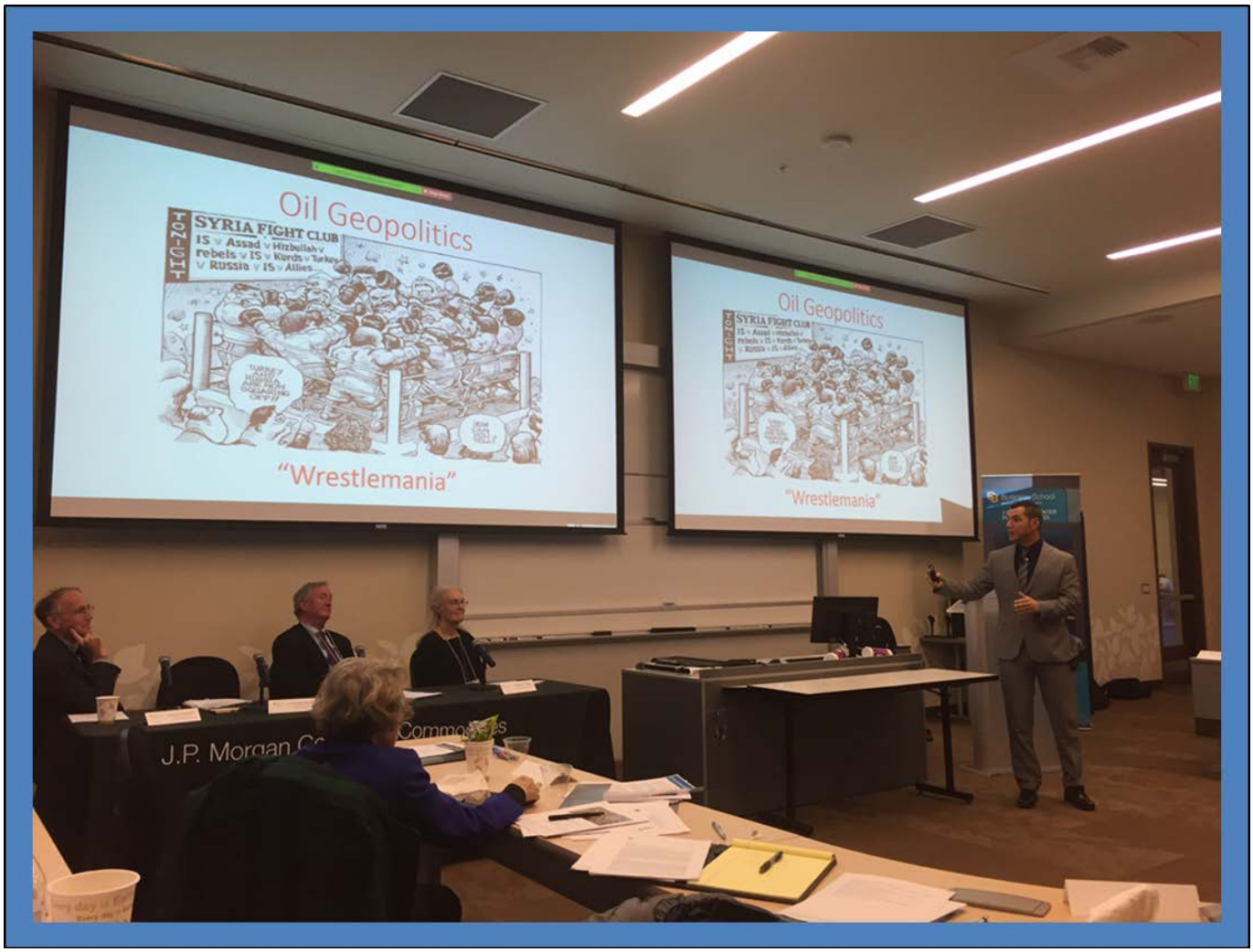
One concrete example of this complexity was provided at the Research Council by an agricultural expert who noted that soybean inventories in China may have been used as collateral for financing other entrepreneurial activities. The driver for soybean demand in this case would not have been food demand. There are similar anecdotes about copper, aluminum, and other metals, noted Kaminski.

Left-to-right: Professor Graham Davis, Ph.D., Colorado School of Mines; Ms. Nancy DeVore, DHF Team; Dr. Benjamin Lee, Ph.D., Research Scientist, National Renewable Energy Laboratory; Professor Vince Kaminksi, Ph.D., Rice University (with microphone), and Mr. Dan Kowalski, Knowledge Exchange, CoBank, at the JPMCC's inaugural Research Council meeting on April 18, 2015.

In an era of very narrow specialization, continued Kaminski, it is very difficult to be aware of any such complexities. That is why the JPMCC's Research Council is so valuable. It brings together people of varied backgrounds, who can brainstorm in a very formal way; this can create a lot value for the industry. This can also help traders and risk managers. A trader also wants to find someone who can "see around the corner." This is very difficult to do when one is in a very narrow academic or business discipline, explained Kaminski.

The Value to Academia

At the December 2015 Research Council meeting, Professor Yosef Bonaparte, University of Colorado Denver Business School, added that one way of thinking about research is as a puzzle to solve. He welcomed industry members bringing up challenges that they face, which could provide interesting puzzles for innovative research.



Professor Yosef Bonaparte, Ph.D., University of Colorado Denver Business School, presenting at the Research Council meeting of December 4, 2015. From far-left-to-right: Professor James Hamilton, Ph.D., University of California, San Diego; Dr. Bluford Putnam, Ph.D., CME Group; and Professor Emeritus Margaret Slade, Ph.D., University of British Columbia and Co-Chair, Research Council, JPMCC.

Research Panels in the *GCARD*

In this issue of the *Global Commodities Applied Research Digest (GCARD),* we cover the agricultural panel's presentations from April 2015, which were delivered by distinguished academic and practitioner members of the Research Council. Future issues of the *GCARD* will cover academic panels on energy, metals-and-mining, and on renewable energy.

Members of the Research Council

- Dr. Sueann Ambron, Former Business School Dean and Senior Advisor, JPMCC, University of Colorado Denver Business School
- Mr. Thorvin Anderson, CFA, Executive Director, J.P. Morgan Ventures Energy Corporation
- Professor Marcelle Arak, Ph.D., Research Director, JPMCC
- Dr. Thomas Brady, Ph.D., Chief Economist, Newmont Mining Corporation
- Professor Colin Carter, Ph.D., University of California, Davis; and Chair, Research Council, JPMCC
- Professor Graham Davis, Ph.D., Colorado School of Mines
- Ms. Nancy DeVore, Principal, DHF Team, LLC
- Mr. Colin Fenton, Managing Partner and Head of Research, Blacklight Research LLC; and Fellow, Columbia University, Center on Global Energy Policy
- Mr. Robert Gray, CFA, Chief Commodities Strategist, Resource Capital Funds
- Mr. Robert Greer, Scholar in Residence, JPMCC
- Professor, James Hamilton, Ph.D., University of California, San Diego
- Mr. Dave Hammond, Principal, Hammond International Group
- Professor Vince Kaminski, Ph.D., Rice University
- Professor Lutz Kilian, Ph.D., University of Michigan, Ann Arbor
- Mr. Dan Kowalski, Director, Knowledge Exchange, CoBank
- Dr. Benjamin Lee, Ph.D., Research Scientist, National Renewable Energy Laboratory
- Mr. Peter McCallum, Director, Global Agribusiness, Bunge Limited
- Mr. Mike Miller, Vice President, Risk Management, Ardent Mills
- Dr. Bluford Putnam, Ph.D., Chief Economist, CME Group
- Professor Forest Reinhardt, Ph.D., Harvard Business School

- Mr. Marco Sampaio, Head of Risk Management, JBS USA
- Professor Emeritus Margaret Slade, Ph.D., University of British Columbia; and Co-Chair, Research Council, JPMCC
- Ms. Hilary Till, Solich Scholar, JPMCC; and Contributing Editor, *Global Commodities Applied Research Digest*
- Mr. Lance Titus, Managing Director, Guzman Energy
- Dr. Robert Vigfusson, Ph.D., Board of Governors of the Federal Reserve System
- Professor Brian Wright, Ph.D., University of California, Berkeley

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The Puzzle of Recent Grain Price Behavior

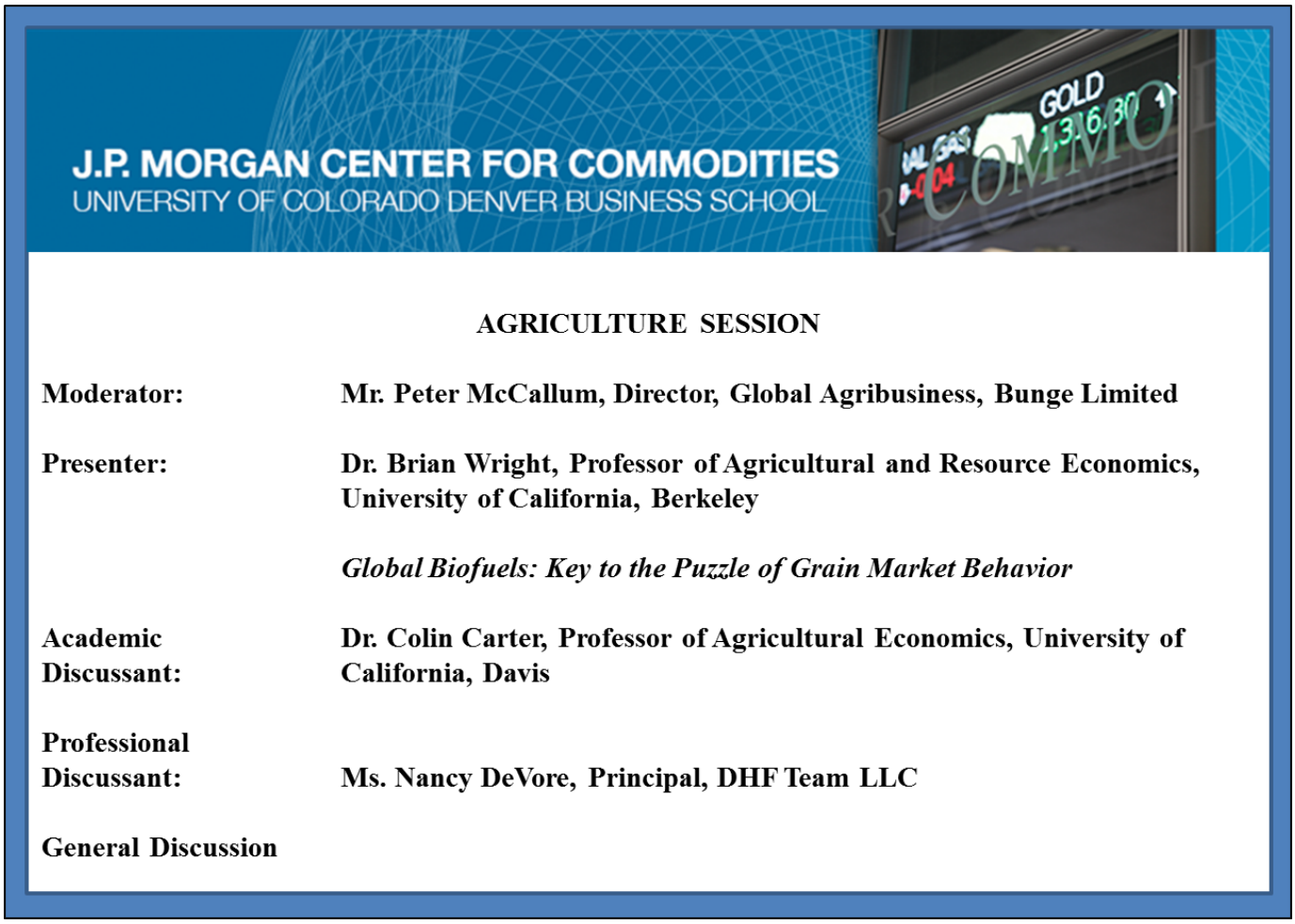
Hilary Till
Solich Scholar, J.P. Morgan Center for Commodities, University of Colorado Denver Business School; and
Contributing Editor, *Global Commodities Applied Research Digest*

At the April 2015 J.P. Morgan Center for Commodities' (JPMCC's) Research Council meeting, Professor Brian Wright, University of California, Berkeley, discussed the puzzling behavior of grain prices during the last 10 years. Professor Wright's biography is at the end of this article. His Research Council presentation is based on Wright (2014). Mr. Peter McCallum, Bunge Limited, moderated the session while Professor Colin Carter, University of California, Davis, and Ms. Nancy DeVore, DHF Team, LLC, discussed Wright's research from both academic and practitioner perspectives, respectively.

Opening remarks by Mr. Peter McCallum (right), Director, Global Agribusiness, Bunge Limited, at the Research Council's Agricultural panel on April 18, 2015. Professor Brian Wright, Ph.D., University of California, Berkeley, is on the left. Both Mr. McCallum and Dr. Wright are members of the JPMCC's Research Council.

Professor Wright's presentation was during the Agricultural panel, whose agenda is in Figure 1. The Research Council meeting also included an Energy panel and a Metals-and-Mining panel. Articles on the other panels will appear in future issues of the JPMCC's *Global Commodities Applied Research Digest (GCARD).*

Figure 1
Excerpt from Research Council Meeting Agenda of April 18, 2015



Presentation from Professor Brian Wright, Ph.D.

Introduction

In summarizing Professor Wright's presentation, this article will draw from his paper, slides, and remarks at the Research Council meeting. This article will adopt the following conventions when referencing Professor Wright. When quoting Wright (2014), this article will include in parentheses, the page number from which the citation is drawn. When quoting Wright's April 2015 presentation, this article will include in parentheses, the slide number from which the citation is drawn. And when quoting Wright's

remarks at the Research Council meeting, this paper will include in parentheses, the timing of when the remarks were made during the afternoon session of the conference.

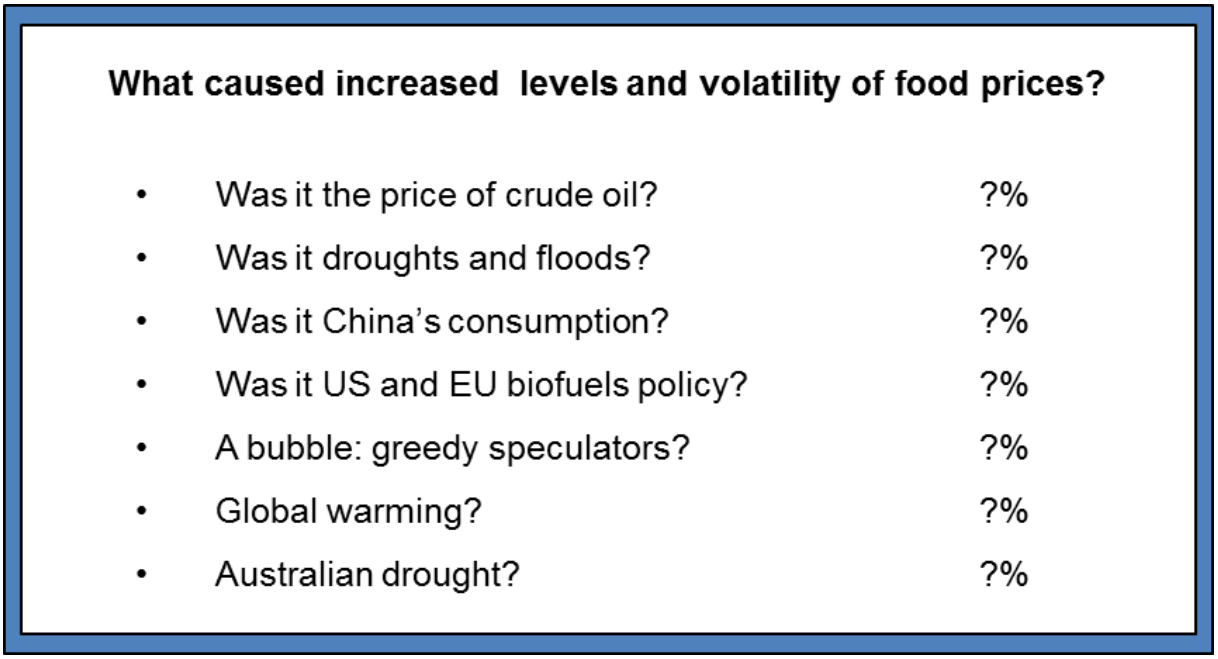
The Problem

"In the last half-decade," recounted Wright, there have been "sharp jumps in the prices of wheat, rice, and corn, which furnish about two-thirds of the calorie requirements of mankind …" (p. 73). In addition, [s]ince about 2005, international grain markets have seen several of the largest price jumps since the 1970s" (p. 84). And the problem isn't just the price spikes in 2007-2008 and in 2011. There has also been a "sustained large change in price level (Slide 7)." Compared to 2005, in 2014, the rice real price is 30% higher; the wheat real price is 40% higher; and maize (corn) prices are 75% higher (Slide 7).

Who is to Blame?

According to Wright, there has been a "bewildering list of factors," apportioning blame for the jumps in grain prices (p. 37). Figure 2 summarizes these factors.

Figure 2
The Blame Game in 2007



Source: Wright (2015a), Slide 2.

Is there an elegant theoretical model that does not treat this century's price spikes as due to a jumble of factors? Yes, and that is the subject of Wright's recent work.

The Puzzle

Wright notes that until 2004, a classic supply-and-demand model with two extensions had been successful in modeling grain price behavior at seasonal frequencies (p. 74 and Slide 4). But this enhanced model stopped working after 2005. Why? That is the puzzle.

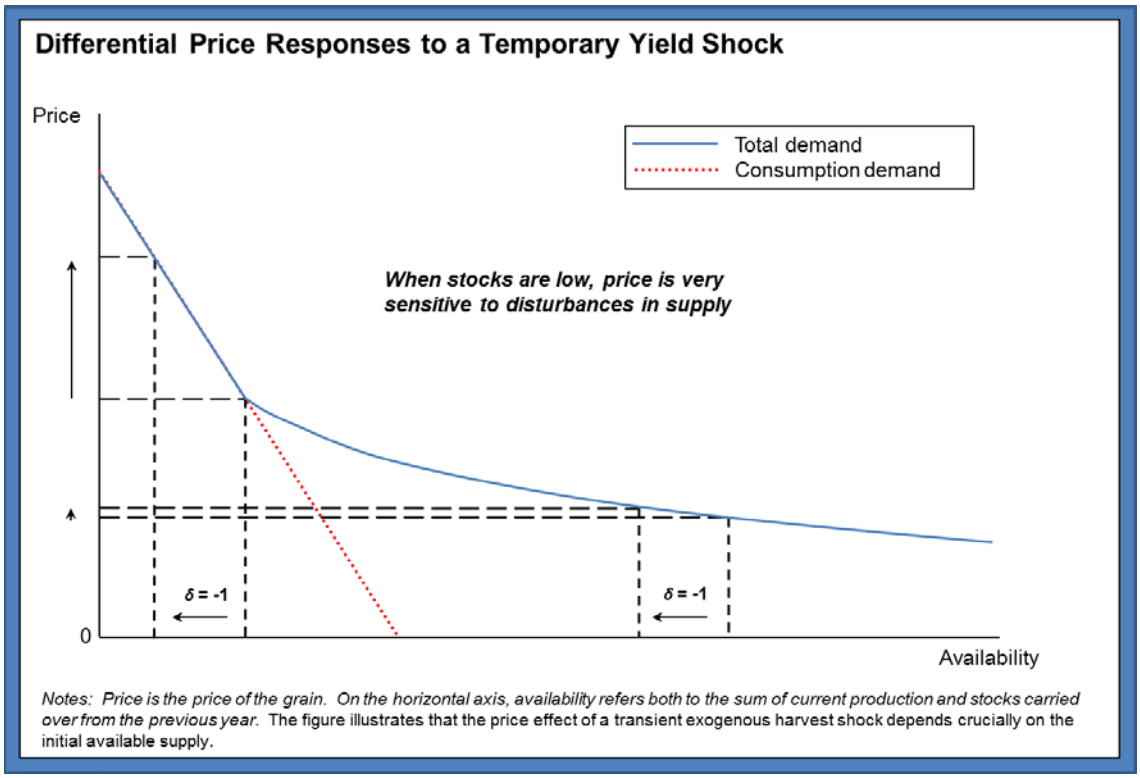
Pre-2005 Supply-and-Demand Models for Grains

In order to best appreciate the recent puzzle regarding grain price behavior, one must first have a basic understanding of the models that had formerly worked. First of all, one cannot analyze a specific commodity like rice solely on its own fundamentals such as its own quantity of inventories or harvest prospects. One has to also take into consideration, on the margin, what other grain might *substitute* for it in order to properly understand the price behavior of rice. Wright examines the market for "aggregate calories," combining the market for wheat, corn, and rice together rather than examining the market for each grain separately and independently (p. 81).

Secondly, one needs to also take into consideration another *substitution* effect, and that is the one across time: grain can be consumed now or in the future. In the latter case, this is the market for storage, which competes against the market for immediate consumption of grain.

From 1961 through 2004, as long as one incorporated the "substitution between grains as sources of calories, and [the] substitution between successive harvests via storage[,]" one could successfully model grain price behavior (p. 75 and p. 84). This model is graphically illustrated in Figure 3.

Figure 3
Storage Adds a Fundamental Nonlinearity to Demand



Source: Wright (2015a), Slide 64.

Wright clarifies that there is a meaningful kink in the demand curve in Figure 3. Demand consists of consumption demand *and* storage demand. The horizontal axis is available supply, which consists of "current production and stocks carried over from the previous year" (p. 78). When current prices are low, it is storage demand that determines prices. This demand is represented to the right of the kink in the graph. The steeply sloped line to the left of the kink is determined by consumption demand. Note how explosive (or not) the price response is to a supply shock depends on the "initial available supply" (p. 78). Note also that Figure 3 is a nonlinear function.

Wright (2015a) uses a delightful example from the popular Australian and New Zealand children's story, Who Sank the Boat?, to illustrate how a nonlinear function can make it difficult to apportion blame amongst various contributing factors (Slides 20 and 21). Please see Box 1.

Box 1

The Story of Who Sank the Boat?

"Imagine a pig carrying an umbrella, a sheep doing knitting, and a cow and a donkey and a mouse, all walking along on their back legs in single file.

What else is there to do on a fine sunny morning but to go for a row in the boat?

But there is one big question. 'Who sank the boat?'

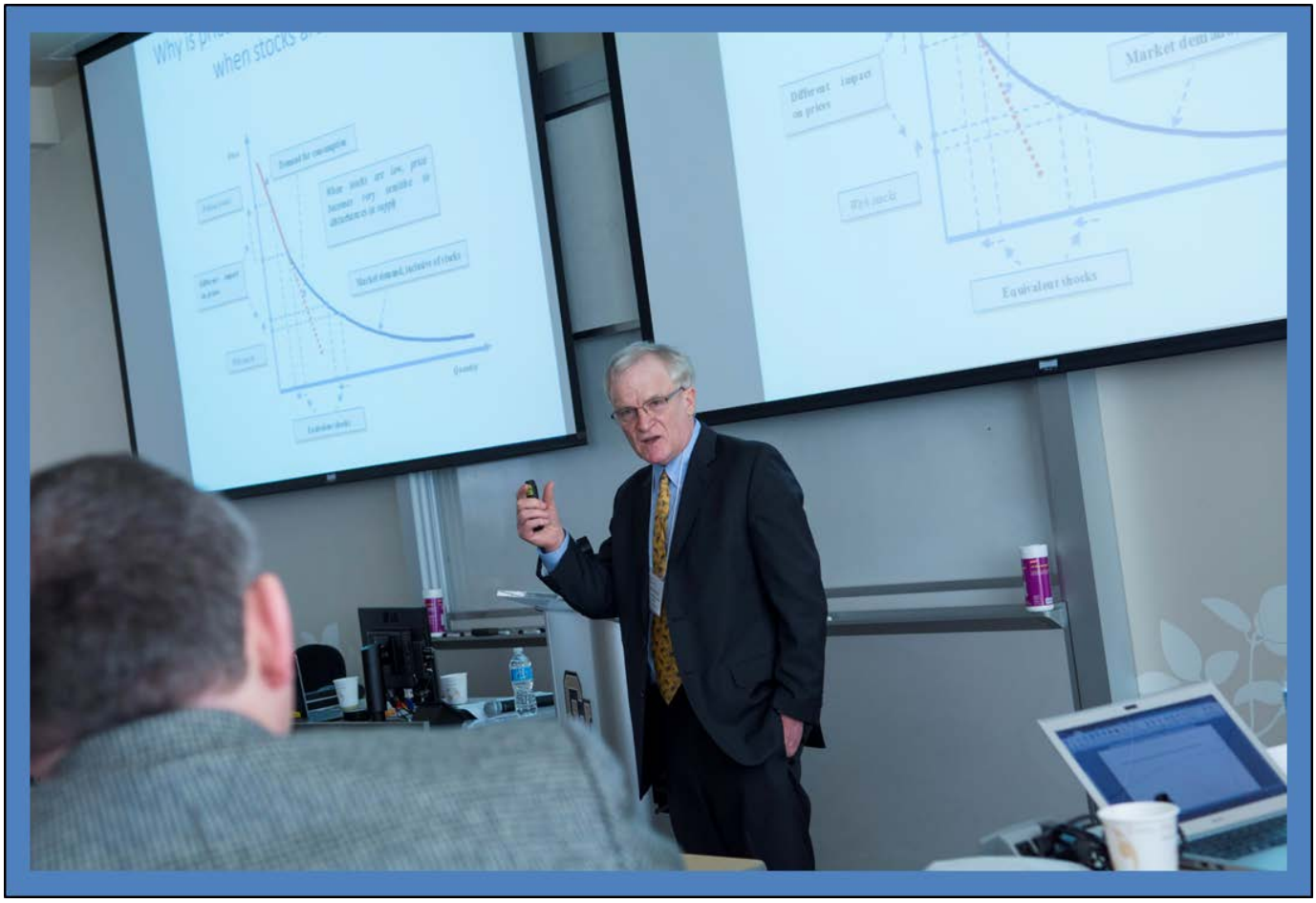
We are told the outcome right up front, but who was the culprit? The tension and suspense is fantastic as each creature in turn gets aboard. The donkey is a smart critter since he knew how to balance the weight of the cow. The sheep was just as smart since he got on the opposite side to the pig. We are now very low in the water now, but still afloat.

The smallest and the lightest of the friends [a naughty little mouse] now gets on board. … 'You DO know who sank the boat' - don't you?"

Source: "One Mouse Too Many" (2011).

In the Who Sank the Boat? story, would one entirely apportion blame on the incidental factor of the weight of the mouse, causing the boat to sink? "So is it 100% the mouse or 50% the pig" that is to blame? "It is … indeed … a nonsense question" when dealing with such a nonlinear function (Minutes 15:14 to 15:20 of Wright (2015b)).

The relevance of this children's story to grain price spikes is as follows. When there are low stocks (relative to consumption), any incidental factor can drive the price dramatically higher. At what price, would one choose not to have muffins in the morning? Wright (2011) had posed this question at a Commodity Futures Trading Commission research conference in explaining a nonlinear market model for grains. Just like with the children's story, one cannot assign a set percentage blame on any one factor when one is in the part of the price curve that is highly nonlinear. "[L]ow stocks make markets vulnerable to temporary harvest shortfalls" (p. 83).



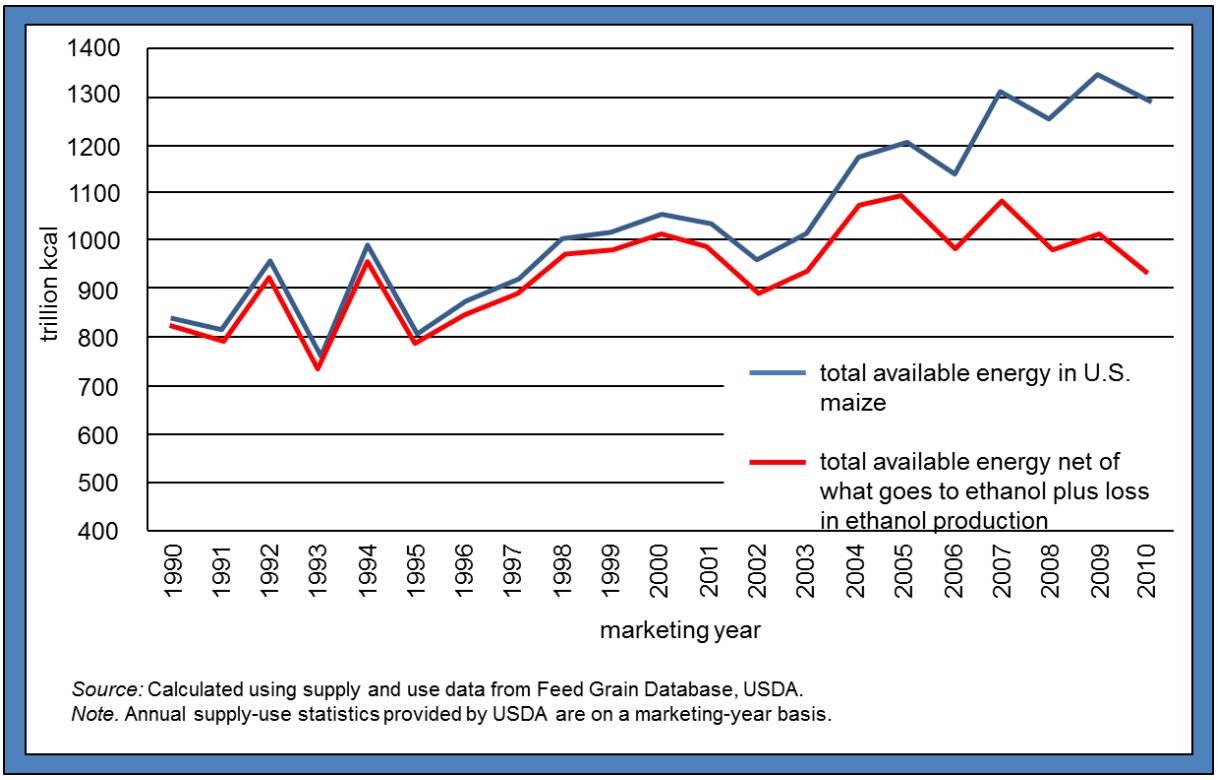
Professor Brian Wright, Ph.D., University of California, Berkeley, presenting at the Research Council's Agricultural panel on April 18, 2015.

A New Supply-and-Demand Model for Grains

"[M]arket observers were puzzled when prices, production, and stocks of grain calories all rose sharply between 2006 and 2008" (p. 87). These outcomes are not consistent with what would be expected based on the model represented by Figure 3.

What changed? "By the standards of agricultural policy changes, the introduction of grain and oilseeds biofuels for use in transport fuels was abrupt, and the effects of the balance between supply and demand were dramatic," especially after the introduction of "biofuel mandates as a policy instrument" in the 2005 Energy Policy Act (p. 85). Figure 4 illustrates how U.S. corn use for food and livestock feed eventually fell below its 1994 peak, as the use of ethanol (a biofuel) increased. Here, we see corn production increasing, but what is available for feed-and-feed eventually decreasing. "Currently, biofuels use accounts for about one-third of United States corn production (p. 86)."

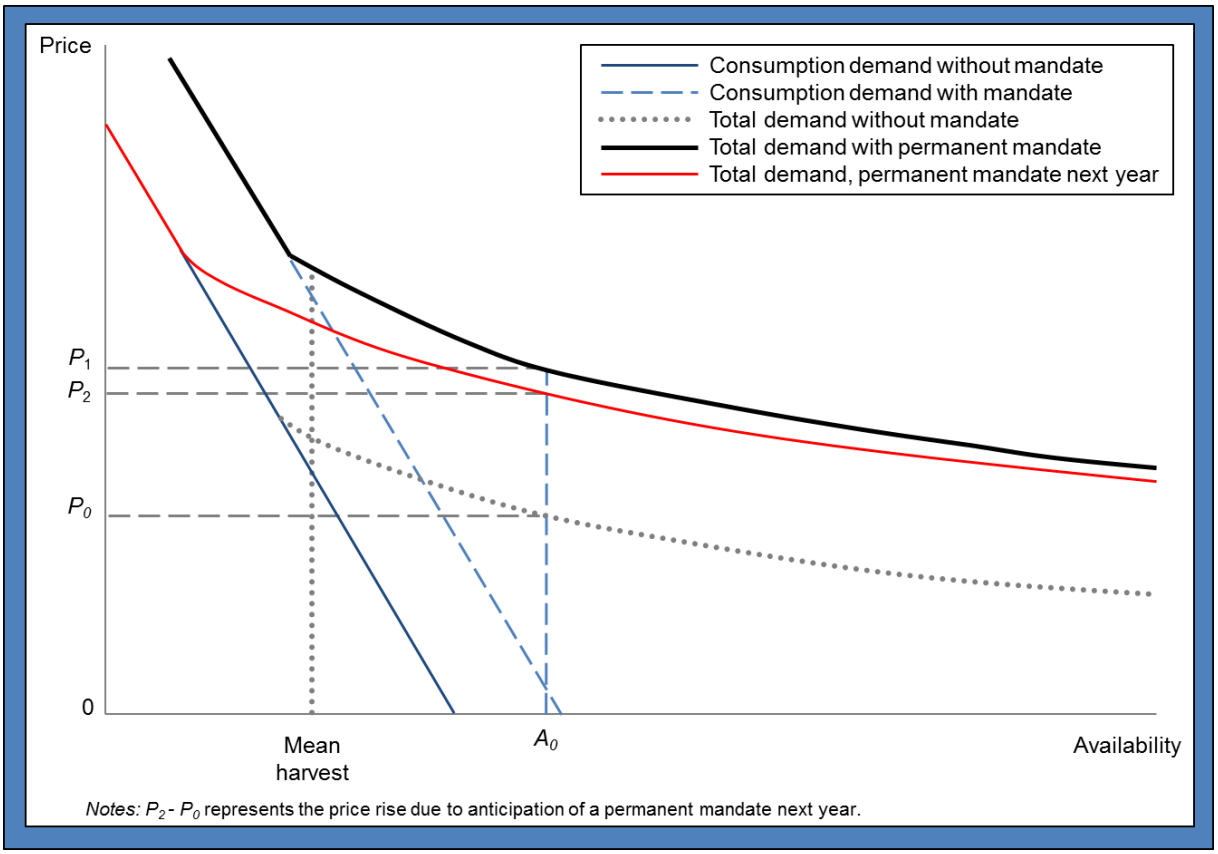
Figure 4
U.S. Maize (Corn) Energy for Food/Feed Fell Below 1994 Peak



Source: Wright (2015a), Slide 27.

Clearly, given the magnitude of this new demand factor, the market model described in the previous section needed to be updated to include biofuels. Specifically, "[t]o solve the puzzle of recent grain market behavior it is necessary to incorporate into the market model – in addition to substitution between grains as sources of calories, and substitution between successive harvests via storage – a third key substitution, that of biofuels for petroleum-based fuels (p. 75)." The updated model is graphically represented in Figure 5.

Figure 5
Why Stocks Rose as Prices Rose Circa 2007



Source: Wright (2015a), Slide 30.

The biofuel mandate is a (likely) *permanent* shift in demand and not a temporary shock so it is <u>not</u> appropriate to just trace along the old demand curve of Figure 3 in incorporating biofuel demand. "The opportunity to cushion the shock is limited by the fact that, by assumption, at any given price, the mandate increases total consumption in every future period (p. 86)." Wright expanded on this point in his remarks to the JPMCC Research Council: "When you have a permanent shift in demand," there will not be a reduction of stocks to meet this demand. These stocks will be increased "in anticipation of even greater demand later. That's exactly what happened. (Minutes 19:40 to 19:56)." Wright notes that the market model, incorporating biofuel mandates, satisfactorily explains the post-2005 behavior of grain prices, and therefore there is no need look further afield at other speculative hypotheses for explanations (pp. 87-88).

A New Link to Petroleum Prices

Wright clarifies that it is not only the biofuel mandates that have mattered. "[The] increases in permissible shares of biofuels in blending with gasoline or diesel[, which] … became attractive when petroleum prices were high[,]" has also mattered for grain prices (p. 94). Professor Colin Carter explained why this has been the case in his discussion of Wright's paper. Carter's discussion is covered in the next section of this article. In addition, Avalos and Lombardi (2015) verify the new statistical connection between corn and oil in post-2005 data. Their paper is summarized in the "Research Digest Articles" section of the Spring 2016 issue of the *GCARD.*

Conclusion

The "[f]ood-competing biofuels global expansion after 2005 led to [a] permanent demand shock [with a] short-run response [of a] price spike [and a] longer-run response [of] raised price levels" (Slide 47).

Policy Consequences

Wright observes that "[w]e have not seen anything even close to the 'worst case scenario' in global food markets" (Slide 45). "Corn ethanol, soy for diesel, and sugar ethanol can be expanded faster than yields can rise, *in response to mandate expansion or high oil price[s]*, keeping stock ratios low and food prices high and volatile for many years" (Slide 68). One might therefore conclude that the existing biofuel mandates should be tailored to realistic yield productivity estimates and to the prevailing oil-price environment. Ms. Nancy DeVore, DHF Team, LLC, covered related topics in her discussion of Wright's presentation. Her discussion is covered later in this article.

Presentation by Professor Colin Carter, Ph.D.

Professor Wright's presentation was followed by a brief discussion from Professor Colin Carter. The following is an edited transcription of Professor Carter's remarks and includes his slides.

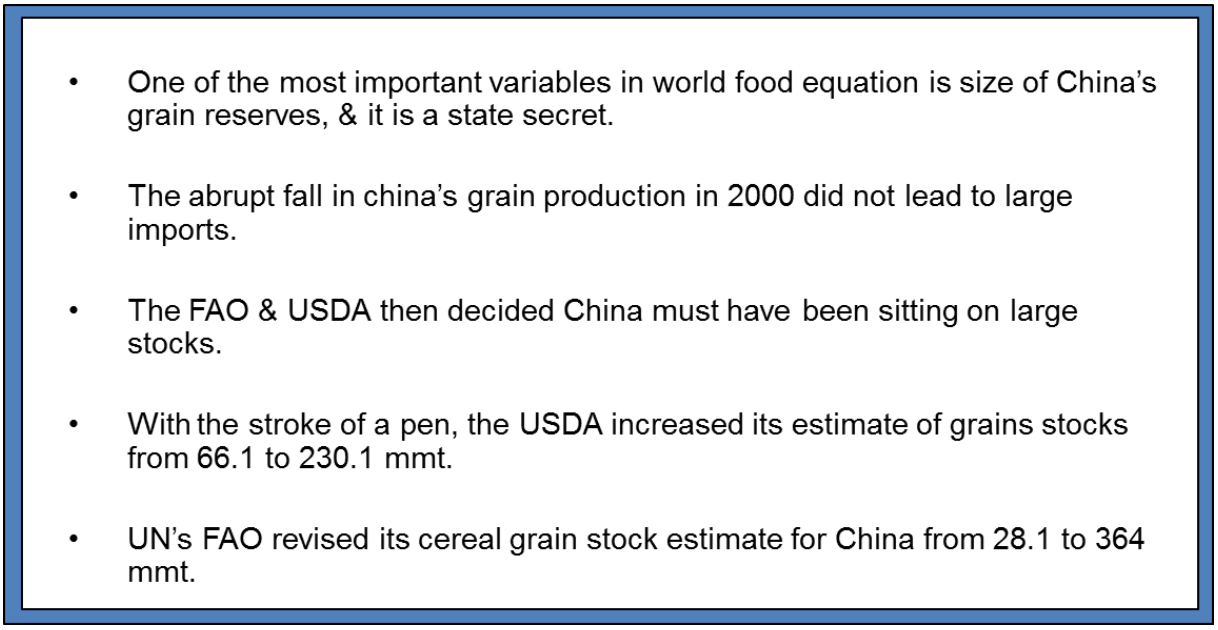
"It's a pleasure and honor to discuss Brian Wright's paper. There's a lot in the paper; I really encourage you to read it; it's very … good. I just wanted to try to make [several] … points …

The first has .. to do with the fact that unlike the oil market when you are studying grain markets, .. it's not even clear as to what a fact is, especially with some of the big players … [such as when] we're dealing with India [and] China.

… I'd also like to discuss where we are going with the renewable fuel standard, [which] Brian didn't really touch on… He talked about the impact of using corn, but my concern today is if we come back here in 3 years, Brian will be talking about the soybean market and biodiesel. …

So, first of all, Brian … alluded to this, and I just wanted to share it with you. We talked a lot about inventories, and his paper emphasizes the importance of modelling inventories properly. When it comes to China, we don't know what those inventories are … because it is a state secret." See Figure 6.

Figure 6
It's a State Secret

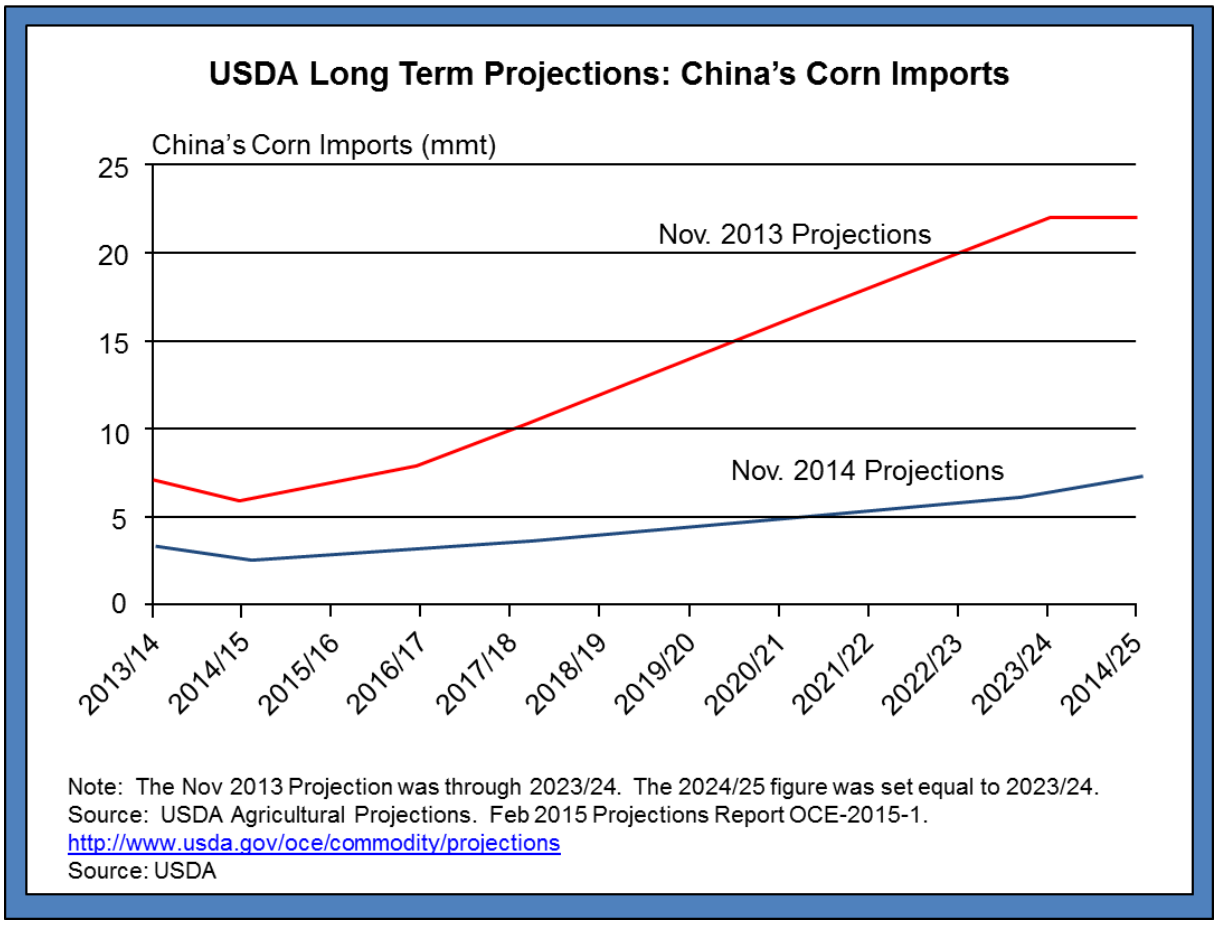


Source: Carter (2015b), Slide 2.

"Brian alluded to this: back in 2000, there was a drop in China's grain production. … It was a sharp drop. … Everyone was expecting imports to surge; it never happened, so guess what? [The] USDA revised its estimate of grain stocks from 66 to 230 million metric tons: that's … more than a small change. Not to be outdone, … FAO … changed their [grain stocks] number from 28 to 364 [million metric tons]. So keep in mind, that's a big number, so we don't really know what is happening in China with grain, livestock, and so on ..."

"This is a graph showing [the] USDA['s] … long-term projections. [See Figure 7.] Once a year, [they] release them in February. The red line shows their long-term projections of China's corn imports for the next 10 years. And you see that is was growing to over 20 million [metric] tons, which is a big change in the corn market. World corn trade is just over 100 million [metric] tons. So, an increase in trade of that extent would probably drive prices up 25 – 30%. This year, they lowered their numbers dramatically down to that blue line. There are alternative theories as to what has happened in the past year to justify that type of revision, and it would be interesting to find out [why]."

Figure 7
Most Recent USDA Projections of China's Corn Imports

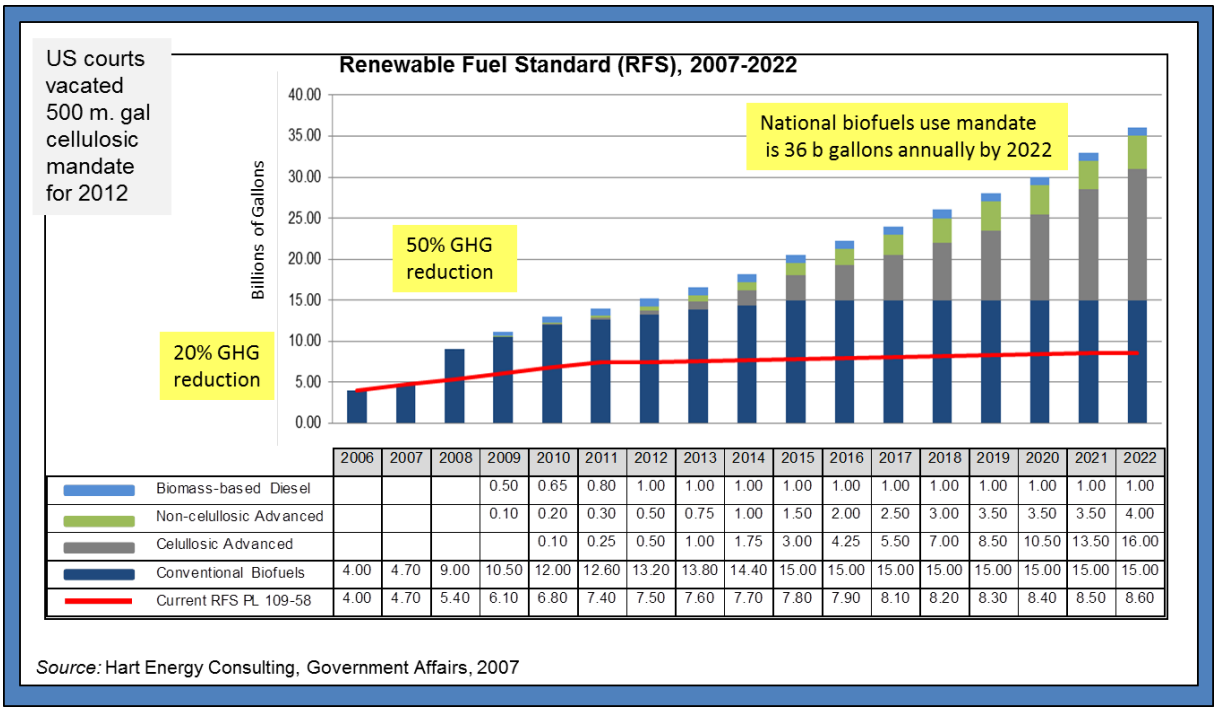


Source: Carter (2015a), Slide 3.

"… My next point is: where do we go with biofuels? Brian talked about the big impact that using corn for fuel has had on world food markets, and this graph shows a renewable fuel standard going through to 2022, which is not that far away. [See Figure 8.] We are looking at a requirement of 36 billion gallons of biofuel."

"The … [dark blue] portion of those bars is biofuels coming from corn; and the rest of it, as Brian said, would be cellulosic or … advanced biofuel. Well it turns out we don't have production of cellulosic. A couple of years ago the courts had to beat [the] EPA back because they were actually fining companies who were not buying cellulosic fuel even though there was no cellulosic fuel. So, my concern is, going forward, if nothing changes in our legislation, those bars are going to be filled with biodiesel and maybe … [using] soybeans. If you look at the economics of producing fuel from soybeans, it is pretty bad in terms of liters per acre, however you want to measure it, and we are currently using about 15% of our soybeans for fuel. My concern is what is going to happen in the next 3 or 4 years."

Figure 8
U.S. Goals re Renewable Fuels



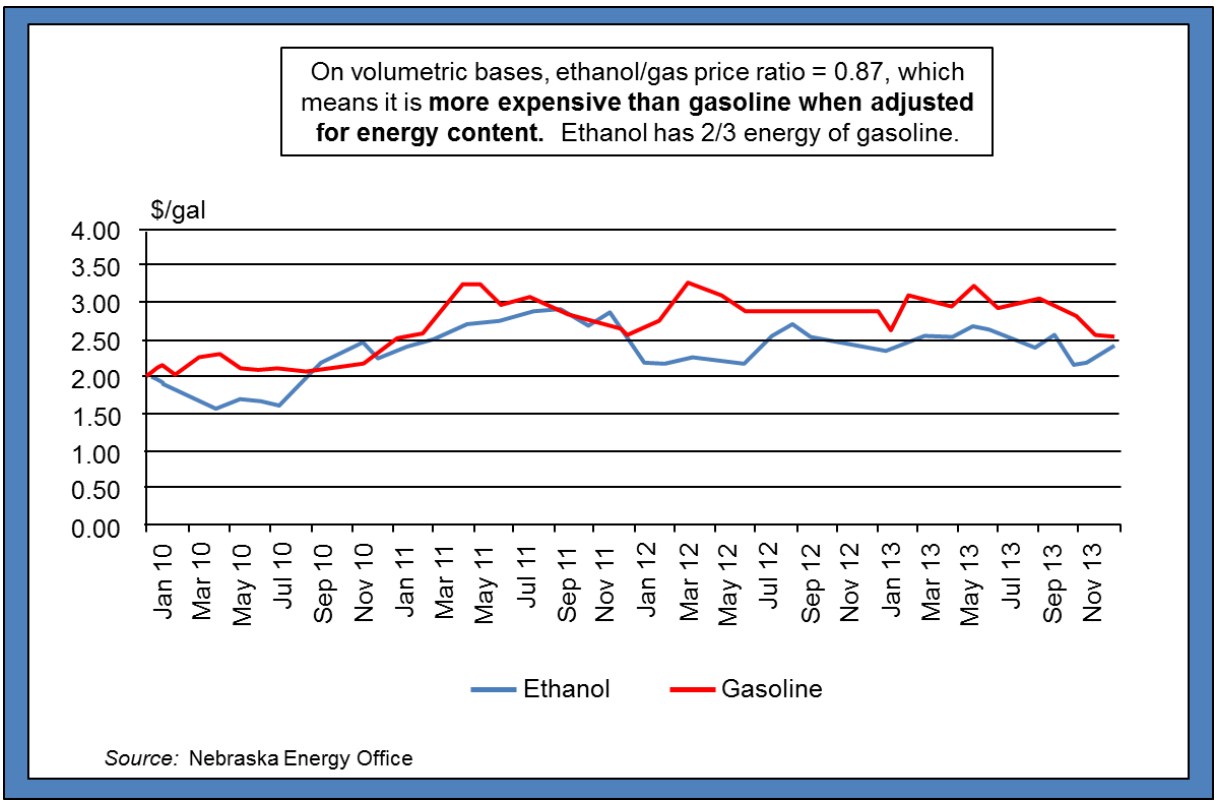
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Biomass-based Diesel				0.50	0.65	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-celullosic Advanced				0.10	0.20	0.30	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	3.50	3.50	4.00
Celullosic Advanced					0.10	0.25	0.50	1.00	1.75	3.00	4.25	5.50	7.00	8.50	10.50	13.50	16.00
Conventional Biofuels	4.00	4.70	9.00	10.50	12.00	12.60	13.20	13.80	14.40	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Current RFS PL 109-58	4.00	4.70	5.40	6.10	6.80	7.40	7.50	7.60	7.70	7.80	7.90	8.10	8.20	8.30	8.40	8.50	8.60

Source: Carter (2015a), Slide 4.

Professor Colin Carter, Ph.D., University of California, Davis, presenting at the Research Council's Agricultural panel on April 18, 2015. Professor Carter is also Chair of the JPMCC's Research Council. Dr. Bluford Putnam, Ph.D., CME Group, is on Professor Carter's left; and Professor Brian Wright, Ph.D., University of California, Berkeley, is on Professor Carter's right.

"One area I mentioned this morning that I am doing some research on is the impact of biofuels on the price of motor gasoline, and Brian talked a lot about the impact on the price of food. I think that the issue that is not discussed enough is the impact on gasoline when you fill up at the pump. And you probably know that corn ethanol has one-third less energy. So it's kind of nice when I go to Canada, I can pull into the pump and I can decide if I want to pump fuel with ethanol or without ethanol. In this country we don't have a choice. And as a result, you see the price of ethanol gets bid up relative to the price of gasoline above the price it should be, based on its energy content. It shouldn't be 87% of the price." See Figure 9.

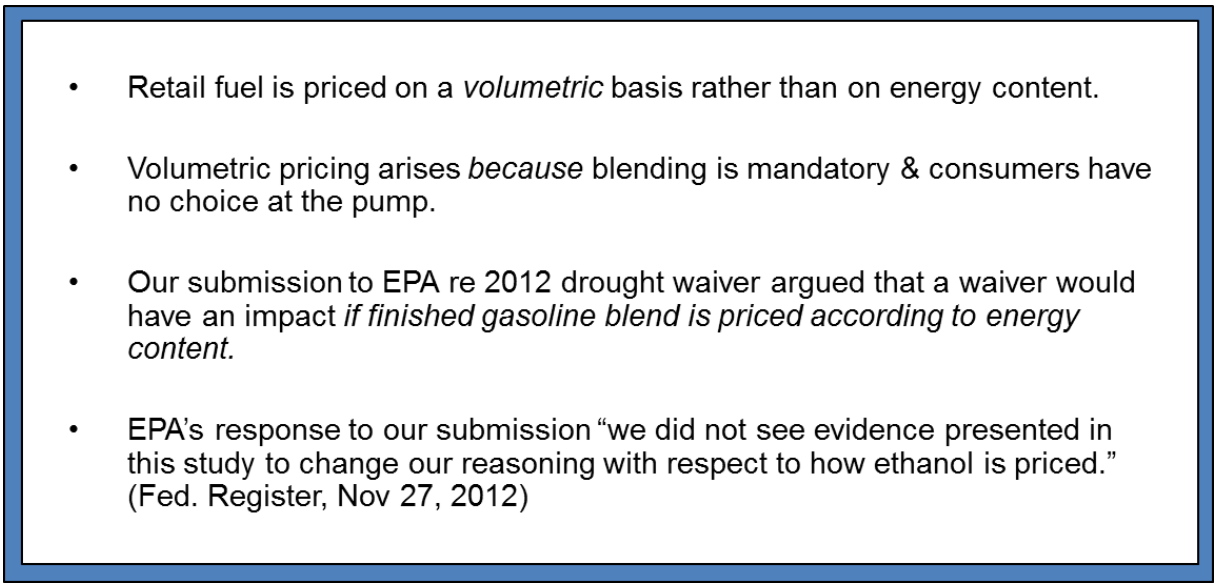
Figure 9
Price of Ethanol vs Gasoline (Rack Prices)



Source: Carter (2015a), Slide 5.

"So that [be]came … an issue a couple of years ago when we had the big drought in the U.S. Some of us, [including] Brian, … argued that the [impact of the] drought, which drove the price of corn to $8 a bushel, … could be modified if [the] EPA lowered its mandate on how much ethanol we have to put in the gas tank. … [A] group of us made a long submission to the EPA, and we said that if finished gasoline is priced according to energy content then if you lowered the mandate, there is going to be less production of ethanol. [Please see Figure 10.] I was a little surprised at first because people pushed us back on this argument. They said if we lower the mandate, if it's no longer required that we have to blend, at that time, 12 billion gallons, [and say] we lowered it to 10 or 8, they are still going to be producing ethanol because oil companies love ethanol."

Figure 10
Why is Ethanol Overpriced Relative to Energy Content in U.S.?



Source: Carter (2015a), Slide 6.

"Well I soon realized the reason they love ethanol is that they blend it into finished motor fuel, and they don't adjust the price for the energy content so they are basically cutting the product. … [This] means that we are [effectively] taxed at the gas pump … because … [ethanol] adds 33% less energy, and [yet] we are paying the same price for ethanol as we are for gasoline. …" The higher that oil and gasoline prices are, the more incentive there is for fuel producers to blend in ethanol to motor fuel, as Brian Wright had also noted earlier in his presentation to the Research Council.

Presentation by Ms. Nancy Devore, Principal, DHF Team, LLC

Professor Carter's presentation was followed by a discussion from Ms. Nancy DeVore. The following transcription is excerpted from her remarks.

"Moving forward I would like to suggest an alternative view … [regarding] the future role of biofuels in the global food picture. Now that capacity exists in biofuels, it actually can act as an equalizer to global supply rather than having sharp price fluctuations annually as we have historically seen in times of very high or very low production.

Biofuels can and do act somewhat as a silent store of grains. [When] weather is very good and yields are very high, biofuels can soak up some of the excess supply and keep grain prices from collapsing so much and impacting global farmers with reduced returns. On the other hand, when there are severe shortages, biofuels could quickly shut down and free up that grain supply, … smoothing out a potential price spike to consumers.

Ms. Nancy DeVore (with microphone), Principal, DHF Team, LLC, at the JPMCC Research Council meeting of April 18, 2015. Ms. DeVore is also a member of the JPMCC's Research Council.

But of course this can only happen if biofuel mandates are somewhat flexible. More governments are going to [have to] respond … [with] policy changes rapidly in times of need. Essentially the existence of [the] biofuels industry, [which] … has some flexibility to increase or reduce production when the economics warrant, … [could] have a price smoothing effect over the long run, … keeping prices from falling as much and softening price spikes and reducing the consumer impact in times of global grain shortages.

Most countries, though, are not that flexible: pretty much all the policies in the world are fairly strict [with] mandates except for Brazil, and I think that Brazil, … with their economic policy, comes closest to having something that is more ideal in terms of responding to the market conditions of the world. There are a lot of problems with the way the US and the EU mandates in particular were created [with] government trying to mandate technology. But the reality is that now we have these industries, … there is a way to turn this into an industry, which has a positive impact on the global food sector. This is … an area that we need more research in."

Conclusion

As Professor Brian Wright noted at the beginning of his presentation, "it's great to have the opportunity to really discuss the fundamental needs of humankind, energy and food, in this venue at a time when these markets are becoming more integrated (Minutes 3:07 to 3:20)." With this article, we are delighted to share some of the insights of the Research Council's distinguished presenters to a larger audience, regarding the recent puzzling behavior of grain prices.

Endnotes

Professor Brian Wright noted that his presentation was based on joint work with the following colleagues: Professor Eugenio Bobenrieth, Pontificia Universidad Católica de Chile; Professor Juan Bobenrieth, Universidad Del Bio-Bio, Chile; Dr. Di Zeng, Lawrence Berkeley National Laboratory; and Mr. Ernesto Guerra, University of California, Berkeley.

Katherine Farren, CAIA, Editorial Assistant for the *GCARD*, transcribed the April 2015 J.P. Morgan Center for Commodity's Research Council presentations in their entirety.

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BRIAN WRIGHT, Ph.D.
Professor of Agricultural and Resource Economics, University of California, Berkeley

Brian Wright's interests in economics of commodity markets, innovation and intellectual property rights date from his early experiences on his family's sheep station near Wakool in the Riverina district of New South Wales, Australia. He received a Bachelor of Agricultural Economics (First Class honors) from the University of New England, Armidale, and won a Frank Knox Fellowship to Harvard University, where he received a Ph.D. in Economics. He then joined Yale University's Economics Department and is now Professor of Agricultural and Resource Economics at the University of California, Berkeley, recently ranked top in its field in research and reputation by the United States National Research Council.

His research interests include economics of markets for storable commodities, market stabilization, futures markets, agricultural policy, industrial organization, public finance, invention incentives, intellectual property rights, the economics of research and development, and the economics of conservation and innovation of genetic resources. He has co-authored or co-edited several books, including Storage and Commodity Markets; Reforming Agricultural Commodity Policy; Saving Seeds: The Economics of Conserving Genetic Resources at the CGIAR Centers, and Accessing Biodiversity and Sharing the Benefits: Lessons from Implementing the Convention on Biodiversity. He has published extensively in the leading journals in Economics and Agricultural Economics and in *Nature*, *Nature Biotechnology*, *The Handbook of Plant Biotechnology*, and *Crop Science*.

Professor Wright is also a member of the J.P. Morgan Center for Commodities' Research Council at the University of Colorado Denver Business School.

An In-Depth Exploration of the Commodity Markets is Essential for a Well-Rounded Business Education

Andy Hecht
Chief Market Strategist, Carden Capital and Carden Futures; and
Subject Matter Expert, "Foundations for Commodities" Professional Education Program, J.P. Morgan Center for Commodities, University of Colorado Denver Business School

At the Professional Education class in the J.P. Morgan Center's Commodities and Finance lab on March 30, 2015, standing, from right-to-left, Ajeyo Banerjee, Ph.D., Executive and Faculty Director of the Center; Roy Salame, Vice Chairman, J.P. Morgan; *Andy Hecht, Subject Matter Expert*; and Thorvin Anderson, Content Director of the Professional Education course, "Foundations of Commodities." The J.P. Morgan Center for Commodities is part of the University of Colorado Denver Business School.

A traditional business education at institutions in the United States and around the world tends to focus on theory and practice in debt, equity and foreign exchange markets. Universities generally do a good job teaching students economics, accounting, finance, risk management theory and a whole host of other business disciplines. When it comes to one important business vertical, commodities or markets for raw materials, education is often the result of on-the-job training.

Mainstream Institutions and Commodities

Undergraduate and graduate degrees in business rarely offer an in-depth exploration of commodity markets. While many institutions of higher learning will touch on the raw material sector, this education is generally limited to a few electives or self-study style programs. Mainstream business education excludes the world of commodities. This is surprising considering the importance of commodity markets on a global basis. Commodity production is limited to certain geographic regions. Only in appropriate climates or regions where mineral ores are present or crops can grow does production take place. However, consumption of these raw materials is ubiquitous. The widespread nature of consumption touches every business in the world. That is why education in this area not only has benefits; it is an imperative for a well-rounded business education.

Four Reasons That a Business Education in Commodities is Essential

While there are many reasons that our educational institutions should be teaching the business leaders of tomorrow about commodity markets, four stand out.

1- **Raw material prices directly affect almost every business worldwide**: one can find commodity applications in every business sector. Consider agricultural commodities and their importance to food businesses. Think about how energy affects the logistics of bringing goods to markets. Additionally, direct manufacturing requires the input of commodities. These are just a few examples. In all cases, commodities are a key cost of goods component in the success or failure of all businesses.

2- **Risk management in commodities differs from other markets**: commodity prices tend to be highly volatile. Commodity prices generally trade in much wider price ranges than other assets including stocks, bonds and currencies. Therefore, understanding and monitoring the price risk in commodity markets requires a different set of risk management standards and tools.

3- **Each individual commodity has a different set of idiosyncratic attributes**: commodities are an asset class, but each sector and individual commodity within that sector has a set of characteristics all its own. For example, corn and wheat are both grains, but each has very different production and consumption issues. Crude oil and natural gas are both energy commodities, but each affects the cost of goods sold of a wide range of different consumers. Copper and zinc are both base metals; however, for each there is a different process that transforms ores into metals. In each of these cases, the idiosyncrasies influence price, which is an input in the cost of running and managing many businesses. Understanding these issues improves results from both a management and profitability standpoint.

4- **The finite nature of commodity production is at odds with demographics**: as world population grows, the demand for commodities increases. Increasing demand requires increased supplies. In 1967, the world's population stood at just under 3.5 billion people. In 2015, it exceeds 7 billion. Farmland is finite. Mineral ore deposits are finite, as are energy reserves. Population growth has and will put strains on commodity resources, which will affect commodity prices.

Therefore, raw material markets are a key component in a well-rounded business education today.

Funding and Participation is in the Best Interest of Business

It behooves business to support education in commodity markets. Not only will it provide a new crop of commodity-savvy employees for the future, it will save both time and resources when it comes to on-the-job training. A standardized commodity education trains employees with a competitive edge. Incorporated into existing business degree programs, a commodity education enhances the program and its graduates. University-based continuing education programs also sharpen the skill sets of existing employees and managers.

Corporations in the United States have been supporters of the institutions from which they harvest employees. Universities depend on these corporate donations to improve programs and enhance the addressable market of highly-qualified employees for the future.

Therefore, well-designed commodity education programs can potentially be of great benefit to universities, their students, and to future employers in the commodity industry.

Endnotes

This article was originally published in "Seeking Alpha."

The J.P. Morgan Center for Commodities offers a professional education course on the "Foundation of Commodities," which provides precisely the type of in-depth explorations of the commodity markets that Mr. Hecht advocates for in this article. For more information on this course, please contact Mr. Matthew Fleming, Program Coordinator, J.P. Morgan Center for Commodities, at matthew.fleming@ucdenver.edu**.** The next course offering is on April 18th and April 19th, 2016 at the University of Colorado Denver Business School.

Author Biography

Andy Hecht

Mr. Hecht is the chief market strategist for Carden Capital and Carden Futures. Previously, he spent nearly thirty-five years on Wall Street, including two decades at the trading desk of Philipp Brothers (which became Salomon Brothers and which later, in turn, became part of Citigroup before ultimately being spun off to Occidental Petroleum.) Mr. Hecht has unique insights into the commodity markets that are a result of his rich and varied Wall Street experience: he's booked vessels, armored cars and trains to transport and store a wide range of commodities as well as working directly with the United Nations.

Mr. Hecht is also a Subject Matter Expert for the "Foundations of Commodities" Professional Education course at the J.P. Morgan Center for Commodities, University of Colorado Denver Business School.

Portfolio Rebalancing and Commodities: The Whole is Greater Than the Sum of the Parts

Robert Greer
Scholar in Residence, J.P. Morgan Center for Commodities, University of Colorado Denver Business School; and
Former Executive Vice President and Real Return Product Manager, PIMCO

Presentation by Robert Greer, Scholar in Residence at the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School, at the JPMCC's Research Council meeting in the Center's CoBank Lecture Hall on December 4, 2015.

Harry Markowitz is credited with saying that diversification is the closest thing an investor can get to a free lunch. In Markowitz (1952), he also suggested that a portfolio should periodically rebalance to target weights. These two concepts of diversification and rebalancing come together in the idea that rebalancing the investments within a diversified portfolio can provide incremental returns: the purported "free lunch." These concepts are especially relevant when investing in commodities, which in fact are a collection of individual assets that can be rebalanced. Individual commodity futures prices are driven partially by changes in supply expectations, which are different for different commodities.

Therefore, a broad-based commodity index represents a portfolio of assets that typically have a low correlation to each other.

Rebalancing a portfolio ultimately means that an investor will sell what goes up and buy what goes down to maintain a desired set of risk-factor exposures. Consider the possibility of not rebalancing, as applied to stocks and bonds. From January 1976 through December 2013, a non-rebalanced portfolio that initially was allocated 60%/40% to stocks/bonds (as represented by the S&P 500/Barclays U.S. Aggregate Total Return Index) would have evolved to a portfolio that was 80% stocks due to the outperformance of equities over that time. Its set of risk factors would be far different from those of the 60/40 portfolio that the investor initially desired.

Maintaining a target allocation mix over time requires rebalancing. In the next section I discuss the incremental return that one can earn from rebalancing. From real-world examples, I show that this incremental return is substantial enough that investors should incorporate it in their forward-looking return projections; that is, portfolios should be prepared for a bite of Markowitz's "free lunch"!

Calculating the Rebalancing Return

In 1982, Robert Fernholz and Brian Shay (with an assist from Markowitz himself) developed a formula to calculate this incremental rebalancing return. In Fernolz and Shay (1982), they relied on the volatility of individual assets in a portfolio, their individual weights, and their sets of covariances (i.e., the extent to which the assets move or change together). Decades later, Scott Willenbrock approached the same issue, but also addressed the contribution of each individual asset to the portfolio's overall diversification return using the same inputs of volatility, weights and covariances, in Willenbrock (2011).

My former colleagues at PIMCO and I applied these theories in the real world of investing. To do so, we first specified components and weights of a portfolio, and then calculated the return over a multi-period timeframe during which we rebalanced. We then compared the realized returns of that rebalanced portfolio with the weighted average geometric return of the individual components. The difference between these two is the rebalancing return, or as Willenbrock calls it, the "diversification return" – or as Markowitz calls it, the "free lunch."

We next compared this empirical calculation of rebalancing return with the theoretical rebalancing return, as specified by Willenbrock and by Fernholz and Shay. First, we examined a portfolio that was weighted 25% stocks, 25% bonds, 25% real estate and 25% commodities (represented by the S&P 500, Barclays U.S. Aggregate TR Index, NCREIF Property Index TR and S&P GSCI Index, respectively).

With monthly rebalancing from December 31, 1979 through December 31, 2013, the empirical rebalancing return was 0.93%, which is within rounding error of the theoretical rebalancing return of 0.94%. We calculated the empirical rebalancing return as described above: it is the actual portfolio return minus the weighted average of returns of the individual components. So in determining a forward-looking estimate of portfolio returns, one could add this rebalancing return to the weighted average of the capital market assumptions of the individual portfolio constituents, as long as one can assume the same volatilities and covariances in the future.

Calculating the Rebalancing Return for Commodities

Because commodities as a separate asset class represent a portfolio of disparate (and often uncorrelated) individual assets, we applied this same analysis to just a commodity index, which may, in turn, be part of a portfolio. To determine weights, we calculated the average weight of each component of the Bloomberg Commodity Index (BCOM) based on data at the end of January of each year since 1992. (For simplicity we combined the weights of the two wheat contracts into a single index component; likewise with crude oil.)

Using this framework, the theoretical rebalancing return as determined by the formula was 3.09%; the empirical rebalancing return was 3.08%, again within rounding error of the theoretical return. The magnitude of this return is very meaningful in the estimation of capital-market assumptions to commodities as an asset class. Due to the effect of the rebalancing return, the investor could even assume that each individual commodity in an index had a zero return over time, but, if the index rebalanced, the asset class could still have a positive return. While the S&P GSCI, another commodity performance benchmark, does not rebalance as prices change, the BCOM rebalances annually (at the same time that it reweights).

As another example, the Credit Suisse Commodity Benchmark (CSCB) rebalances monthly with annual reweighting. And in an informative exercise, I once used the Fernholz and Shay formula to calculate the theoretical year-by-year rebalancing return of the JPMorgan Commodity Futures Index (JPMCFI), a CSCB predecessor, which rebalanced daily. This daily rebalancing allowed about 250 observations each year with the same set of weights. From 1970–2000, the average of all the annual rebalancing returns was 2.5% – in the same ballpark as the returns calculated for the BCOM.

I believe these rebalancing returns should be added to the weighted average of individual commodity return expectations, plus collateral returns, in determining the capital market assumptions for commodities as an asset class. Further, the rebalancing return might also be considered when combining asset-class capital-market assumptions into estimates of overall portfolio returns.

Conclusion

By taking a practical and informed approach to understanding the rebalancing aspect of commodities allocations in their investment portfolios, investors may be better positioned to harness the real returns of this critical (but sometimes difficult to evaluate) asset class.

Acknowledgements

Research assistance from my two former PIMCO colleagues, Klaus Thuerbach and Shawn Coffman, is gratefully acknowledged.

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Author Biography

Robert Greer
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Mr. Robert (Bob) 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 JPMorgan 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 (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.

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*, and *Pensions & Investments*. 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 is the editor of *The Handbook of Inflation Hedging Investments*, oriented to the institutional investment community, which was published by McGraw Hill in December 2005. He also is the co-author of *Intelligent Commodity Indexing*, published by McGraw Hill in 2012. Among other activities 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. In addition, he is a Senior Advisor to CoreCommodity Management LLC. Mr. Greer received a bachelor degree in mathematics and economics from Southern Methodist University and earned an MBA from the Stanford Graduate School of Business.

Introduction to Editorial Advisory Board Commentaries

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

In late 2015, the J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School established an Editorial Advisory Board for the JPMCC's *Global Commodities Applied Research Digest (GCARD)*. This international advisory board consists of 19 experts from across all commodity segments. Nine members have Ph.D.'s while five have CFAs. In addition, five of the members have policymaking backgrounds.

In summary, the board is composed of academics, researchers, educators, policy advisors, and practitioners, all of whom have an interest in disseminating thoughtful research on commodities to a wider audience. Board members provide the Contributing Editor with recommendations on articles that would be of particular relevance to commodity-industry participants. Members will also, from time-to-time, contribute articles to the *GCARD*.

In this issue's "Editorial Advisory Board Commentaries" section of the *GCARD*, we are pleased to include articles from two accomplished members of the board. This issue's authors are (1) Jan-Hein Jesse, Founder, JOSCO Energy Finance and Strategy Consultancy, Amsterdam, and an international expert for the International Energy Agency, Paris; and (2) Richard Heckinger, Associate Editor, *Journal of Financial Market Infrastructures*, and a member of the Working Group on Financial Markets for the Federal Reserve Bank of Chicago.

Jan-Hein Jesse's article provides an extensive analysis of the complex role that international oil benchmarks play in oil price discovery across the globe. Richard Heckinger's paper, which was written in December 2015, clarifies what is known thus far about the astonishing collapse (in October 2011) of the futures broker, MF Global.

The following summarizes both papers, which are highly relevant for international crude oil trading and ongoing public policy debates, respectively.

"Evolving Benchmarks in the New Oil Order" by Jan-Hein Jesse, Editorial Advisory Board Member, *GCARD*

This article describes the incumbent and new-entrant crude oil benchmarks at a time the oil markets are going through a period of great turbulence. The daily prices of hundreds of crude oil streams around the world are determined by the price discovery process that takes place in the physical and futures markets of West Texas Intermediate (WTI), Brent and Dubai, the three key crude oil benchmarks. Global, regional and domestic industry as well as market dynamics constantly challenge these price markers and give rise to the possible establishment of a new price marker in Asia. Each marker is characterized by its own history and cultural setting. Competition among them is fierce. At the same time, they are highly

interconnected. The article starts with an introduction about the current state of the industry and market, including a description of benchmarks and the price discovery process in general. The article aims to provide insights in how physical and paper markets function. The next sections describe each benchmark – WTI, Brent, and Dubai in more detail. The article ends with the pending introduction of Shanghai crude oil futures contracts, which may create a new benchmark for Asian markets.

"MF Global Five Years On" By Richard Heckinger, Editorial Advisory Board Member, *GCARD*

The liquidation and settlement of claims stemming from the collapse in October 2011 of the futures commission merchant and broker–dealer entities of MF Global (MFG) Group took nearly four years to settle. The key trustees, and other liquidation authorities, were able to recover sufficient assets of MFG to pay substantially all claims by late 2015. MFG's collapse was characterized by its default to its counterparties and customers due to its failure to maintain sufficient liquidity in order to sustain its investment strategies and agency businesses. Its key investment strategy was leveraged proprietary trading of high yield sovereign debt securities with refinancing of the positions through repurchase agreements (repos) and securities lending. Various investigative initiatives have revealed evidence that customer monies were probably used at times to fund the proprietary trading of the firm in violation of law and regulation in certain jurisdictions and contrary to international principles. This paper examines the conflicting business objectives of MFG overall, its proprietary trading strategies and its eventual collapse, with some lessons learned.

Evolving Benchmarks in the New Oil Order

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Introduction

World oil prices continue to show large unexpected swings, including devastating lows. For the third time since 1999, oil prices have fallen to production-cost levels. Persistent surplus requires lower prices for even longer, where aggressive market forces will shake out the weakest players and will cause others to cut investments and hence curtail production in the absence of a voluntarily supply reduction led by Saudi Arabia. Instead, we are witnessing a Battle of the Giants, a fight for market share between Saudi Arabia, the US, Russia, Iraq and Iran and many of the other large producing countries. But once lower prices have done their work, prices have to go up again to stimulate adequate investments to avoid tightness in later years. However, $50-60 per barrel may be enough for the coming years to revamp US shale supply growth, so it is unclear when more expensive projects will be needed again.

It is important to understand that commodities such as crude oil are spot assets where prices need to clear today's supply and demand unlike financial markets, which are anticipatory assets that are driven by expectations. Thus, oil prices are strongly driven by the actual balance between demand and supply that eventually results in the commercial inventories in the consumer countries and spare capacity in the OPEC countries. Hence the importance market participants give to the large daily flow of information and reports about the status of the market in order to get as accurate information as possible for a proper price formation process. Any mismatch causing oversupply or shortage will directly find its way in the setting of the price. This dynamic process, which is dominated by supply-demand fundamentals, is further exacerbated by 1) geopolitics, particularly in case of market tightness or more recently by the oil (price) regime change inflicted by the Saudis who unilaterally decided to change the rules of the game, and 2) geo-finance, most importantly by the strength (or weakness) of the US dollar. Longer term, climate change & the technology revolution will need to be added, along with geopolitics and geo-finance, as additional driving forces that set the oil prices around the world.

Oil benchmarks are the most visible tools capturing the results of this price game, representing over 500 distinct pricing hubs around the world. This large and varied group of crude grades all heavily rely on a small number of liquid, transparent price markers, on which the global or regional oil pricing system is anchored. The key marker grades currently include WTI, Brent and Dubai. The financial layers that have grown around the crude oil benchmarks have become central, not only for market participants to hedge their risk and to bet on oil price movements, but also in determining the oil price through the complex price discovery process. The information derived from financial layers is essential for identifying the price for the benchmark crude oils that are traded at a flat price and the many crudes that are traded at a differential to these benchmarks.[1] Box 1 describes the role of commodity traders in the physical flow of oil.

Box 1

> A large role in the physical flow of oil is taken by the commodity traders, who identify and act on imbalances between supply and demand, focusing on margins (via price differentials) and not on flat price levels. They basically achieve this role by moving - and where applicable transforming - physical commodities from places where they are plentiful to where they are required. For this purpose they negotiate off-take agreements with hundreds of oil producers, each crude having its own unique characteristics. And they also negotiate off-take agreements with hundreds of refiners, each of whom have their own unique configuration to process specific sets of crude oil. They are also large participants in the futures markets. The activities of large-scale commodity traders improve market competitiveness.[2]

In recent years Brent crude has become the world's most commonly referenced crude oil price benchmark outside the US and a large proportion of global physical oil trade is priced at a differential to the Brent oil complex. In the US, WTI has firmly re-established itself as the most important price marker for all the types of crude produced in North America. Dubai, the main Asian benchmark since the mid-1980s and responsible for about 20 million barrels per day (mln b/d) of crude oil currently exported to Asia, has also further evolved in recent years. The Dubai benchmark has been impacted by (a) China's intensified trading activity and the general oil demand growth in Asia, (b) the revolutionary increase in US Light Tight Oil (LTO) production and its global impact, and (c) the associated shifts in crude oil and oil products trade dynamics.[3] The current dynamics in each of the benchmarks regions, their interaction, co-dependency and competition, and the role each of these three markers take, and the challenges they face, are discussed in more detail below.

Several initiatives have been occasionally undertaken to establish new (competing) benchmarks, such as the Russian East Siberia Pacific Ocean (ESPO) benchmark, but so far, all without great success. That said, the new entrant, Shanghai International Mercantile Exchange (INE), in conjunction with the major state-owned Chinese oil companies, is determined to win a big position in the price formation of oil. This is not unreasonable given the fact that China will quickly grow to become the single largest crude oil importer in the world by far. China already imports 6.5 mln b/d in 2015, and imports are expected to grow to almost 9 mln b/d in 2020, an amount equal to 17% of the world's total seaborne crude oil trade. But before looking to the east, let's first look to the west, to WTI.

The WTI Benchmark

West Texas Intermediate (WTI) consists of a blend of several U.S. domestic streams of light sweet crude oil. The delivery point is in Cushing, Oklahoma. Cushing is a vital transshipment point with many intersecting pipelines, storage facilities and easy access to refiners and suppliers. This strategic position led to WTI's development as a significant physical market price reference well before crude oil futures contracts were listed on the New York Mercantile Exchange (NYMEX) in 1983. (The NYMEX is now part of the CME Group.) Every day, many hundreds of thousands of light sweet crude oil futures and options

are traded, each contract representing 1,000 barrels. Although physical delivery will take place at expiry at Cushing, in reality, only a small fraction is actually delivered.

In 2015 many new trading records were broken, the last one on December 8, 2015 when the CME Group announced it reached a new trading volume record for combined NYMEX WTI futures and options of 1,841,295 contracts, and for futures alone of 1,595,710 contracts, showing the increased need by participants in the global oil markets to manage their risks during times of heightened price volatility and uncertainty.[4] Together with the Intercontinental Exchange (ICE) Brent futures and options, these two futures contracts are the most liquid, transparent oil trading instruments available to the industry today. Each futures contract jockeys for pole position in an ever-larger market, competing fiercely to attract the different market participants, which include commercial players, swap dealers and money managers. Both contracts compete in helping (a) commercials to manage price risk by hedging their physical crude oil sales and purchases, as well as in helping (b) swap dealers to shift exposure and manage price risk for clients, and in helping (c) speculators to make money by buying or selling futures without the intention of buying or selling actual commodities.

The latter group has grown in importance, which includes long-term passive oil exchange-traded-funds (ETFs) and hedge funds with high-frequency trading strategies. These funds take positions by buying and selling energy commodity derivatives, creating large swings in net speculative length at times of high price volatility. For example, in 2015 excellent returns were made from systematically owning delta-hedged straddles on particular WTI futures contracts. The particular underlying futures contracts were three-months out from maturity and twelve-months out. A straddle is a combination of at-the-money calls and puts. Delta hedging means that a trader buys or sells a sufficient number of futures contracts against the options strategy such that the net exposure to the market is zero, as of the time of the hedging activity. Such a strategy will be profitable if the realized volatility of crude oil is greater than that expected by the options market. In this particular strategy, the options were delta-hedged daily at the close using futures contracts that had the same maturity as the options, and then each month the strategy entailed rolling into fresh at-the-money options.[5]

Historically, WTI was very connected to Brent and vice versa: the spread was set by the transport differential. Between 1993 and 2006, the spread was typically very narrow at an average of $1.66 for spot WTI and not very volatile. However, with the fast growing captive supply base of US Light Tight Oil (LTO), this tightly knotted link disappeared. As of the start of 2011, WTI prices saw a further widening between Brent and WTI, reaching a peak spread of $29.70/bbl on September 22, 2011.[6] Quickly markets started to talk about the irrelevance of WTI in the price formation of oil, and focus shifted squarely to Brent. WTI was seen as an island, isolated and no longer relevant to determine the true price of oil. However, WTI did its work exactly as it should, giving a strong signal to US investors in oil that pipelines and other midstream infrastructure had to be built in order to accommodate the fast growing volumes of oil produced in the new super-3 shale oil fields: the Bakken Formation in North Dakota and the Eagle Ford Shale and Permian Basin in Texas. This new infrastructure changed the flow of crude oil to North-South and West-East instead of South-North.

During the years, 2011 through 2013, a big investment spree took place at times when the US was “long crude.” During this period, bottlenecks constantly constrained a free flow of LTO from wells to the

refinery centers around Chicago and the Gulf Coast. Tanks at Cushing, Oklahoma, became unpleasantly full while new storage facilities were still under construction, leading industry players, especially the non-commercial ones active in the futures markets, to push WTI prices lower for oil that could not flow. However, at the start of this period, crude oil markets were navigating between tight markets and the possible impact of the Arab Spring and the civil war in Libya, and the threat that the EU debt crisis could trigger a global economic recession. As a result speculative positions showed large swings with NYMEX net long non-commercial positions (futures and options) in crude oil increasing from 25 million barrels in 3Q2010 to over 250 million barrels in 2Q2011.[7] But with the arrival of a vast new infrastructure, in combination with a reversal-to-negative production growth for US LTO, spreads started to rapidly shrink to virtually zero today. Meanwhile 2015 was closing out with crude oil prices at recent record lows at about $36.50/bbl for both WTI and Brent. This is reflecting ongoing oversupply of one to one-and-a-half million b/d in global oil markets at a time crude oil storage in the world could become rapidly exhausted.

The current state of the industry has led to the great paradox where the country that drives the oversupply and has to shrink production, and is seen as the new marginal swing producer, is also pulling more oil from outside its territory to its continent; crude imports into the US are likely to stay elevated and could ultimately also create storage problems on the Gulf Coast during the next seasonal refinery maintenance period in the spring, despite LTO output likely declining further.[8] This is where WTI connects to the global price marker Brent (through the Louisiana Light Sweet (LLS) crude marker at the US Gulf Coast.) With 600,000 bbl/d of new pipelines in 2015 bypassing Cushing and directing Permian oil towards Houston, the region already "closed its door" to more oil and started to redirect oil supplies to other hubs like Cushing, where inventories reached a new record of 61 million barrels. As a result, LLS - WTI is now below uncommitted pipeline tariffs. This closes the arbitrage ("arb") to move additional inland light oil to the Gulf Coast.[9] At the same time, the LLS-Brent import arb has to stay open - i.e., LLS trading at a premium to Brent - to facilitate excess waterborne crude heading to the US where there remains 100 million barrels of available storage.[10] Thus WTI becomes an increasingly important benchmark, not standing alone, but also in its interplay with Brent through LLS for imports and in its interplay with other crudes, which are either produced in Canada or domestically in the US, including in deepwater Gulf of Mexico. The sour grade of crude oil, Mars, for example, is produced in deepwater Gulf of Mexico.

Regarding Mars, it is one of the three grades of crude used in determining the Argus Sour Crude Index (ASCI) price. The ASCI index provides a daily price for medium sour crude at the US Gulf of Mexico trading hub, and is used amongst others by Saudi Arabia, Kuwait and Iraq to price exports to the US of Arab Extra Light, Arab Light, Arab Medium, Arab Heavy, Kuwait Export Blend and Basrah Light and Kirkuk. Although export volumes from the Middle East have decreased materially since the shale oil revolution, the ASCI index will most likely stay relevant - as long as production levels of medium sour crude in the Gulf stay at adequate levels - because of its strong correlation to prices in the international crude oil market, and especially now that the US crude oil export ban has been lifted (in December 2015.) This is supported by the fact that the ASCI price is published both as a differential to WTI and as a fixed flat price, enabling users to hedge financial exposure using WTI futures.[11]

Finally, what will be the possible impact on WTI now the crude export ban has been lifted? In the short run, the US and Canada are poised to produce less oil and hence have less to export. The US also has a very efficient refinery industry that is highly competitive versus other refinery centers around the globe, and for that reason there is no reason to export crude for processing in less efficient refiners outside the US. Nevertheless, there will be some small benefits to US producers based on the tighter Bakken-WTI spreads because Bakken and other domestic sweet crudes will now have new export markets that will bring higher revenues overall.[12]

Furthermore, after a year of production decline, shale oil will have to start growing again in 2017 to balance the markets. Recent forecasts show crude oil and condensate production in the US is expected to increase from about 8.8 mln b/d later this year to 10.6 mln b/d by 2020.[13] At that level, crude exports might double to about 1 mln b/d. Moreover, connecting the US as one of the three largest crude oil producers - together with Saudi Arabia and Russia - with crude oil markets in the rest of the world should result in a more efficient, liquid and robust global oil price discovery process.

The lifting of the export ban could have another result. It could make an incremental difference in maintaining a narrow spread between North Sea Brent and US West Texas Intermediate as was the case before 2011. Also, in the US Gulf Coast, WTI and LLS could go up further in price relative to the sour crude grades such as Mars, as the export ban artificially depressed sweet crude in the US Gulf Coast market relative to sour crudes. By way of explanation of the latter point, the Gulf refiners had been designed for heavier sour crudes, but could operate less efficiently with domestically produced light sweet crudes as long as domestic sweet crude prices were artificially depressed. But with the US now able to freely export crude, the price of domestically produced light sweet crude oil would no longer need to be artificially depressed in order to find a market, so one would also expect a reversion to importing heavier, sour crudes that maximize yield (and profits) for Gulf refiners.

Most importantly, the lifting of the ban expands the geographical reach of WTI and makes the benchmark closer to a seaborne price marker, improving its responsiveness to global changes. That said, especially in the shorter term, there will only be a marginal increase in the total net export flows from the US.

Of note, the NYMEX has recently announced that it will launch six new WTI Houston crude contracts to give clients greater ability to participate in the rapidly evolving and internationalizing WTI market now that the crude export has been lifted.

In conclusion, WTI as a benchmark is expected to benefit from the lifting of the crude export ban, narrowing the Brent-WTI spread on average, although it can be still quite volatile due to industry dynamics (such as supply-demand fundamentals, geopolitics, geo-finance and climate change & technological innovation.) It will also make WTI a better benchmark for managing oil price risk around the globe, although definitely not perfect because of regional dynamics that point to volatile basis risks, which can quickly become much higher at certain moments in time.

The Brent Benchmark

On the other side of the Atlantic Basin, in the North Sea, we find the home of the Brent complex, the primary benchmark for international oil prices. Brent serves as the price reference for roughly two-thirds of the world's physically traded oil volume - with hundreds of other grades of crude oil traded against a price differential with Brent. Launched in 1986, the complex consists of spot physical (Platts Dated Brent), cash BFOE (forward physical cargoes), ICE Brent futures and options as well as many inter-product, inter-month and inter-quality spread-trading opportunities.[14] (BFOE is defined below.) Here, the ICE Brent futures contract is a key component of that complex, financially settled against the Brent Index, and ultimately deliverable via the Exchange of Futures for Physicals (EFP) mechanism. (Box 2 provides a fuller description.)

Initially, the Brent futures contract was based solely on crude from the Brent field. However, as the physical market suffered from declining production to levels that constrained liquidity, additional crudes were added to align the Brent futures contract with the forward (cash) market. Brent futures contracts are currently based on the underlying physical crudes from the Brent, Forties, Oseberg and Ekofisk complex (BFOE), together consisting of more than one hundred oil fields. Given that these four crude oil blends have slightly different sour grades and separate delivery points, highly successful price de-escalators were introduced by Platts and Argus, the two most important price reporting agencies, to give value to the individual BFOE characteristics and changing refinery feedstock needs.[15] Together with all the synthetic financial products delivered by ICE, these innovative mechanisms help to generate long forward price curves, and to further optimize the price discovery process.

Box 2

The ICE Brent futures contract is linked to the forward BFOE physical contract and hence the underlying (spot) Dated Brent market by the Exchange of Futures for Physical (EFP) mechanism.[16] The futures contract settles against the ICE Brent index price for the day following the last trading day of the Brent futures contract. At expiry of a Brent futures contract, the index price is based on the average value of BFOE cash cargoes on expiry date. The index is also calculated by the exchange every day. Such EFP allows the exchange of a futures position for a physical position in the underlying cash market, and allows traders to choose their trading partners while retaining anonymity in the market-at-large rather than accepting a randomly matched partner. Meanwhile, trade in Dated Brent has had highly volatile monthly volumes - both in aggregate as well as per BFOE crude stream - of 4 to 16 million barrels per month over the period, April 2014 and April 2015, while physical BFOE production hovers around 800,000 barrels per day.[17]

There are large differences between the WTI and the Brent complex. The US is characterized by a large number of domestic oil companies and other players, whom use futures and options to manage their risk. The US is also characterized by a strong and active capital market with other financial participants, whom have shown an increased interest in oil prices. In contrast, the Brent market is the home of a very small exclusive club of industry players, historically also joined by financial players, but since the great financial crisis, much less so. Also the contract size in the US is much smaller, 1,000 barrels per lot with

the ability to trade partials of nearly every size, while a physical Brent cargo is 600,000 barrels. Another remarkable difference is that in the US there is always physical delivery of crude at expiry of the future, which is not the case of Brent. Finally, physical Brent is bought by oil companies as far away as South Korea, while WTI can only recently be exported to beyond a handful of countries. But irrespective of these differences, the ICE Brent futures contract has seen impressive growth in open interest and average daily volume in recent years similar to what we have witnessed in the NYMEX WTI futures market; ICE Brent saw an open interest record of over 2 million lots on June 10, 2015.[18]

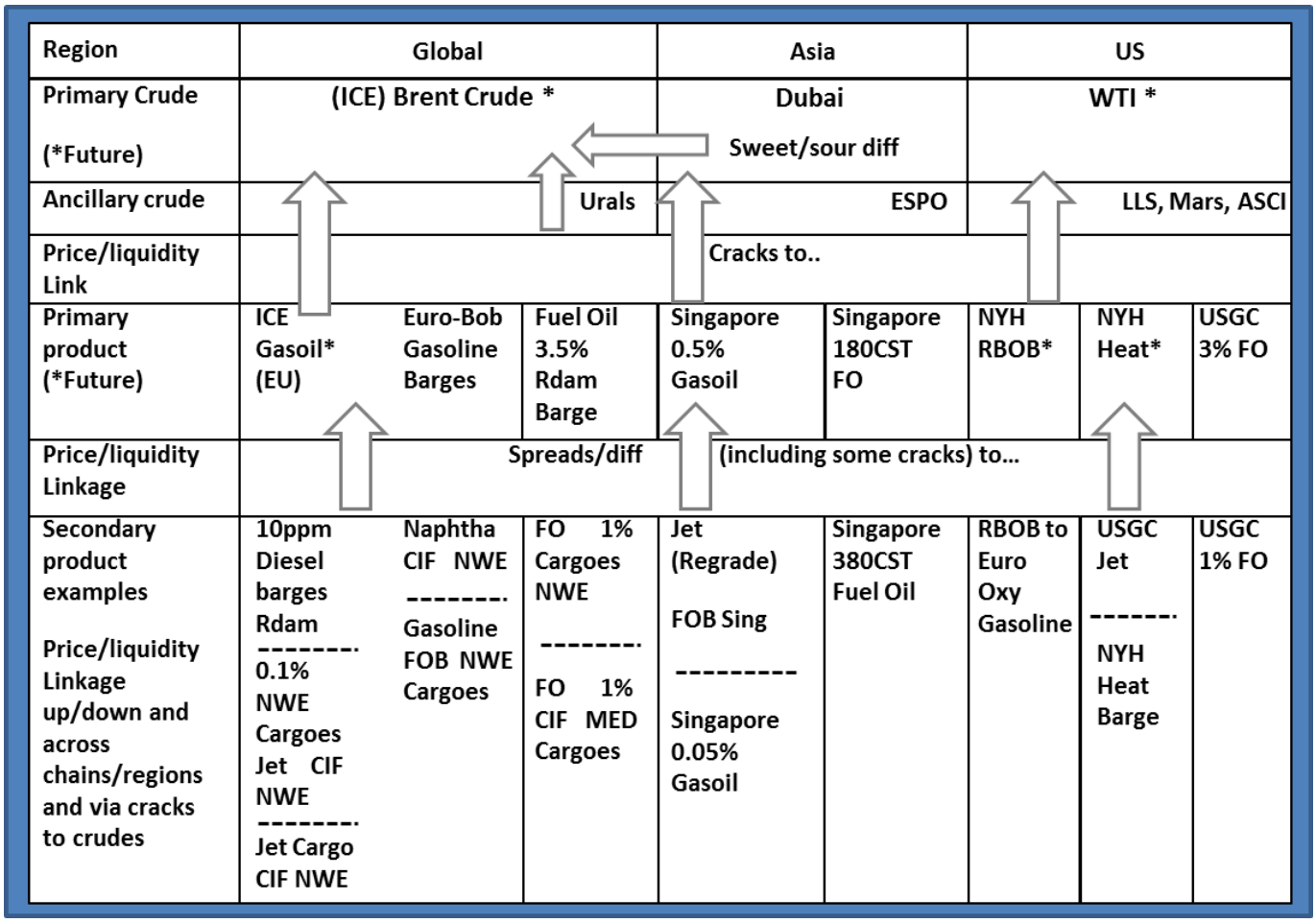
While Brent is currently the primary benchmark for pricing many international traded grades of crude oil, it has constantly evolved in order to maintain its relevance and suitability, especially over the medium and longer term. The main challenge facing Brent is a faster than expected decline in oil production in the North Sea, especially now that oil prices are expected lower for longer, and capital expenditure cuts are the flavor of the day. With aging fields that have ever-shrinking output, production from fields that constitute the current BFOE benchmark could become too low during summer maintenance periods to support the benchmark with enough liquidity - especially when physical volumes fall under the cargo size of 600,000 b/d, and thus result in not enough fresh cargos available for sale during the summer months. For this reason, discussions amongst the key players in the Brent market, notably Platts, Argus, ICE, CME on the one hand, and on the other hand, Shell, Vitol and a handful of other major oil companies and oil commodity traders active in the Brent market, have already taken place for some time now regarding which new crude streams to add to BFOE and when. Fortunately, Norway's reserve base has grown by the discovery of the giant Johan Sverdrup oil field. Together with other smaller developments, about 800,000 b/d of new capacity additions will be added between 2015 and 2020, more than enough to offset lost production from the current producing fields in decline. However, the situation is much worse on the UK part of the North Sea. UK production has been in steep decline since its peak at close to 2.6 mln b/d in 1999, to about 0.8-1 mln b/d today from 170 fields, and there are no new major developments at hand to stem the underlying decline currently pegged at 12% p.a.[19]

Besides its own "internal" challenges, Brent is also likely to face more competition both from the East (of Suez) and the West (US). The ongoing shift in the center of gravity of global oil demand to Asia, and the rise of Middle East exports to this region for the remaining and next decade, could result in a stronger role for the Dubai Mercantile Exchange (DME) and the planned introduction of new crude oil futures by the Shanghai International Energy Exchange (INE). The decision by the US to lift its current ban on crude oil exports will also alter global supply-and-demand and thus trade flow dynamics. For that reason, Platts recently opened consultation with its 280 or so participants in the Market-on-Close price discovery process on a possible 45-day structure for Brent from 2020 in order to align with the evolution of the North Sea supply trend towards the trading of cargoes with longer lead times ahead of loading.

Finally, increased regulation of commodity markets in Europe may have a big impact on Brent. There are strong perceptions that new regulations will ultimately squeeze the number of active participants and dry up liquidity in the Brent complex - a prerequisite for good functioning of price markers - and trigger a shift of the business to Asia, where new entrants are working on establishing new benchmarks. Although the jury is out if and when those new entrants will be successful in a very conservative market, perhaps Brent has to further develop as a "virtual" or even "synthetic" benchmark, where price

discovery taking place in the paper market is supported by a larger group of similar seaborne crudes beyond the North Sea. In any case, the Brent futures contract's outright price underpins a vast matrix of global prices. The contract's deep liquidity and real-time prices provide price discovery and numerous trading and hedging opportunities for both physical and financial market participants. Figure 1 illustrates the linkages that the ICE Brent futures contract has to other oil benchmarks and related petroleum-complex products.

Figure 1
The Co-Dependency of Price Across the Oil Complex



Source: ICE, "Oil Markets: The New Opportunities and Risks," Mike Davis, Head of Market Development, ICE Futures Europe, October 23, 2015.

The Dubai Benchmark

Dubai is the primary pricing reference for crude oil delivered to Asian refineries from the Middle East Gulf. For the time being, Dubai is the only physical energy exchange East of Suez. It has also become the pricing reference for cargoes of crude oil sold from Russia's East Siberian port of Kozmino to refiners using the East Siberia Pacific Ocean (ESPO) crude oil pipeline. Starting with the spot trade in Dubai crude

oil since the mid-1980s, additional crude oil streams have been added to the contract in recent years, currently allowing for the individual physical delivery of mid-sour Oman, Dubai and Upper Zakum grades of oil at a range of appropriate differentials. Aggregate production underlying the contract currently stands at 1.8 mln b/d, the largest comingled crude steam under any of the benchmarks in the world, and production is still growing with more Upper Zakum oil coming on stream. Price assessment of the Dubai price takes place during the Platts Dubai window, which has grown in importance in recent years as the liquidity in the Platts "window" has increased significantly. Approximately 18 million b/d of crude oil passes through the Strait of Hormuz, largely priced against the Platts Dubai assessment.[20]

This price discovery process has been strengthened by the deep financial layers that have emerged around Dubai and which have linked Dubai to the highly liquid Brent complex, of which the Brent/Dubai exchange of futures for swaps (EFS) and the Dubai inter-month swaps are the most important. The EFS allows traders to convert their Dubai price exposure into a Brent exposure, which is easier to manage given the high liquidity of the Brent complex. The intermonth-swap reflects the price differential between two swaps and allows traders to hedge their position from one month to the next. Given these strong links, one can argue that Brent sets the flat price level while the EFS and inter-month Dubai spread market set the price differential against Brent, followed by these differentials being used to calculate a flat price for Dubai. Higher demand from Asia should then lead to a larger differential and thus a higher price for Dubai crude versus Brent.

The financial layers are centered at the Dubai Mercantile Exchange (DME). The DME was founded in 2006. The CME Group has a stake in the DME and acts as its clearinghouse. The DME launched the Oman crude oil futures contract in 2007 to serve as a pricing benchmark for the Gulf region and Asian demand centers. It was also launched to overcome the dominant position of a small elite group of price makers, with Shell and Vitol being the biggest ones, in the Platts window. This is analogous to what happens with the Brent "Window-on-Close," but there the hugely liquid futures market is working in tandem with the Platts assessment process in providing price discovery. The DME's futures contract aims to link the Dubai paper market on which these futures are traded to the physical Dubai market and involves price signals between the paper market and the Platts physical Dubai price assessment market.[21] In the first three quarters of 2015, about 120 entities have traded on the DME, of which 90 were independent of each other and where the largest commercial player had about a 10% market share. Through the Oman futures market, DME Oman is currently seen as the best proxy for China's energy imports.

Although volume and open positions have both increased in recent years, liquidity of the EFS market at the DME continues to be an issue. But ongoing improvements in the contract structure has meant that traders can now arbitrage the Oman between DME and the Platts window, which has increased liquidity, transparency and overall volumes in both markets. In addition the larger Upper Zakum barrels sold spot without destination clauses are also helping the further development of the Dubai price discovery process. What has also helped is the greater involvement of Asian traders and refiners.

China has established a major presence in trading crude oil in recent years, where Chinaoil and Unipec - the trading arms of China National Petroleum Company (CNPC) and Sinopec respectively - have emerged as key spot buyers. This occurred at a time that investment banks have largely moved out of the

physical oil markets. The growth of Chinese involvement is in contrast with Middle East national oil companies (NOCs), who have taken a more active role in refined products by building new world-scale refineries, but so far have remained neutral on crude trading and pricing. This intensified activity has become most visible in the many trades these two Chinese state-owned companies are doing, occasionally leading to uncomfortable numbers such as in August 2015, when it became apparent that out of a total of 78 Dubai cargoes, 72 were held by Chinaoil, allegedly all purchased through the Platts window.[22] This was a repeat of earlier large concentrated purchases in October 2014 and April 2015, in each case the exact reasons still not fully understood, other than it impacted the formulas used by Middle Eastern oil exporters, given their reliance on Platts as the basis for their own official selling prices (OSPs). But with such large positions, it has become clear that these super-large crude oil buyers are now regularly acting as price makers instead of price takers, which is a sign of a growing sophistication in trading skills during a time of growing Chinese import needs.

This increased activity has resulted in several papers on how Dubai and DME should further evolve or even been replaced. One question is if there is a need for a genuinely Asian marker for East of Suez medium-sour crude oil that would be outright priced instead of being a "derived benchmark," as has been put forth by the Oxford Institute for Energy Studies (OIES). In their view the way forward is to fix both Dubai and DME Oman by delinking Dubai from Brent and instead to link the physical Dubai benchmark with the DME paper market. OIES believes that this should lead to better risk management possibilities and improved trading volumes and liquidity, while creating more financial layers around Dubai as an additional source of price discovery. In this respect, discussion with producers to inject more volumes into the benchmark because of the huge purchases by Chinaoil has resulted in the announcement by Platts last year that it will add in two more grades of crude oil to its Oman/Dubai benchmark - Qatar's Al-Shaheen and Abu Dhabi's Murban - from January 2016 in order to further improve the liquidity of the assessment that is used to price the crude.[23] With this increase, the available crude will increase to about 2.4 mln b/d, about three times the size of the volumes available for Brent.

Time will tell how this Middle Eastern marker will further evolve and how Middle Eastern exporters will embrace these initiatives for the price discovery of their crude oil. But for now and given the fact that DME is heavily dominated by commercial customers, DME is building more storage facilities in Oman outside the Persian Gulf to facilitate trading and to become the leading crude hub for the region. In addition, DME has also communicated interest in cooperating with the Shanghai International Energy Exchange (INE), which is planning to introduce a new crude oil futures contract to be traded on their own platform out of Shanghai's new free trade zone.

The Shanghai Benchmark

China's leaders have long been concerned about the strategic vulnerability from their country's steadily rising dependence on imported oil. In 2014, when global oil prices stood at $100/bbl, China's average monthly bill from importing 190 million barrels reached $19 billion. Yet, in 2015, with prices being halved, 210 million barrels per month of crude imports accounted for a bill of $11.5 billion.[24] If prices start rising again, the annual ticket could quickly reach the $250 billion mark. At times the share of imported oil is already over 60% of total demand and still growing. Given the high stakes involved,

priority is now given to further expand and increase the sophistication of the trading arms of the state-owned oil companies, and to allow a new generation of Chinese oil importers to enter the international market. By increasing the number of participants in the oil markets beyond the four large national oil companies, China has laid the groundwork for the planned launch of oil futures trading at INE in Shanghai's new trade zone. To Platts, "it is absolutely the vision in China to have their commodity markets priced as much as possible off of Chinese reference contracts whenever they can."[25] Hence, such introduction might have far-reaching consequences for the global oil markets, at least for markets East of Suez, perhaps not as of day one, but gradually over time.

The crude oil under this new futures contract will be medium and sour, based on a contract size of 100 barrels compared to the standard lot of 1,000 barrels for both Brent and WTI futures. Physical delivery will be in a free-trade zone in Northeast China, based on seven different crude oil grades including one domestically produced Chinese crude and six from the Middle East. The contract will be quoted in Yuan per barrel.[26] Having about 240 refineries in mainland China, of which 75 are owned by CNPC, Sinopec, ChemChina and CNOOC, and having an aggregate capacity to process 12.88 mln b/d, it is certainly possible that China will conquer a material slice of the global oil futures market. They may be able to foster some of the individual companies that will reach the premier league of global oil traders soon, where they will not be just buyers, but active traders and marketers on both sides of the equation, both in crude and in products alike.

By quoting the futures contract in local currency, while allowing the international players to keep the currency outside the country, the INE could also further increase the Yuan's role as an international currency, and to break the absolute dominance of oil being traded exclusively in dollars in open markets. Yang Mai Jun, chairman of INE has said that crude oil futures from the outset will be traded from an international platform where international investors can freely participate in this market transaction. On the one hand, INE will facilitate the involvement of Chinese investors. On the other hand, the INE will facilitate international investor transactions by allowing US dollar and other foreign currencies to offset local-currency margin.[27] In addition, the INE might also create more competition among the Chinese participants, driving efficiency and improving transparency in the Chinese market. Some even believe that this new futures contract can expect to see high trading volumes from day one, given the tremendous liquidity in the onshore futures market and the strong support of the Chinese authorities. That said, the jury is still out if international traders will use this new platform, and therefore, if it will become a purely local market.

At this stage, market participants still have concerns relating to (a) the large size of China's state-owned oil majors, (b) recent moves by regulators, and (c) the use of the Yuan. Recent financial turmoil in China - triggered by the unexpected devaluation of the Yuan - has complicated the pending launch of the futures contract. In addition, aggressive trading by Chinaoil and Unipec has made trading much more difficult for everybody from producers to refiners outside China. Moreover, the market is uncomfortable with the idea of a benchmark that is dominated by the world's oil importer if the regulator is suspected of having the goal of lowering prices.[28] But over time, oil majors and the global traders might have no choice but to start participating. Thus while it might take some time to develop, it is not unreasonable to assume that one day China will become a central player in the marketplace. The

big question is whether the Middle Eastern producers are prepared to see the price of oil set in Shanghai, or whether they will fiercely defend the current platforms for price discovery.

Conclusion

Competition between the main benchmarks is expected to increase further. How and in what way are still big questions. Many participants, both incumbents and new entrants, will ultimately define the journey and set the new rules for price discovery process in the New Oil Order. Beside the insiders, politicians and regulators periodically become important stakeholders when geopolitics and geo-finance are dominant factors in the oil markets. Risk management is growing in importance in highly competitive markets. Market participants are likely to have to adapt their strategies to deal with the current situation, and the way the oil market will further evolve. How many benchmarks the world ultimately needs, how they compete and interact, and which ones will win are all difficult questions to answer. However, to just assume that the dynamics of oil price discovery will stay as is and that oil (price) regimes will never change is quite risky. For that reason, oil continues to be a highly interesting commodity to watch!

Endnotes

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Author Biography

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MF Global Five Years On

Richard Heckinger
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On October 31, 2011, the broker–dealer (B/D) and futures commission merchant (FCM) firms of MF Global Group (MFG, the group and all its parts) collapsed, causing significant 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. Approximately $1.6 billion of customers' funds were not immediately available for liquidation proceedings, and more significantly, due to apparent misallocation (i.e., not segregated between firm and customers' accounts) and use of the funds to fund proprietary trading, thereby resulting in encumbrance of such funds.

In the event, by late 2015 all customers were made whole by recovery and distribution actions of the respective bankruptcy trustees and administrators appointed to liquidate the firm, depending on the jurisdiction and particular MFG business entity. Other creditors such as vendors or suppliers of services to MFG received approximately 95% of the value of their claims. In the five years following its collapse this episode has been well documented by trustee/administrator reports, legal proceedings and journalists[1].

MFG's collapse was characterized by a run on its liabilities and a hasty sale of its assets at possibly concessionary prices (known as a fire sale). As MFG suffered a crisis of liquidity (the inability to fund its proprietary positions) customers did not exit the firm *en masse*, at least not initially.

The eventual exit[2] by customers amounted to US$1.1 billion and accelerated when MFG was in the throes of credit downgrades[3]. This US$1.1 billion reduction in MFG's customer funds represented a drain on MFG's liquidity certainly, but likely it was not of sufficient magnitude nor happened rapidly enough, to cause the firm to collapse at the start of MFG's liquidity crisis.

To put it simply, some actual or potential providers of liquidity to MFG, such as commercial banks, reduced their liquidity provision at the same time that counterparties demanded additional collateral from MFG by increasing their margin requirements. MFG used multiple sources of liquidity, and, in some cases, the liquidity providers and the demanders were the very same firms. Such arrangements are not unusual in broad-based client relationships between, say, banks and their commercial customers.

In this context MFG faced various entities (banks in particular) as their customer (i.e., the bank as MFG's agent) and/or their counterparty (i.e., the bank as the other side of a dealt position). MFG's other key counterparties were the various central counterparties (CCPs, i.e., clearinghouses) that required collateral and liquidity for positions held by MFG, with the opposite sides of the positions guaranteed by the CCPs.

The liquidity crisis was experienced with respect to MFG's proprietary trading of mainly European sovereign debt. The strategy was based on earning the yield to maturity of the securities, but the strategy had the risk of default by the issuers. As with most investment strategies the other risks included the market (price/yield) risks of changes in interest rates overall and/or changes in the credit rating attached to the securities.

MFG's liquidity risk was based on the need to fund its positions through the full maturity of the securities (most were one year or less), thereby vacating the opportunity to sell the securities before maturity, to take either a profit or loss. This "lock-in" aspect of MFG's strategy was exacerbated by use of repurchase agreements (the sale of securities with an agreement to repurchase them at a later, agreed, date) to effect the so-called repo to maturity (RTM) strategy. With an RTM, the maturity of repo funding exactly matches the maturity of the security being financed. MFG was motivated to use the RPM strategy for two important reasons. First, the firm could use the cash generated by the repo (minus the margin haircut, which is the amount held back from the repo to cover the risk of the deal) to fund further positions, thereby creating leverage.

Second, because the accounting rules characterized the securities in the repo positions as "sold" MFG realized profits on the RTM immediately. The other leg of the repo transaction (i.e., the repurchase from the RPM counterparty at the maturity of the repo) was characterized as a forward purchase agreement (a derivatives transaction) which was marked-to-market with variations recognized as current profit or loss. Regardless, the consequence was that MFG was committed to using its capital to fund the strategy for the full duration. In effect, this strategy was akin to a highly levered portfolio of zero-coupon securities held until maturity.

However, as with market and credit risks, liquidity risks might change over time. MFG faced possible downgrades in the credit ratings of the sovereign issuers (such as Italy and Ireland) and the securities being financed could be subject to margin calls for additional collateral. As happened, such downgrades did occur and required MFG to obtain additional funding and liquidity to meet the calls. Concomitantly, due to its re-leveraging of positions, MFG itself was put on alert/watch lists by regulators[4] and rating agencies, and its eventual downgrades caused additional margin calls, reflecting MFG's increased counterparty credit (and liquidity) risk.

Institutionally, MFG's back office systems were appropriate for FCM and B/D business, and were not well-suited to managing a book of leveraged proprietary positons. Further, its use of two settlement banks (JP Morgan Chase and Bank of New York Mellon) to settle its securities (fixed income) transactions, as well as for access to immediate liquidity versus pending settlements (so-called in-the-box securities) complicated its liquidity management. This resulted in cases where liquidity was available at one bank but needed at the other. Its settlement banks were also key liquidity providers/agents, and as noted generally above, demanders of liquidity as MFG's counterparties, among others. As the downgrades occurred, MFG's access to liquidity would have been stressed at only one bank, and the use of two banks increased its operational and coordination risks substantially.

The trustees and administrators note that MFG apparently used customer-segregated funds, held in respect of its FCM activities[5], to fund some of the margin calls. The exact extent of such use was in doubt due to the chaotic conditions at MFG during its last weeks, compounded by its inadequate management information and control systems. The consensus was that between US$1 billion and $1.6 billion was possibly used inappropriately. Regardless of that possible violation, any amount of customer funds that may have been used was beyond MFG's capital and balance-sheet ratios, thereby allowing the firm to fund risks that it should not have been capable of taking.

In seeking liquidity, MFG sought to sell assets as essentially a fire sale. Due to the haste of and administrative chaos surrounding such attempted sales, and failures by counterparties to consummate the deals and the claiming of proceeds by settlement agents for monies owed, MFG was left with securities, especially corporate bonds, which were not sold. The unsold securities required full funding thereby locking up potential liquidity. Given MFG's market standing at the time, potential buyers of any of MFG's assets were unwilling to accept the settlement risk attached to trades with MFG. Even for securities that MFG was able to repo, the counterparties increased their haircuts, closed out their reverse repos, that is, calling for their cash back by returning the securities (as might have been allowed in the terms of the repo) to MFG, or took both actions. In response, MFG attempted to extend its fire sale to securities it had lent out after paying back the collateral in cash to the borrower, a further drain on its liquidity. It continued attempts to sell, possibly by auction, whole portfolios of holdings and further attempted to unwind some of its RTM positions. This latter effort itself called for short-term liquidity, in that the return of the securities (to allow their sale) from its CCP counterparties would require MFG to return the cash provided from the original repo (net of the margin already paid). Further, it would require that MFG take a charge (not a cash transaction) for the profit already realized from the RTM.

In the end and in total, these efforts were not adequate to save the firm, nor, due to questions about the status of customer funds and the extremely short time available (a week from the downgrades), to allow for its sale to another firm. MFG in all its parts was liquidated, and as noted, customers were left with unhedged positions and/or their assets tied up in liquidation proceedings for an extended time, essentially four years.

Among the lessons that may have been learned is that the public face—the customer business of MFG, and the institutional face—the proprietary business of MFG, were very different. Customers were relying on the rigorous and consistent regulations that existed on their behalf, with little knowledge of the risks the firm was taking overall and possibly by use of their monies without their consent. The customers could exit, run, from the firm and they did so. But, many may have not had much choice due to the suddenness of MFG's demise. Some customers may have had a false sense of security based on their expectation, that, in the event of a default, they would be protected by regulatory safeguards (e.g., funds segregation). Such expectations were reasonable given the explicit segregation requirements (per footnote 5), but further, their reasonable expectation that MFG was well managed and in compliance with applicable laws, regulations and rules. Customers believed they were dealing with a reliable agent, and generally they did not have full knowledge of the "other" MFG, namely the proprietary trading activities of the firm. Customers' collective faith in the customer-facing business exposed the moral hazard implications of the protections.

These severe tests of customer protections raised new regulatory questions as to the adequacy of their scope and application. New, more specific, customer funds segregation structures were proposed and implemented. Among them are the legally separate operationally comingled (known as LSOC) accounts that, as the name implies, would provide more visibility to any one customer's funds versus the comingled account used for operational purposes such as clearing. Another innovation was individual segregated accounts so that funds would be totally segregated on behalf of the customer. On their own initiative many customers have withdrawn any excess margin that might have formerly been left at an FCM.

Another lesson from the MF Global collapse is to pay more attention to the full scope of an FCM's business activities. In comparison to customers of MFG who assumed they were dealing with an agent, MFG's counterparties had access to more instantaneous data as counterparties or agents. Both classes lacked a full picture of MFG's financial condition except for periodic corporate filings and disclosures.

Reacting to what information they had, the institutional counterparties had several remedies such as demanding more collateral to protect their interests, which they did. It was more difficult for customers (many were hedgers) to either extract their funds or re-establish their hedge positions in a timely manner. Consequently, they suffered real and opportunity costs from the lack of access to FCM services.

Other claimants, creditors of various classes, had little choice but to hope for sufficient recovery of assets to cover their claims against the estates of MFG. Some former employees of MFG sued to recover vacation, deferred compensation and bonus pay as unsecured general creditors and as administrative and priority claimants depending on the nature of their claims. There may remain civil and criminal judgments to be resolved.

Ultimately, MFG's counterparties of all kinds were satisfied in whole or in large part, but their collective trust in the regulation and management of financial intermediaries in general was tested. Key among the results of the demise of MFG are the provision of additional customer protections, and more rigorous investor due diligence in choosing agents and counterparties.

Endnotes

1 See, for example, trustee reports by Giddens, via the Commodity Futures Trading Commission web site, first report at: http://www.cftc.gov/idc/groups/public/@newsroom/documents/file/mfglobaliinvestreport060412.pdf; plus other summaries in public media. See also, Heckinger, *Journal of Financial Market Infrastructures*, Volume 3, Number 2, December 2014, at: http://www.risk.net/journal-of-financial-market-infrastructures/technical-paper/2385913/mf-global-a-case-study-of-liquidity-risks

2 To exit, a customer would need to either liquidate open positions and withdraw available cash and securities, or transfer the open positions with cash and securities to another FCM or B/D.

3 In particular, credit downgrades by Moody's Investors Service and Standard & Poor's during the period October 24–27, 2011, reduced MFG's rating to junk status.

4 Notably, by the US Financial Industry Regulatory Authority (FINRA), a supervisor of US B/Ds; and by the Financial Services Authority (FSA), a supervisor of UK financial intermediaries (now the Financial Conduct Authority.) Each questioned the adequacy of MFG's capital to support the RTM strategy, specifically imposing a default risk capital charge to cover the sovereign debt that was the collateral for the RTM.

5 The segregation of customer monies and positions is part of law in the United States (US Commodity Exchange Act, Section 4d), for example, and is available to customers of intermediaries in other jurisdictions. Such segregation is called for in the Principles for Financial Market Infrastructures, Principle 14, CPSS (now CPMI)—IOSCO, as published April 2012, at BIS: http://www.bis.org/cpmi/publ/d101a.pdf

Author Biography

Richard Heckinger

Richard Heckinger was formerly Vice President and Senior Policy Advisor, Financial Markets Group, at the Federal Reserve Bank of Chicago. He started his career in financial markets at the Chicago Board Options Exchange in 1973, and has held positions in trading, exchange operations, project management, clearing, risk management, product development and marketing. In the 1990s he was Chief Operating Officer of the Stock Exchange of Hong Kong, and subsequently Chief Executive of the Hong Kong Securities Clearing Corporation. Other positions include Director and Head of the Deutsche Böerse/Eurex US Representative Office located in Chicago and Managing Director for Global Link at State Street Corp in Boston.

He has also served on international committees, including a Federal Reserve Bank of New York working group, the OTC Derivatives Regulators' Forum, SWIFT, and the International Securities Services Association. He has a M. Phil. degree in economics from the London School of Economics, a B.A. degree in mathematics from the Illinois State University, and completed the Advanced Management Course at the University of Chicago.

He is a member of the Editorial Advisory Board of the *Global Commodity Applied Research Digest (GCARD)*, and also is an Associate Editor of the *Journal of Financial Market Infrastructures*. In addition, Mr. Heckinger is a member of the Working Group on Financial Markets at the Federal Reserve Bank of Chicago.

Interview with Professor Colin A. Carter

Distinguished Professor of Agricultural and Resource Economics, University of California, Davis; and Chair, J.P. Morgan Center for Commodities' Research Council

Professor Colin A. Carter, University of California, Davis and Research Council Chair, J.P. Morgan Center for Commodities (JPMCC) at the University of Colorado Denver Business School, addressing the JPMCC's Research Council in the Center's CoBank Lecture Hall on April 18, 2015.

In the inaugural issue of the *GCARD*, we interview Dr. Colin A. Carter, who became the Chair of the J.P. Morgan Center for Commodities' (JPMCC's) Research Council in the Fall of 2015. Dr. Carter is also a Distinguished Professor of Agricultural and Resource Economics at the University of California, Davis where he has been a researcher and educator for over 30 years. His Ph.D. thesis at the University of California, Berkeley was on soybean futures markets, and he still has a research program on futures markets. At UC Davis, Professor Carter is responsible for developing an introductory undergraduate course on futures and options where there are about 250 to 300 students who take this course each year. "It is so exciting to introduce the world of commodities to these excellent students," he said.

"They have no idea what I am talking about on the first day [of class]. What I do the first day is I put a list of commodities up on the screen that affects them on a daily basis, and I start with orange juice and coffee and so on and go through that and by the time I am finished … they are actually paying attention." Professor Carter's research covers the grain and livestock sectors in China as well as the economics of biotechnology, global agricultural commodity markets, and biofuels policy in the United States.

Interview with Professor Carter

The Research Council of the JPMCC consists of "eminent researchers and successful professionals in practice, who are interested in a shared platform for relevant academic commodities research and its dissemination to the wider commodities community." What encouraged you to become Chair of the JPMCC's Research Council?

When I was asked to Chair the Research Council by Ajeyo Banerjee, I jumped at the opportunity because the Council members are such an impressive group of individuals, each with considerable experience and a strong interest in commodities. I knew that I could learn from each and every member of the Council. At the same time, I believed that I could help … [Ajeyo] and the Center achieve its initial objectives.

What were the highlights of the April and December 2015 Research Council meetings in Denver?

From my perspective, the highlights were participating in the open discussions on areas where the Center could and should focus its efforts. There were some very innovative and interesting suggestions that came out of those sessions. The synergy created between the academics and industry professionals was a very unique and fruitful outcome of the meetings.

What are some of your goals for the Research Council over time?

I would like to see the Council endorse and facilitate commodity-related research that not only expands our academic understanding of commodity markets but also has a strong practical relevance. It is an exciting industry with complicated dynamics, giving rise to many interesting questions and issues.

Amongst your research interests is the Chinese agricultural sector, including environmental issues. What have the results of your research been, and what are you currently working on in this area?

I am working on a very exciting project with colleagues at UC Davis and Nanjing Agricultural University in China. We are studying the impact of air pollution on crop yields in China. Our initial focus is on rice and we find that in southeastern China the negative impact of pollution on rice yields is of commercial importance, with implications for food security in China and globally. In my opinion, pollution may be a more pressing issue than climate change in China from the agricultural perspective, but of course pollution and climate change are related.

You are also working on the impact of biofuels on the price of gasoline. What are some of your insights in this area?

At the present time about 10 percent of motor fuel is ethanol, which has lower energy content than gasoline. In fact ethanol gives only two-thirds the mileage of gasoline with a standard automobile engine. However at the gas pump motorists are not offered a discounted price on the ethanol blend that accurately reflects the lower energy content of the blend. The upshot is that the price of motor fuel at the pump is increased due to the mandatory requirement that we must use ethanol and it is not priced according to its energy content. This is yet one more hidden cost of U.S. biofuels policy.

Do you think that the establishment of "information markets" would be a useful activity for an academic institution?

Yes, I do. I will give you one example. Information or prediction markets were very common for U.S. elections from the late 1800s until the 1940s. Traders could buy or sell standardized contracts that gave a fixed dollar payment if the candidate in question won the election. The markets were extremely large and they were very accurate at forecasting election outcomes long before "scientific polling" was developed with telephone surveys.

Today we are finding that telephone surveys are not all that accurate because they miss a segment of the population that does not use landlines. I think we should go back to supporting information markets for purposes of predicting election outcomes. They are not only accurate but also very efficient. In the commodities space, there are numerous other potential applications for information markets.

What is your view on the revolutionary changes in publishing, particularly in bringing the costs down for textbooks? What has been your experience in this regard?

I think the days of large publishing houses charging $150 to $250 for a textbook are on the way out. I have a textbook on futures and options markets and I obtained the copyright back from my publisher and now self-publish through Create-Space, owned by Amazon. The book is published on demand and retails for less than $35. The students save money and my royalties are about the same as they were with a large publisher. Another benefit of this modern approach to supplying textbooks is that the author can easily update the book regularly by uploading a new pdf file, because the book is published on demand.

Water usage seems to be a particularly controversial topic in California. Are there areas of research, including on allocation principles that are useful in resolving this controversy?

There is excess demand for water in California because the pricing mechanism is not used extensively in the state. Furthermore, the water storage and delivery system is old. I live near Sacramento and some residential areas in Sacramento are still without water meters. 2015 was a severe drought year, and homeowners without water meters had no incentive to cut back on usage. California is experimenting with water markets, with tiered pricing, etc. However, there are still a lot of behavioral unknowns regarding homeowners, farmers, and industrial water users and how they respond to different incentive

systems. This is an area where further research could help policy makers do a better job of introducing market-based solutions to the water problem in California.

What topics do you think we should cover in the future in the "Global Commodities Applied Research Digest," given its practitioner focus?

One topic I would like to see addressed is whether or not innovations in commodity derivatives are keeping up with the changing structure of commodity production, processing and marketing. In commodities we are still using basic derivatives developed more than one hundred and fifty years ago. Should we be looking at the potential to introduce new forms of derivatives, given the dramatic changes in the economic structure of the commodities industry?

COLIN A. CARTER, Ph.D.
Distinguished Professor of Agricultural and Resource Economics, University of California, Davis

Dr. Carter is Distinguished Professor of Agricultural and Resource Economics at the University of California, Davis, where he served as Department Chair from 1998 to 2001. He is the current Director of the Giannini Foundation of Agricultural Economics at the University of California and his fields of interest include commodity markets and international trade. He has produced roughly 150 academic publications on topics including international trade, agricultural policy, futures and commodity markets, the economics of China's agriculture, and the economics of biotechnology adoption in agriculture.

He has received numerous professional awards for teaching and research including the Agricultural and Applied Economics Association's (AAEA) Annual Award for Quality of Research Discovery in 1981 and 2008, the Quality of Communication award in 1994 and 2011, a Distinguished Policy Contribution award in 1998, and an award for Outstanding Essay for the 21st Century, in 2001.

Dr. Carter was elected a Fellow of the AAEA in 2000 in recognition for his many contributions to the field of agricultural economics, and he served as Editor of the *Review of Agricultural Economics* from 2004 through 2008.

Dr. Carter has been engaged by over 40 different entities as a consultant, including several law firms and international organizations. Carter has extensive litigation experience as an economics expert witness, dealing with the following commodities: wheat, corn, barley, soybeans, rice, orange juice, hogs, cattle, broiler chickens, onions, strawberries, eggs, tomatoes, potatoes, and sugar. He has worked on a number of legal cases involving the economics of commodity markets, and he has testified in court and in front of domestic and international trade tribunals.

Dr. Carter is also the Chair of the J.P. Morgan Center for Commodities' Research Council at the University of Colorado Denver Business School.

GLOBAL COMMODITIES
APPLIED RESEARCH DIGEST

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In addition to its education mission, the J.P. Morgan Center for Commodities' aim is to become a focal point for worldwide research on commodities.

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