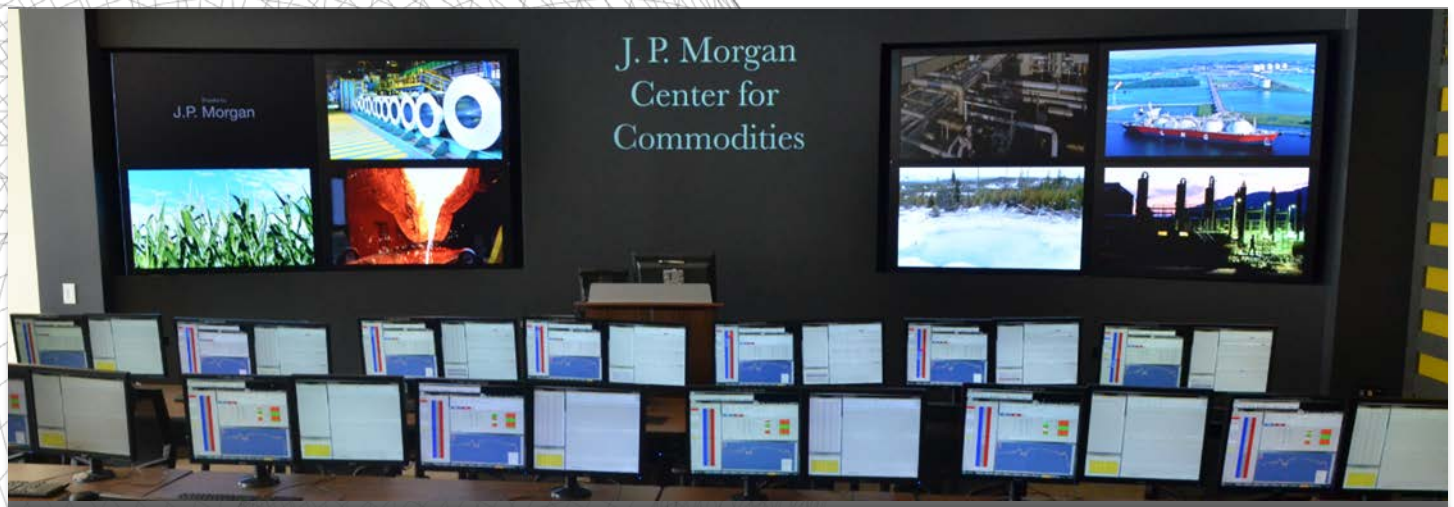

International Trading Conference 2017

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Inferring Energy Fundamentals through Price-Relationship Data

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Inferring Energy Fundamentals through Price-Relationship Data

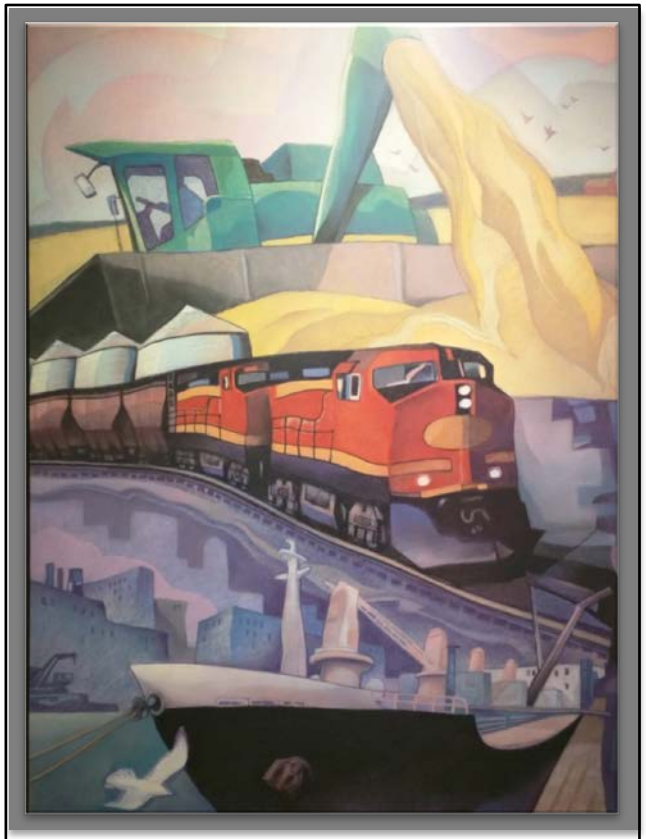
I. The Promise of Big Data

II. The Reality of "Black Holes"

III. The Wealth of Futures Price Data

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

V. Caveats on the Use of Price Data



Source of Image: "From Field to Market," a painting by Gary Kelley, located in the CoBank Lecture Hall at the University of Colorado Denver Business School.

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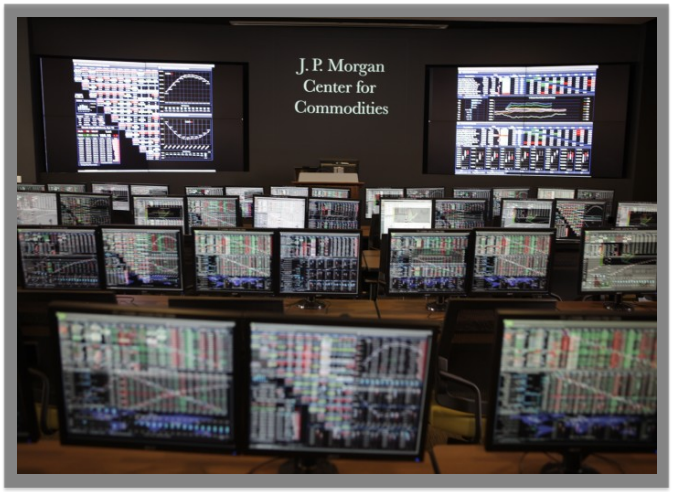
I. The Promise of Big Data

A. Algorithmic Trading

B. Industry Cost Reduction

C. Tapping the Value of Data Embedded in Industry



Source: Anderson (2017).

I. The Promise of Big Data

A. Algorithmic Trading

Commodity trading is different from other asset classes in that new fundamental data that seemingly should impact prices (at least of certain tenors) is continuously coming at us, including:

(1) geopolitical developments, (2) weather, (3) rig counts, (4) gasoline sales, (5) gas storage reports, (6) crude and product inventory reports, (7) oil and LNG tanker positions, and (8) power plant outages.

Source: Anderson (2017).

I. The Promise of Big Data

A. Algorithmic Trading (continued)

Perhaps no other asset class consistently receives as much new, material fundamental information into the market that needs to be assimilated.

Thus, the "bigness" of the data involved can potentially dwarf that of other asset classes, and the value of the high-tech analytics may hold great potential.

Source: Anderson (2017).

I. The Promise of Big Data

B. Industry Cost Reduction

Examples of the application of big data in the energy industry include:

(1) component failure prediction, (2) maintenance optimization, (3) transmission grid infrastructure management, and (4) oil and gas imaging and the prediction of geology and drilling results.

Improvements in these areas can have a dramatic impact on industry cost structure, as occurred during the shale oil revolution.

Source: Anderson (2017).

I. The Promise of Big Data

C. Tapping the Value of Data Embedded in Industry

There is a wealth of data potentially available that simply is not collected currently.

For example, utilities have not historically kept highly time-granular records of electricity consumption.

Companies are looking at tapping this information.

As a result, energy companies serving retail customers could eventually see themselves as in effect, data and information companies.

Source: Anderson (2017).

II. The Reality of "Black Holes"

A. In Emerging Markets

B. Even in Some Markets in the U.S.

II. The Reality of "Black Holes"

The preceding section mainly emphasized applications of big data in the U.S.

A. In Emerging Markets

But with "emerging markets … [becoming] increasingly dominant in the international economy, we have more and more 'black holes'" in data coverage, explained Ed Morse, Global Head of Commodities Research at Citi in CFTC (2017).

"We know what [crude oil] inventories are … in OECD countries … We have a … decent idea in some other countries; Saudi Arabia is very good for example at posting their inventories of products and crude oil, as is Brazil."

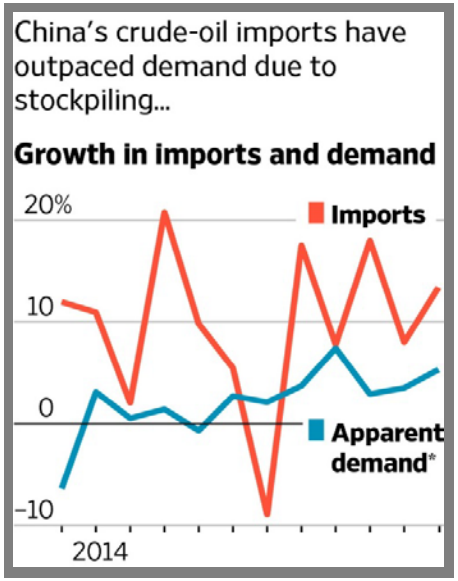
Source: [CFTC] Commodity Futures Trading Commission (2017).

II. The Reality of "Black Holes"

A. In Emerging Markets (continued)

"Even China, which produces a lot of statistics, has a lot of missing barrels, a lot of missing molecules, [and] a lot of missing tons of grains because their inventory [data] is a state secret."

"So black holes are getting larger and larger and impacting our understanding of [commodity] fundamentals."



Source of Graph: Magnier et al. (2015).

Magnier *et al.* (2015): "A lack of good data is a 'very big black box for global oil markets,'" said the director for energy markets and security at the International Energy Agency.

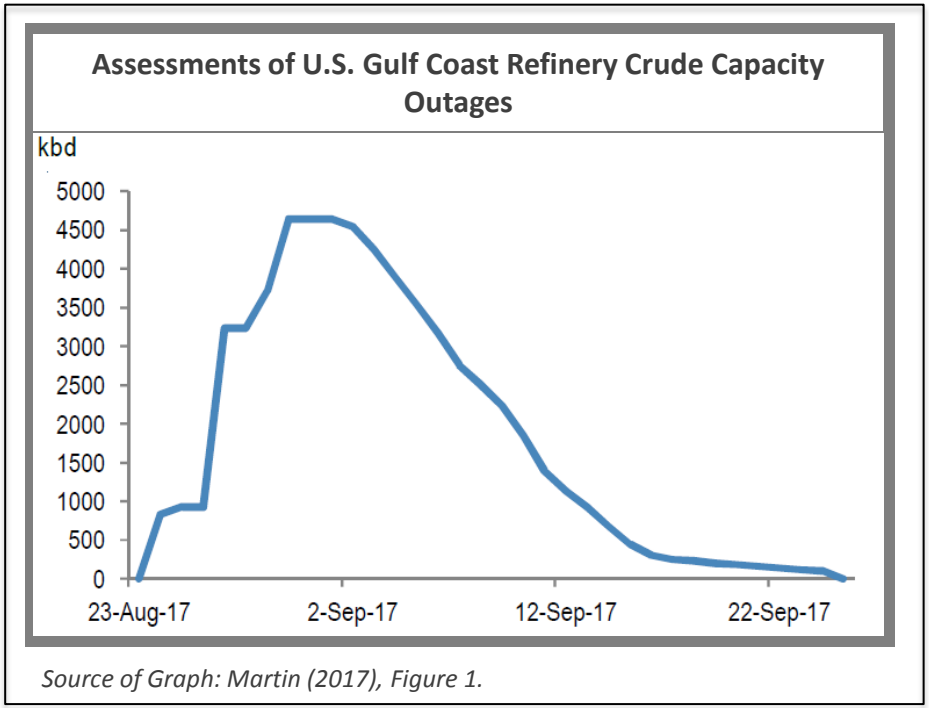
"Stockpiling for … [China's] strategic reserves remain a wildcard."

Source: CFTC (2017).

II. The Reality of "Black Holes"

B. Even in Some Markets in the U.S.

Martin (2017) discussed how "Hurricane Harvey hit the Texas refining system hard". As a result of the disruption to refinery crude processing, the J.P. Morgan commodities research team assessed the "cumulative loss of product supplied as … 22 [million barrels] mb of gasoline and 20 mb of middle distillates …"



Source of Graph: Martin (2017), Figure 1.

II. The Reality of "Black Holes"

B. Even in Some Markets in the U.S. (continued)

"The majority of this shortfall will turn up in [U.S.] PADD 3 inventory levels in future weeks' [Energy Information Administration] EIA reports.

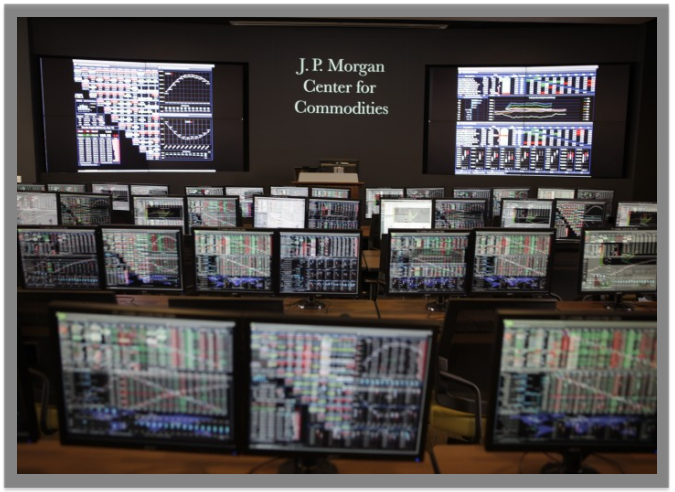
However, some of this was destined for export markets, and some for shipment … via pipeline to PADD 1 – so the impact will be dispersed across *several markets, not all of which will publish data that makes the true impact transparent, and thus, we continue to look at price signals as a guide for the underlying market dynamics,*" noted Martin (2017).

(Italics added.)

III. The Wealth of Futures Price Data

A. The Evolution of Pricing in the Oil Markets

B. Petroleum Complex Futures Markets Provide Needed Transparency

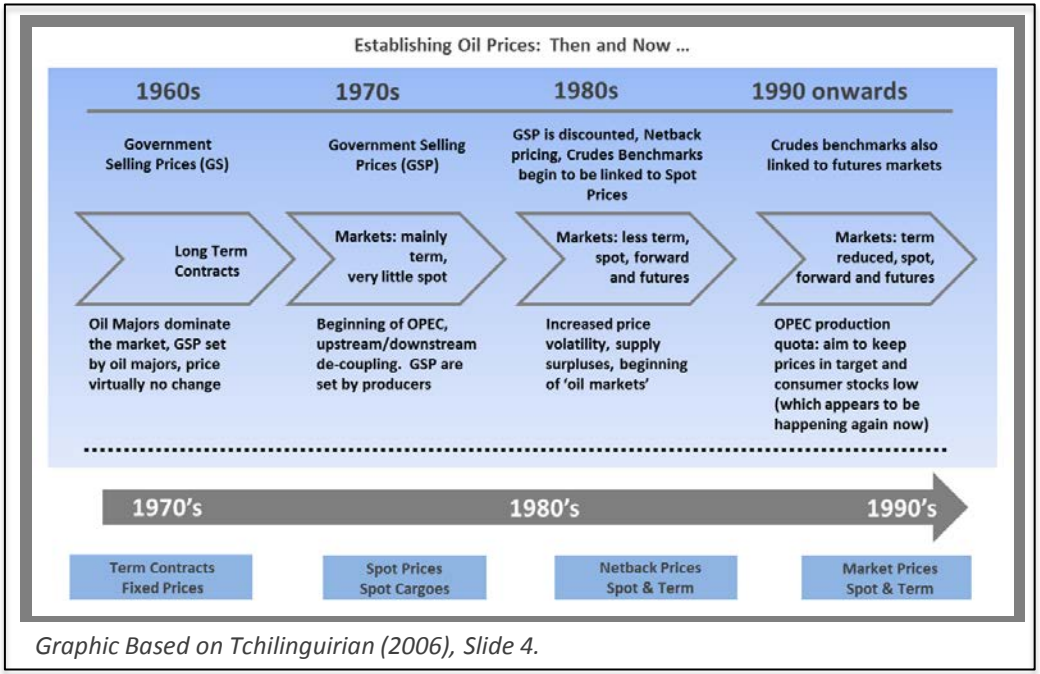


III. The Wealth of Futures Price Data

A. The Evolution of Pricing in the Oil Markets

"The whole framework for commodities changes rapidly. Sometimes more rapidly than [what] you [would] think."

The biggest change of all was "moving from fixed prices to market determined prices," recalled Ed Morse in CFTC Talks (2017).



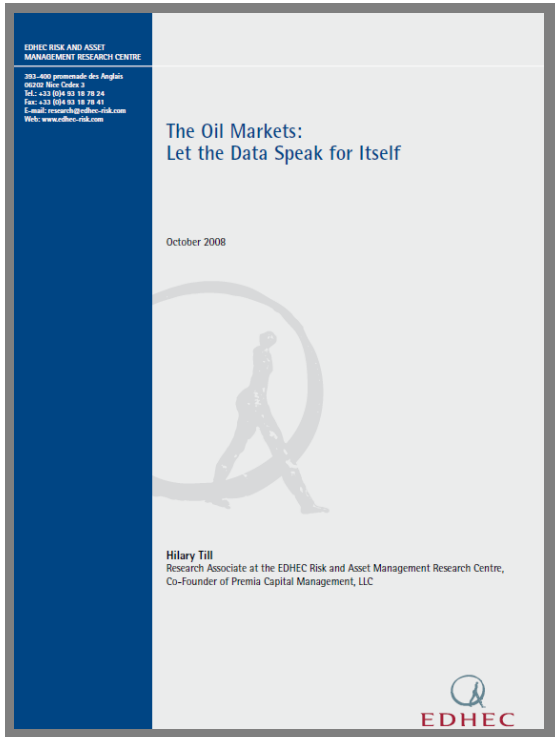
Graphic Based on Tchilinguirian (2006), Slide 4.

III. The Wealth of Futures Price Data

B. Petroleum Complex Futures Markets Provide Needed Transparency

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

In the presence of active futures markets, an observer need not be a member of a cartel or a large corporation to gain insights into the oil market.



Source: Till (2008).

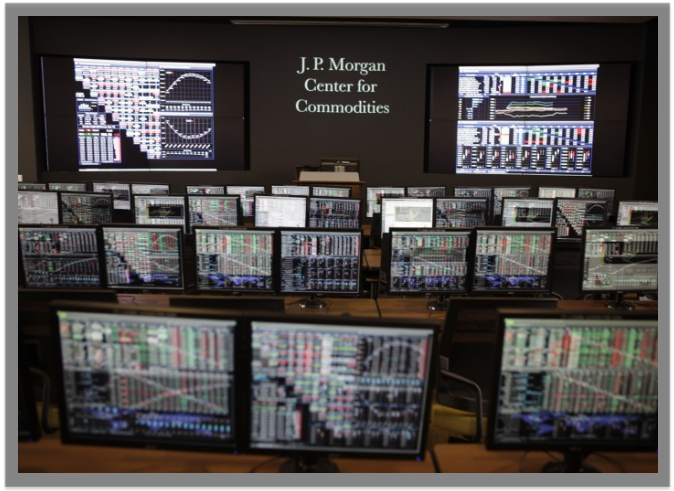
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior

B. Driving Fundamental Behavior

C. Proxying the Physical Market with Futures Spreads

D. Understanding Chinese Demand (Through 2008)



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

F. The Market's Perception of the Marginal Cost of Production

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior

A futures trader interprets a commodity's price as part of a dynamic process. A commodity's price moves in whatever direction is needed in order to elicit a supply or demand response that will balance a commodity market.

It may be useful to review the technical aspects of this interplay.

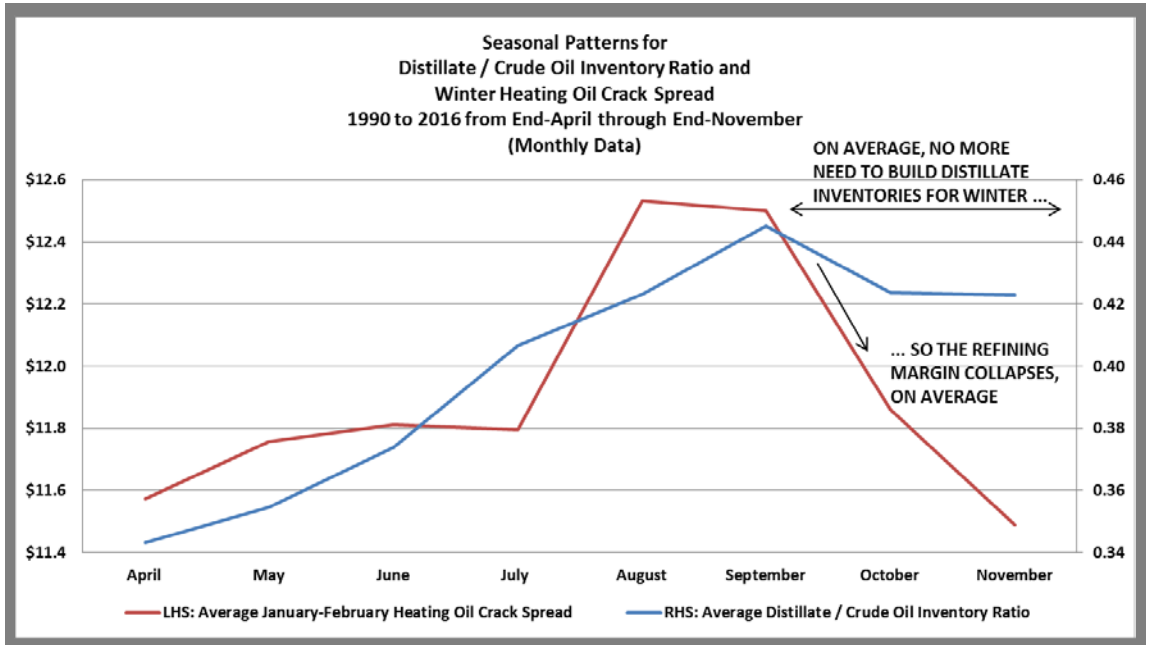
Source: Till (2008).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Building Distillate Inventories Before Winter (1990 to 2016)

This analysis is based on research work by Joseph Eagleeye of Premia Research LLC.



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

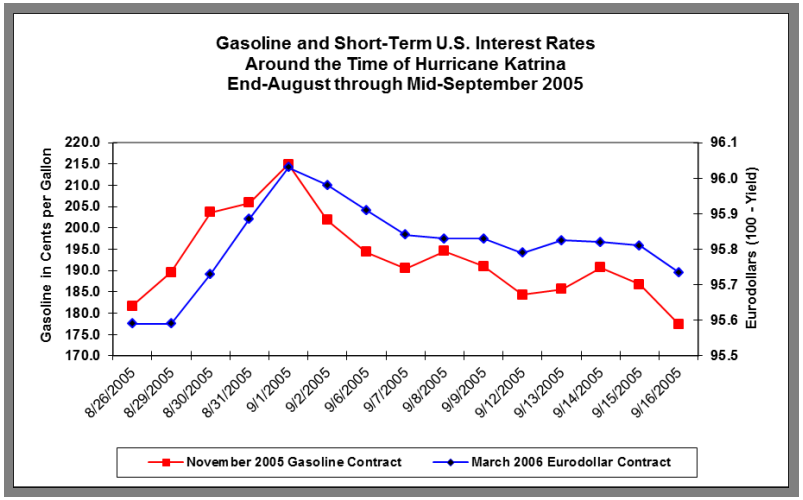
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Hurricane Katrina (2005)

One can also look at the aftermath of Hurricane Katrina in the United States in 2005 for a good example of the dynamic interplay between an oil product's price and its supply-and-demand situation.

With the onset of Hurricane Katrina, the price of gasoline rallied 18% in four days before falling back about the same amount fifteen days later.



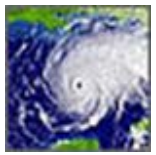
Source: Till (2008).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Hurricane Katrina (2005)

(continued)



According to a 2005 *Dow Jones Newswire* report, "[Hurricane] Katrina shut in nearly all of oil and gas production in the Gulf of Mexico.

The large scale supply disruption and fear of an economic shock triggered a massive [domestic and international] government[al] response."

This unprecedented governmental response caused gasoline prices to decline from their post-Katrina peak.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Hurricane Katrina (2005)

(continued)

Further, and as also illustrated in the graph on Slide 19, with that response, fears of an economic slump diminished, which in turn caused deferred interest-rate contracts to decline, …

… as the market resumed pricing in the expectation that the Federal Reserve Board could continue tightening interest rates at the time.

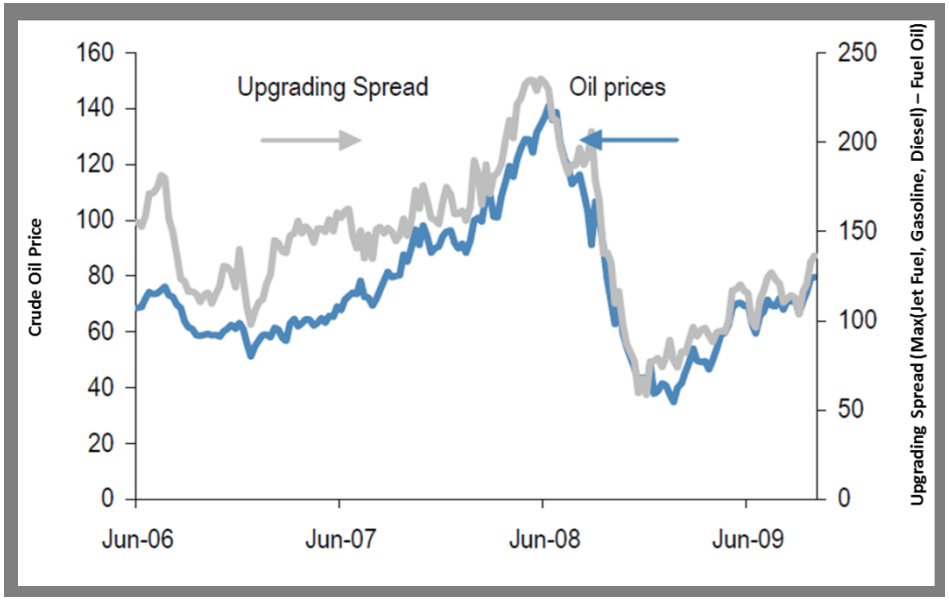
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Refinery Constraints (2008)

The upgrading spread "will widen not only if there is a shortage of refinery capacity, but also if there is insufficient flexibility in the refining system to meet the demand for lighter products."

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



Source of Graph: Ribeiro et al. (2009), Chart 2. [Notes on Data: "The upgrading spread is the difference between the maximum price of transportation fuels and the price of fuel oil … This acts as a proxy for refinery constraints."]

Source: Ribeiro et al. (2009).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Refinery Constraints (2008)

(continued)

"This was … the case during the middle of [the first] decade, when refiners were using more marginal capacity and could not raise gasoline of diesel output without producing excess fuel oil."

When markets are tight, prices increase "to provide the right incentives for both current production and *future investment*." (Italics added.)

Source: Ribeiro et al. (2009).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

A. Incentivizing Fundamental Behavior (continued)

Refinery Constraints (2008)

(continued)

And in fact, “the first half of 2009 [was to] represent … the first large increase in refinery capacity additions,” observed Tchilingurian (2008), having previously noted that “oil refining capacity [had] peaked in 1981” in Tchilingurian (2006).

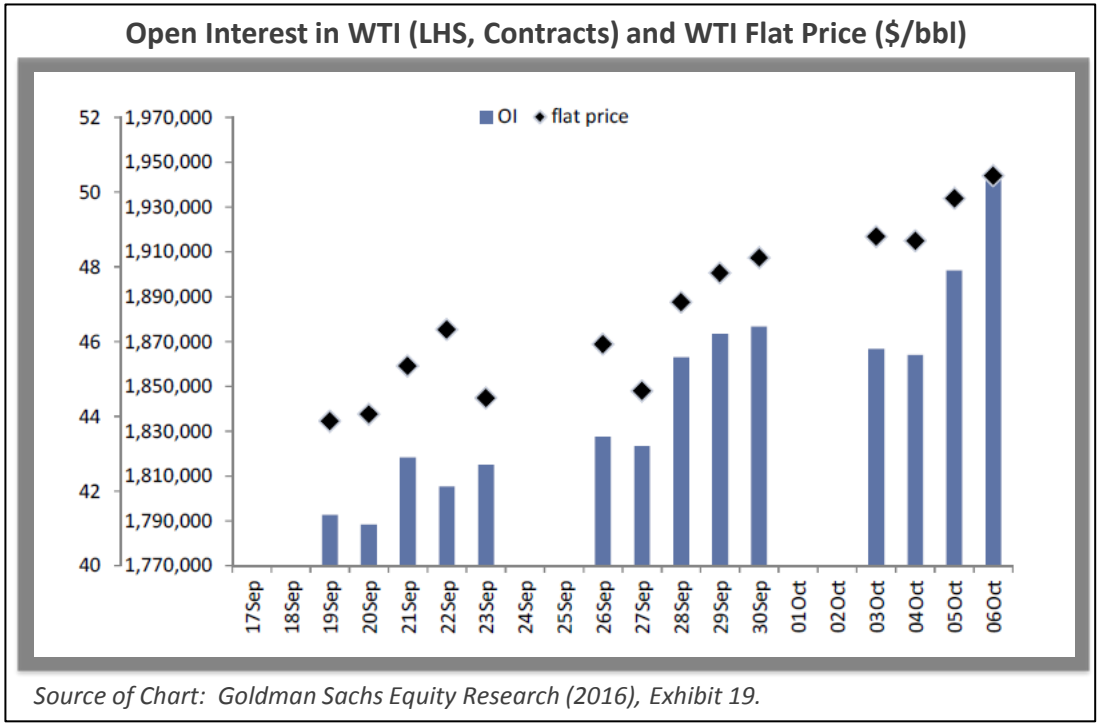
Sources: Tchilingurian (2006, 2008).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

B. Driving Fundamental Behavior

Hedging Opportunities (Particularly for Short-Cycle U.S. Light Tight Oil Projects)

Goldman Sachs Equity Research (2016): "[A]s prices have trended higher[,] there has been a marked increase in hedging activity."



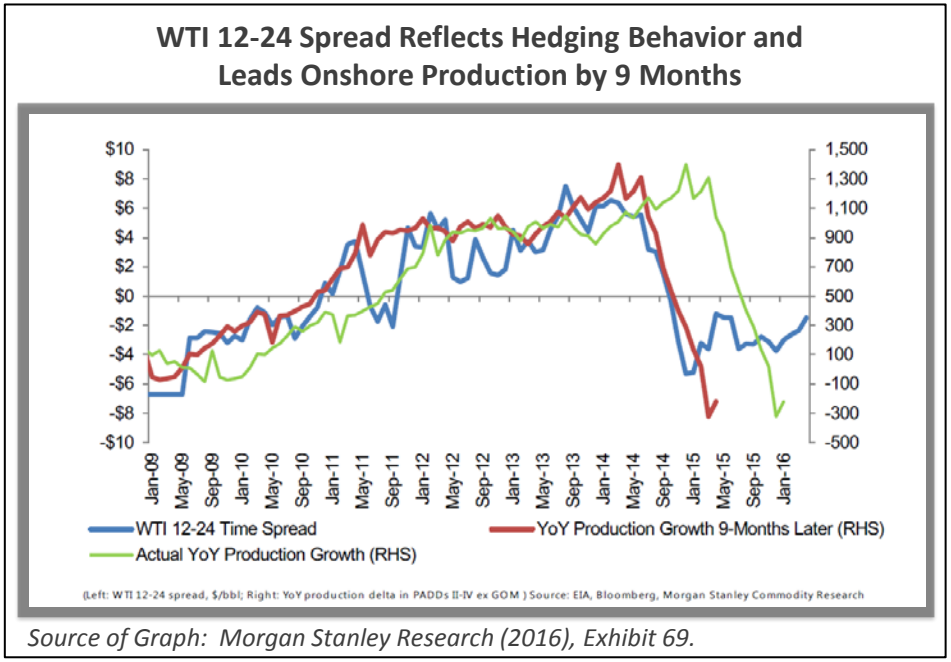
Source of Chart: Goldman Sachs Equity Research (2016), Exhibit 19.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

B. Driving Fundamental Behavior (continued)

Hedging Opportunities (continued)

Morgan Stanley Research (2016): "History shows a 9-month lag between hedging and production …"



Source of Graph: Morgan Stanley Research (2016), Exhibit 69.

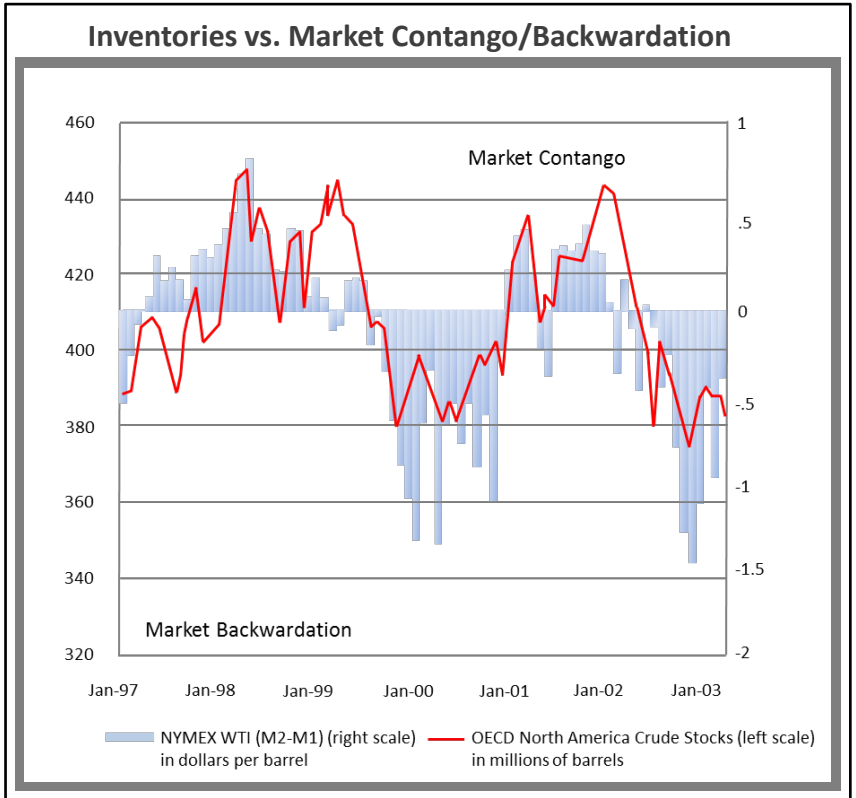
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads

Example from 1997 to 2003

Longson and Volynsky (2015):

"Prompt [term] structure can be a good real-time proxy for the physical [oil] market, and the data proves that out."



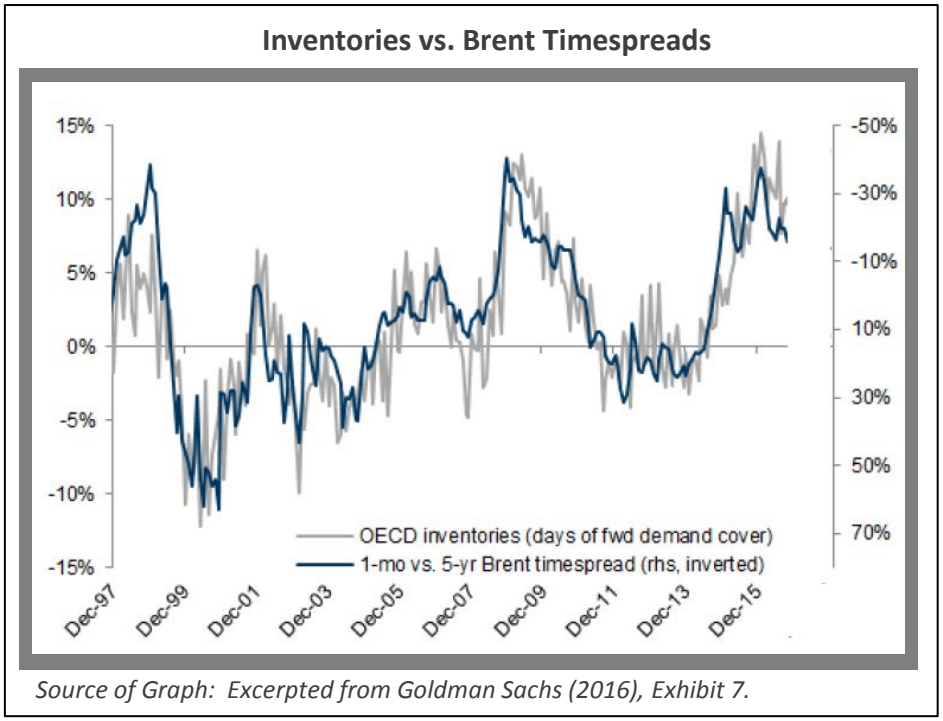
Graph Based on Tchilinguirian (2003), Left-Hand-Side of Slide 18.

Explanation of Abbreviations: NYMEX = New York Mercantile Exchange; OECD = Organization for Economic Co-operation and Development; and M2- M1 = Second-Month Futures Contract Price Minus First-Month Futures Contract Price.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads (continued)

Example from 1997 to 2016



Source of Graph: Excerpted from Goldman Sachs (2016), Exhibit 7.

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

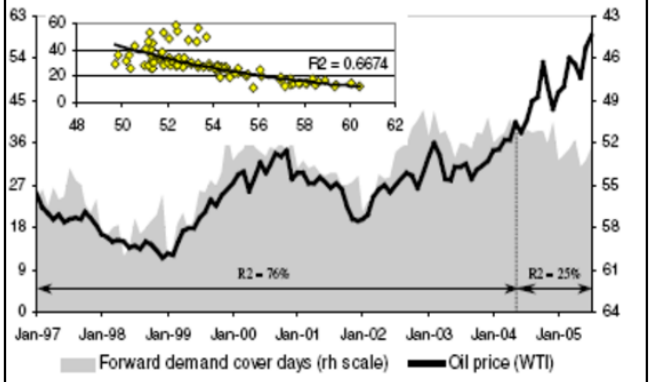
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads (continued)

Caveat: Inventories are Just Part of the Picture

1. From inventory led …

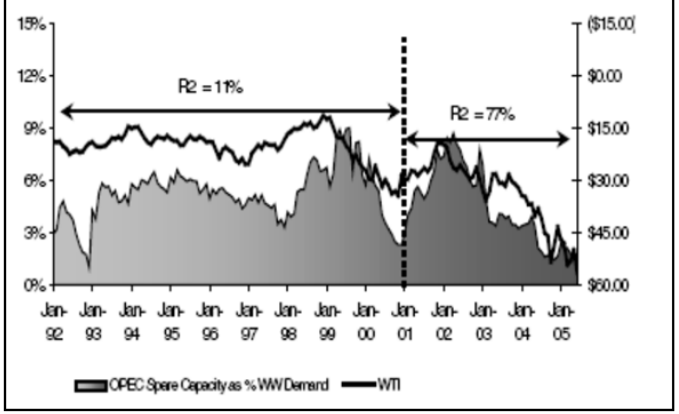
Oil Prices (Highly) Negatively Correlated to Inventories



Source of Data: Smith Barney, Bloomberg, CIR.

2. … to capacity driven

Oil Prices (Highly) Negatively Correlated to Spare Capacity



Source of Graphs: Hicks and Smith (2006), Slide 5.

The upper small graph on the left-hand-corner shows Oil prices (y-axis) vs. Forward demand cover in days.

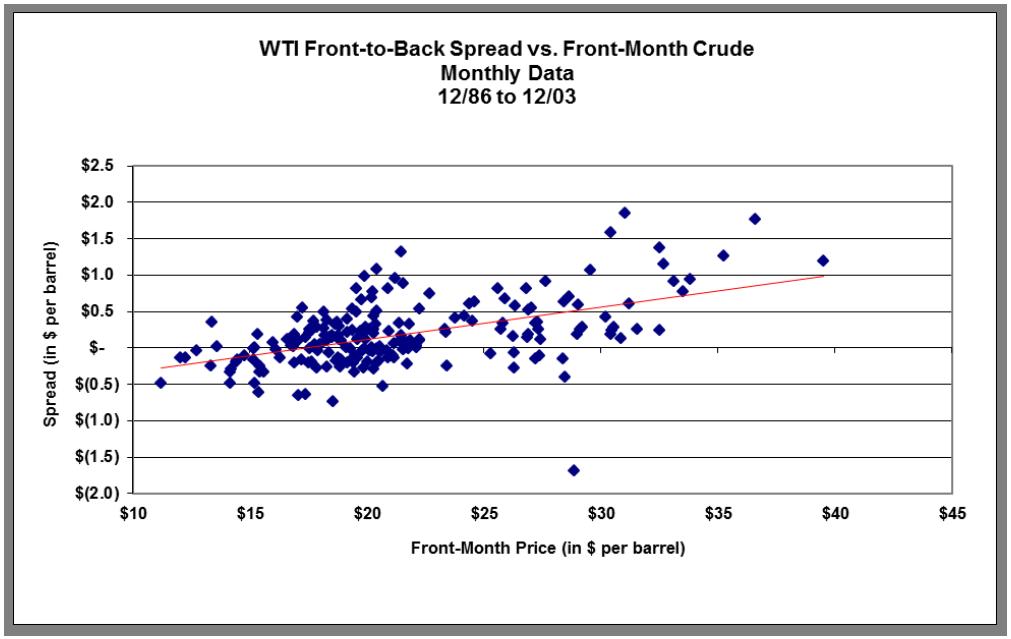
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads (continued)

Caveat: Spare Capacity Also Matters in Interpreting the Oil Futures Curve Shape

A futures curve can be "backwardated" when there is no pressing need to incentivize precautionary stockholdings in oil.

In this state of the world, when the curve is in contango, this indicates that there is ample supply relative to near-term demand.

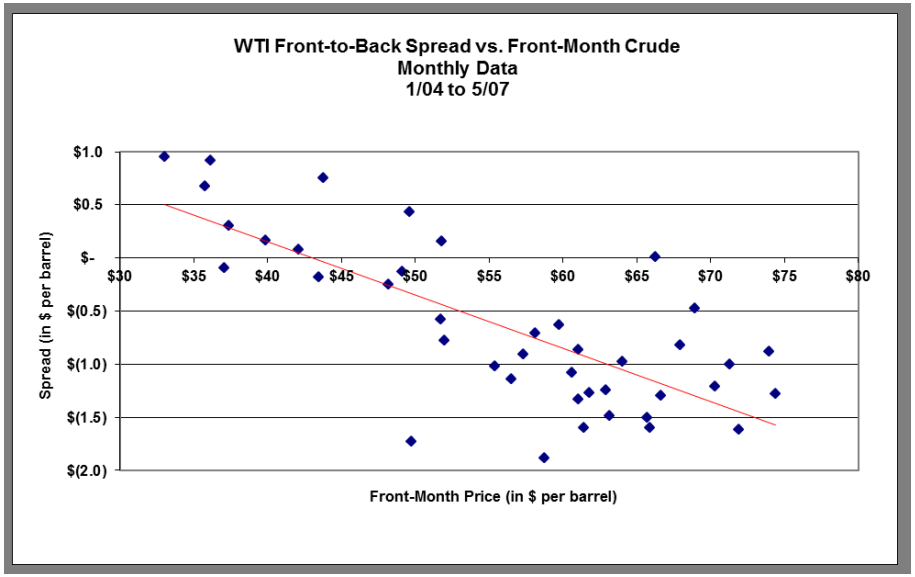


IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads (continued)

Caveat: Spare Capacity Also Matters in Interpreting the Oil Futures Curve Shape (continued)

When there is inadequate spare capacity, a futures curve needs to be in "contango" since there is a pressing need to incentivize precautionary stockholdings in oil.

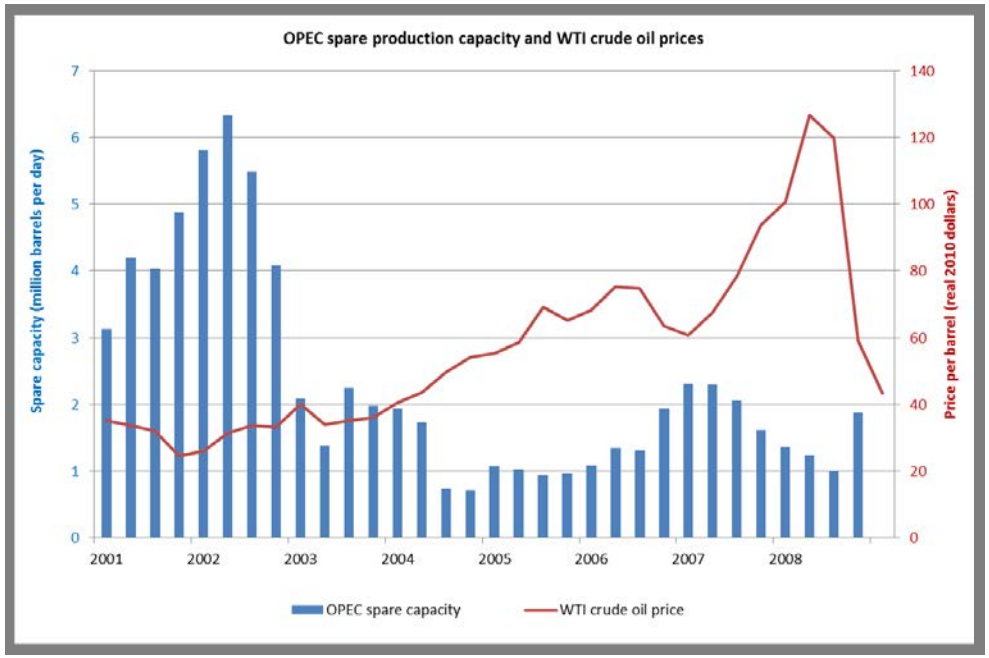


In this state of the world, when the curve is in contango, this would indicate the risk of an eventual demand-destroying oil price spike, followed by a dramatic drop in the price of oil, such as in 2008.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads (continued)

Caveat: Spare Capacity Also Matters



Graph Based on EIA (2014), Slide 12.

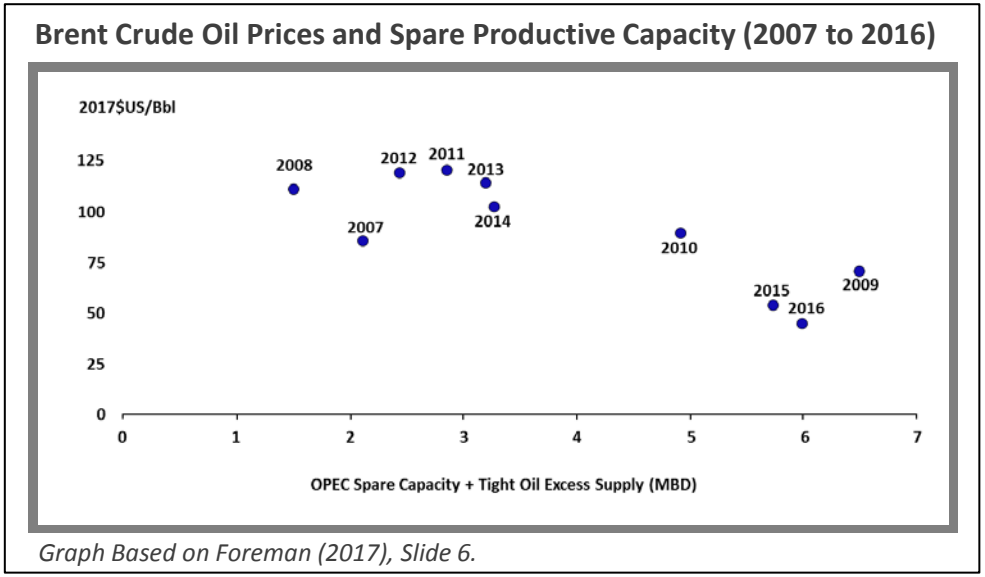
Explanation of OPEC Spare Capacity from the U.S. Energy Information Administration (EIA): "The extent to which OPEC member countries utilize their available production capacity is often used as an indicator of the tightness of global oil markets … EIA defines spare capacity as the volume of production that can be brought on within 30 days and sustained for at least 90 days. … OPEC spare capacity provides an indicator of the world oil market's ability to respond to potential crises that reduce oil supplies."

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

C. Proxying the Physical Market with Futures Spreads (continued)

One More Caveat on Spare Capacity:
An Analyst Now Needs to Also Include Tight Oil Excess Supply, Not Just OPEC Spare Capacity

Foreman (2017): "Although the OPEC swing producer model is outdated, excess productive capacity continues to correspond with prices."



Graph Based on Foreman (2017), Slide 6.

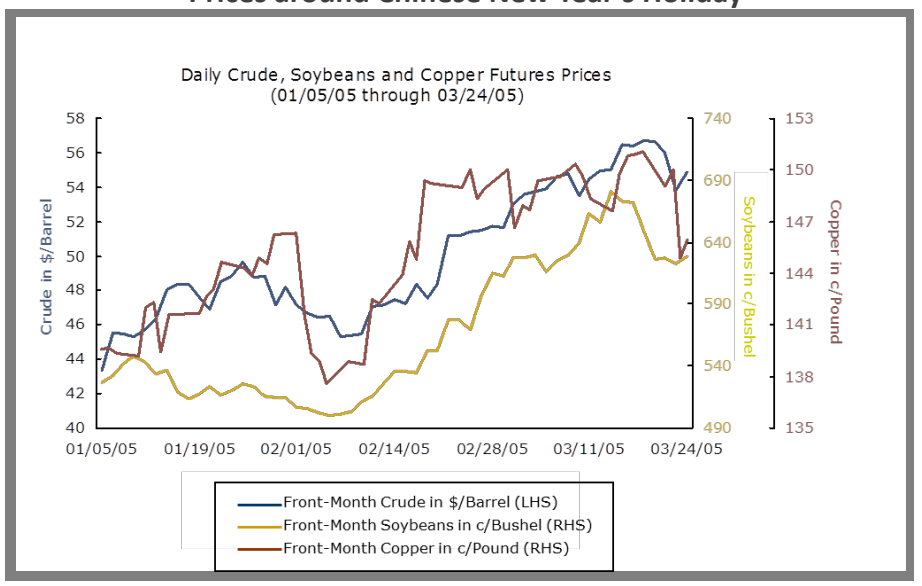
IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

D. Understanding Chinese Demand (Through 2008)

Stein (2005): "This is the first business cycle where Chinese demand is having a global effect on prices, notably of energy and other raw materials."

The graph on the right provided an early indication of the structural changes to come in the commodity markets, and particularly, in the oil markets.

Common Waxing and Waning of Commodity Prices around Chinese New Year's Holiday

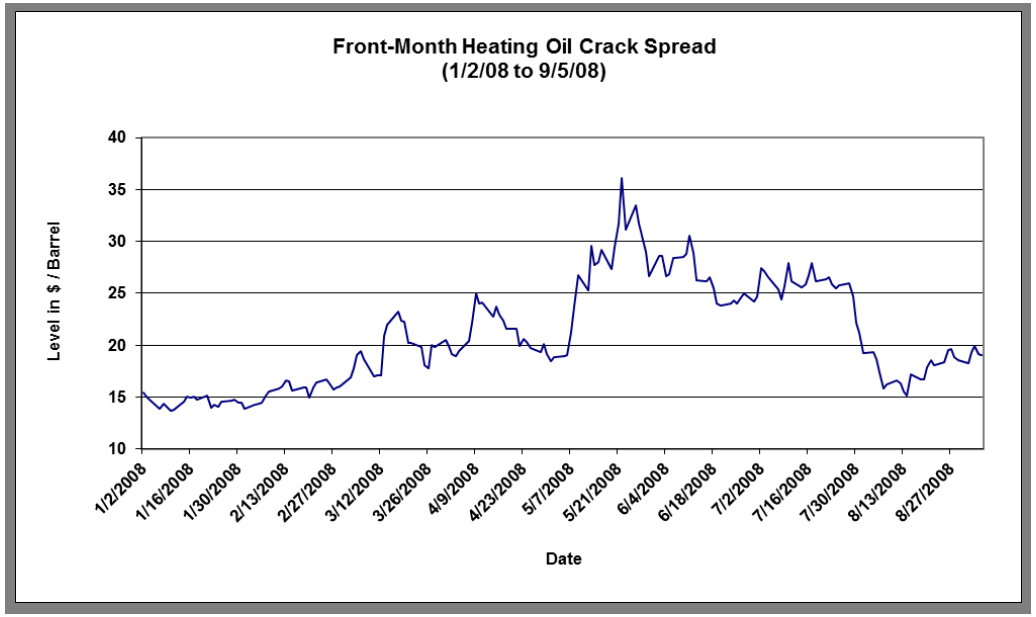


Source of Graph: Till and Eagleeye (2005).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

D. Understanding Chinese Demand (Through 2008) (continued)

Through the summer of 2008, the heating-oil crack spread indicated extraordinary demand for middle distillates.



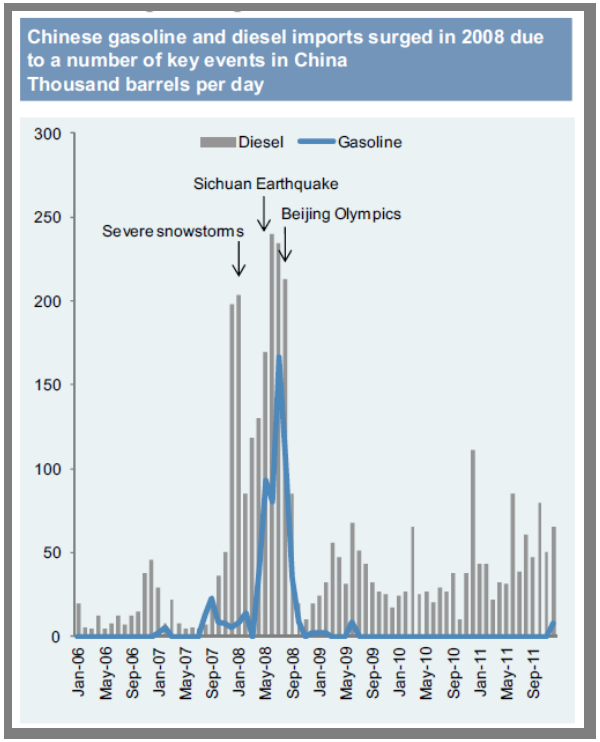
There were no severe weather events, supply disruptions, or large-scale trading blowups in the U.S. or Europe at the time, so it was not immediately apparent why this relationship should spike so extraordinarily.

Source: Till (2008).

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

D. Understanding Chinese Demand (Through 2008) (continued)

That is, except for news from China, including the devastating earthquake in Sichuan, China, which damaged power-supply grids, and also pre-Olympic petroleum-product stocking in order to ensure that there would be no shortages during the historic Beijing Olympics.



Source of Graph: Fenton (2012), Slide 24.

Author's Source of Data:
China Customs General Administration.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

D. Understanding Chinese Demand (Through 2008) (continued)

Kaufmann and Ullman (2009) looked into where "innovations in world oil prices enter the market," using data from 1987 through March 2008.

One of their results was that spot price for Dubai-Fateh oil had been a "'gateway' for innovations to crude oil prices."

"A large fraction of the crude oil shipped to Asian nations from the Middle East (more than 10 mbd) uses the spot price for Dubai-Fateh as a benchmark … As such, innovations in the spot price for Dubai-Fateh may [have] reflect[ed] increasing demand in Asia."

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

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

Blas (2011): "[F]rom time to time, the [WTI] contract [has] disconnect[ed] from the global oil market due to logistical troubles at its landlocked point of delivery in Cushing, Oklahoma."

Two years later, Platts (2013) noted that "many pieces of the logistical puzzle" in North America were now falling into place, due to the "ingenuity of logistical engineers," in managing the increase in U.S. domestic crude supplies.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

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

J.P. Morgan Commodity Research (2013) further explained that "[t]ruck, rail, and barge have all served to move the large increase in domestic crude supplies to U.S. refineries," whom, in turn, could export petroleum *products* abroad.

This had been the mechanism for connecting the U.S. oil markets to global markets since exporting crude oil *itself* was illegal with some minor exceptions until December 2015.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

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

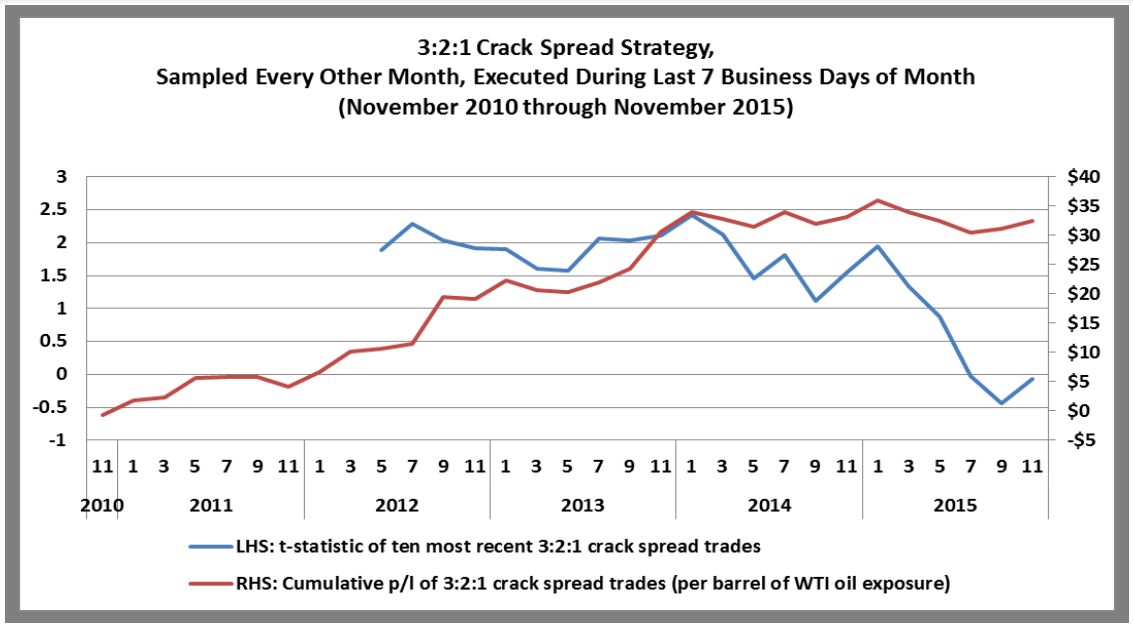
At the end of 2013, alert futures traders had an early signal that "the boom in … [domestic oil] production ha[d] been well absorbed by existing U.S. infrastructure."

Refinery margins (as represented by the 3:2:1 crack spread) no longer needed to consistently rally at the end of each month to provide an extraordinary return for transporting domestic crude oil, in whatever way possible, to U.S. refineries.

This observation is illustrated on the next slide with a graph that shows the degradation of performance of such a strategy, starting in late 2013.

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

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



Source of Graph: Premia Research LLC.

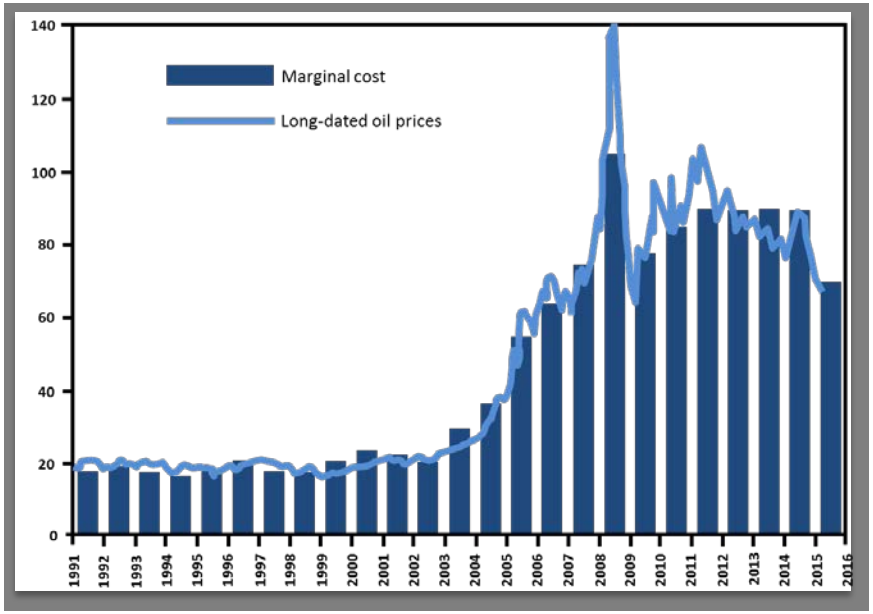
Notes on Graph: "A 3:2:1 crack spread reflects gasoline and distillate production revenues from the U.S. refining industry, which generally produces roughly 2 barrels of gasoline for every barrel of distillate. The 3:2:1 crack spread is calculated by subtracting the price of 3 barrels of oil from the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

IV. What Futures Prices Reveal about Petroleum Complex Fundamentals

F. The Market's Perception of the Marginal Cost of Production

"[T]he long-dated commodity price …[is usually] a reflection of [a] … commodit[y's] marginal cost of production …"

Marginal Cost (Defined as the Average of the Highest Cost (or Bottom Quartile) Producers) vs. 5-Year WTI Futures Price

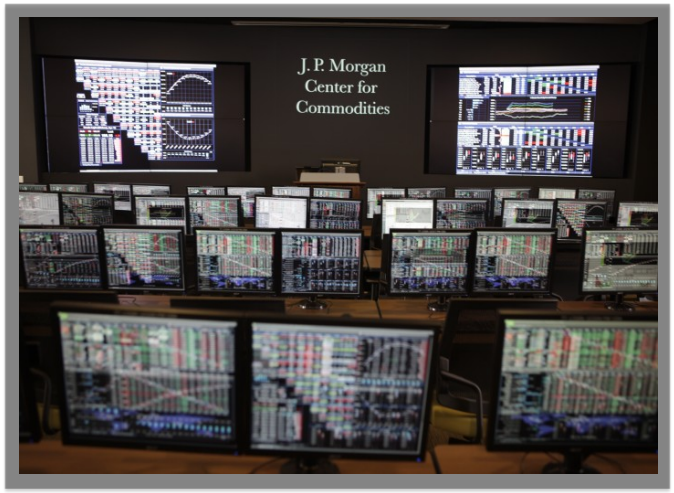


Source of Graph: Goldman Sachs Economic Research (2015), Exhibit 2.

V. Caveats on the Use of Price Data

A. Purely Technical Effects

B. Not Predictions

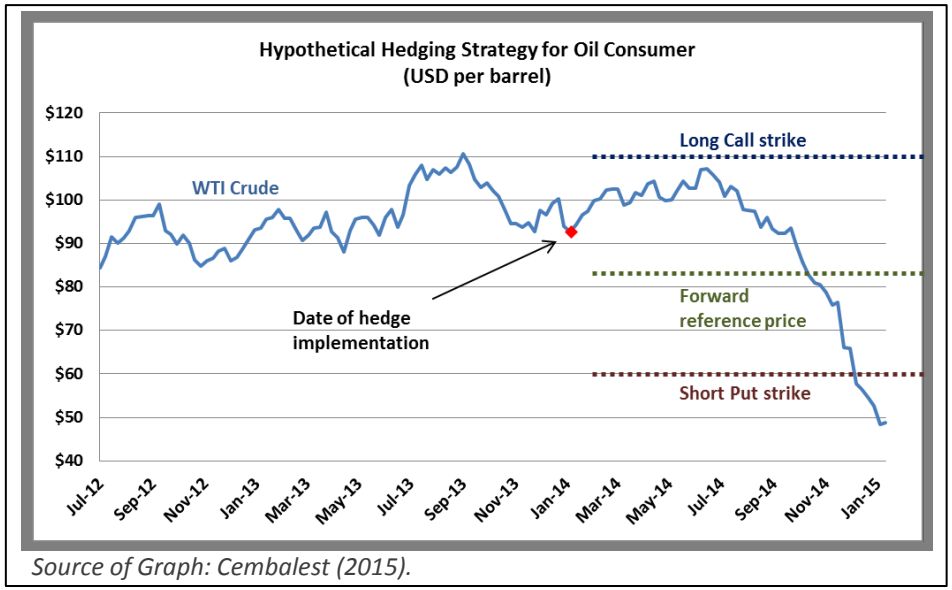


V. Caveats on the Use of Price Data

A. Purely Technical Effects

Dynamic Hedging

"An additional … factor is worth mentioning as it relates to the speed and magnitude of the oil price decline [in the Fall of 2014]: the impact of hedging unwinds."



Source of Graph: Cembalest (2015).

In October 2014, "Wall Street banks … scrambled … to neutralize their exposure to big oil options trades, adding to the downward spiral in crude prices as they s[old] futures contracts to offset options deals that … [became] unexpectedly in the money."

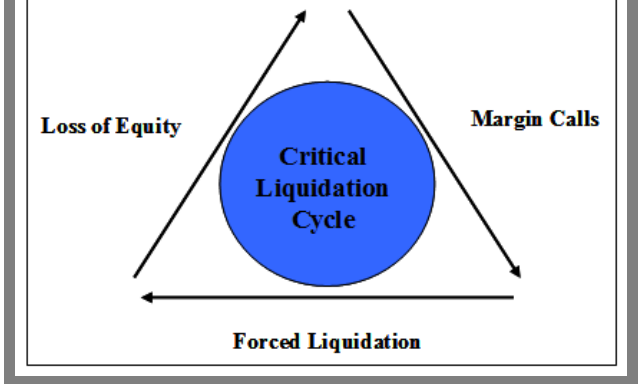
Sources: Cembalest (2015) and Ngai (2014).

V. Caveats on the Use of Price Data

A. Purely Technical Effects (continued)

Liquidation Pressure

Futures traders are also aware that the effects of traders having to liquidate large positions can be a temporary, but meaningful, driver of price.



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

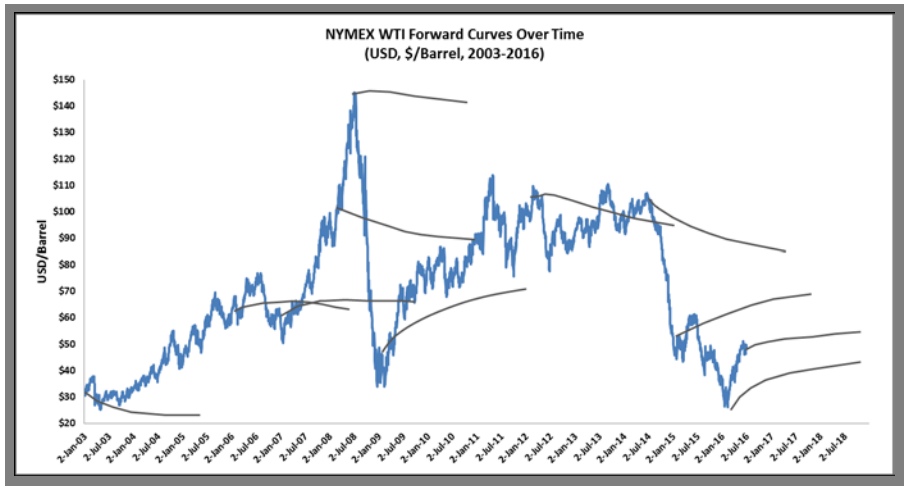
This scenario illustrates another interaction effect between trades and price.

V. Caveats on the Use of Price Data

B. Not Predictions

CSIS: The "forward curve is not a good price predictor, but still functions well for hedging storage costs and requirements."

Tchilingurian (2003): "Supply and demand determine spot prices, and inventory levels affect the difference between the price of oil today against the price tomorrow."



Source of Chart: Center for Strategic & International Studies (CSIS) and Citi Research

Conclusion

Instead of asking: do the fundamentals justify the oil price? …

… this presentation adopted the view of a veteran oil futures trader and asked the opposite question: what is the price telling me about fundamentals?

The reason for this outlook is as follows: the market imposes sufficient discipline to prevent a trader from ignoring price but for a very short space of time!

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