Oil Futures Prices and OPEC Spare Capacity

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Oil Futures Prices and OPEC Spare Capacity

I. Crude Oil's Importance for Commodity Indexes

II. Structural Curve Shape of Individual Futures Contracts

III. Structural Curve Shape and the Implications for Crude Oil Futures Contracts

IV. Commodity Futures Curve Shape and Inventories

Icon above is based on the statue in the Chicago Board of Trade plaza.

Oil Futures Prices and OPEC Spare Capacity

V. Special Features of Crude Oil Markets

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

VII. The Plausible Link Between OPEC Spare Capacity and a Crude Oil Futures Curve Shape

VIII. Current (Official) Expectations on OPEC Spare Capacity

IX. Trading and Investment Conclusion

Oil Futures Prices and OPEC Spare Capacity

Appendix A: Portfolio-Level Returns from Rebalancing

Appendix B: Month-to-Month Factors Influencing a Crude Oil Futures Curve

Appendix C: Consideration of the "1986 Oil Tactic"

I. Crude Oil's Importance for Commodity Indexes

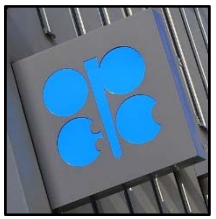
The main commodity indices are heavily weighted in the petroleum complex, and so the fortunes of crude oil weigh heavily on commodity index results.

Froot (1995): In order for a commodity index to not only hedge bond investments against inflation, but also do so effectively for equity investments, then the index needs to have a concentration in the petroleum complex.

Source: Till (2014a).

I. Crude Oil's Importance for Commodity Indexes

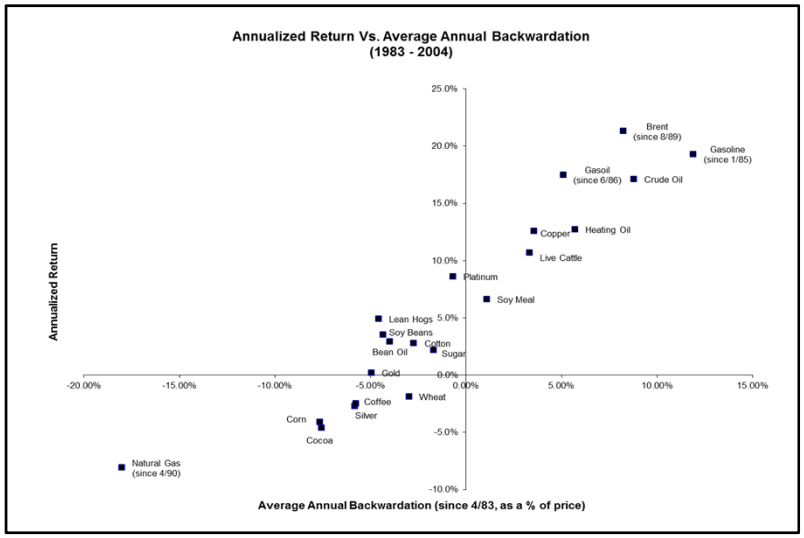
Is holding long futures positions in crude oil a wise decision?



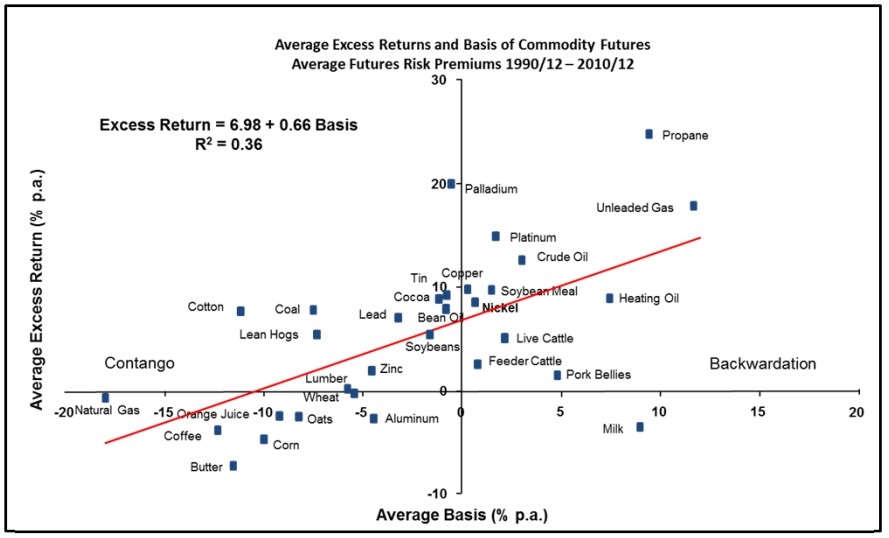
One should examine OPEC spare capacity levels before deciding upon structural crude oil futures positions, as will be argued in this presentation.

II. Structural Curve Shape of Individual Futures Contracts

What property seems to have a strong influence on whether an individual futures contract has a positive return *over the long-run*?
Answer: Structural curve shape.



Graph based on Nash and Shrayer (2005), Slide 2.



Graph based on Gorton et al. (2012), Figure 3.

Erb and Harvey (2006) provide analogous results.

II. Structural Curve Shape of Individual Futures Contracts

There is comfort in the peer-reviewed literature with treating a commodity futures contract's curve shape as *predictive* of future returns.

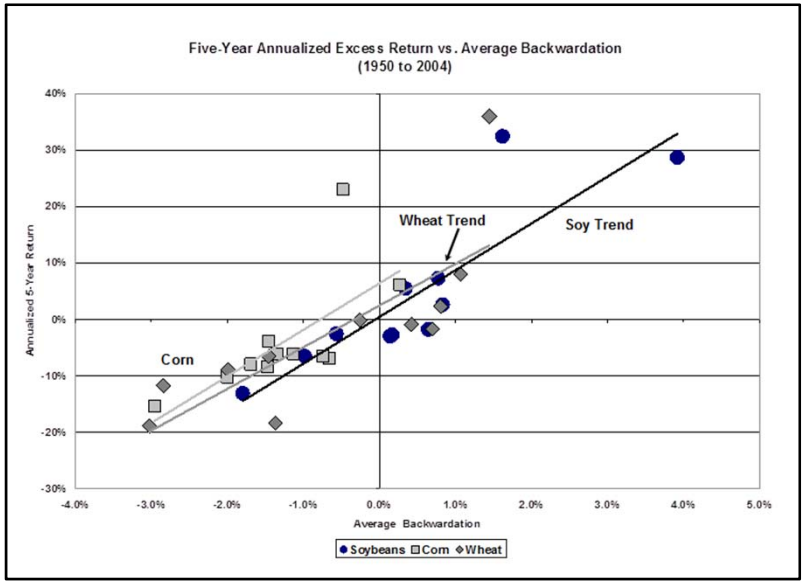
One recent example is Gorton *et al.* (2013).

II. Structural Curve Shape of Individual Futures Contracts

Slide 8 had shown results over about 20-year timeframes *across individual futures contracts.*

We can also examine the impact of a futures contract's structural curve shape *across time*, for those contracts that have long histories.

Over a 50-year-plus timeframe, the returns of three agricultural futures contracts were linearly related to their curve shapes *across time*; this result only became apparent at five-year intervals.



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

II. Structural Curve Shape of Individual Futures Contracts

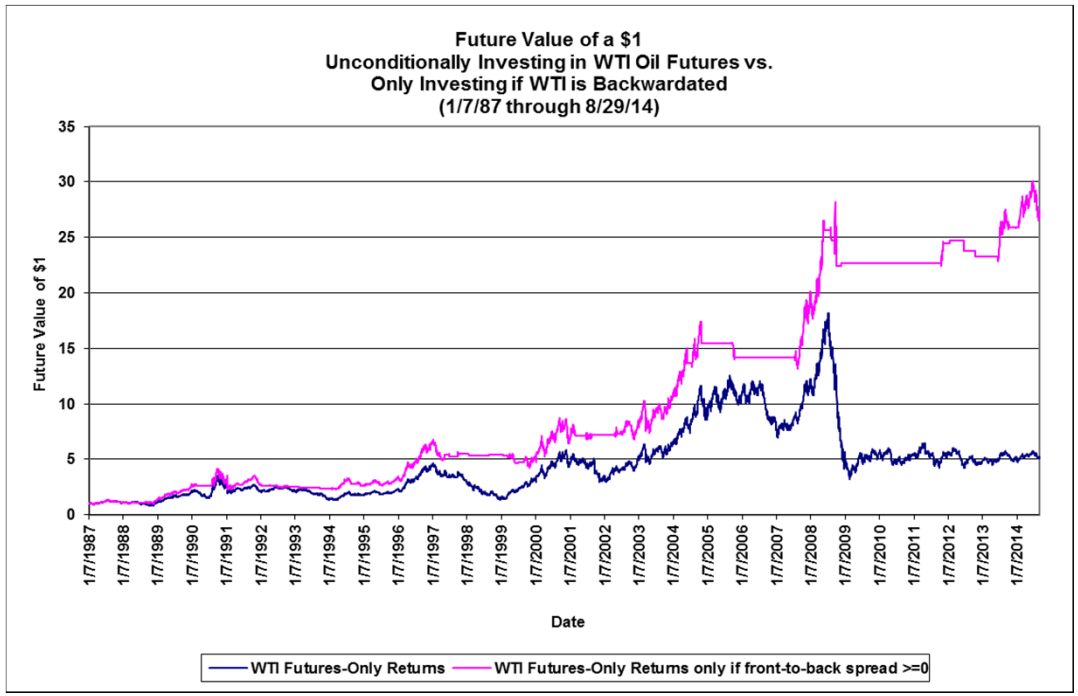
There is an additional structural source of return when holding *baskets* of commodity futures contracts.

This is covered in Appendix A: "Portfolio-Level Returns from Rebalancing."

III. Structural Curve Shape and the Implications for Crude Oil Futures Contracts

Has the shape of a crude oil futures curve demonstrably mattered for a contract's long-term returns?

The short answer is yes.

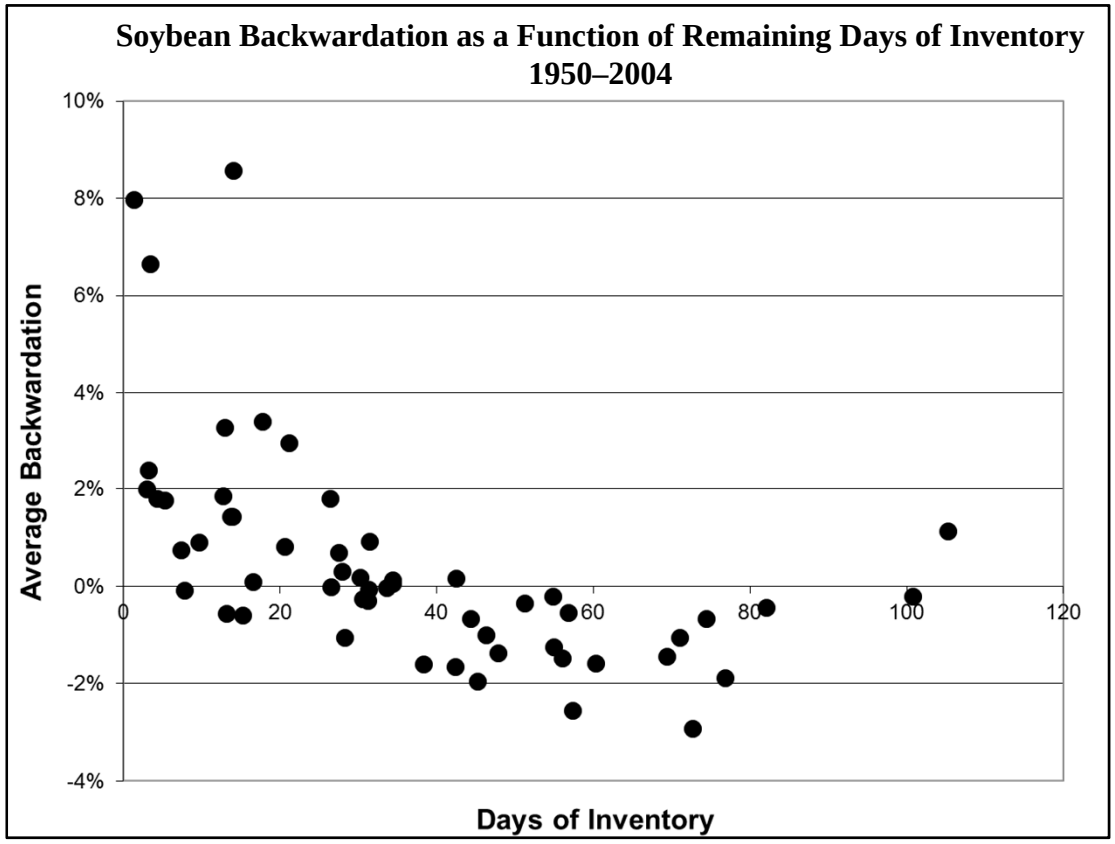


Source of Data: The Bloomberg.

The Bloomberg ticker for WTI Futures-Only Returns is "SPGSCLP <index>."

IV. Commodity Futures Curve Shape and Inventories

Feldman and Till (2006) demonstrate the familiar relationship between a commodity's futures curve shape and its inventories in a scatter plot, using long-term data in the soybean markets.



Source: Feldman and Till (2006), Exhibit 9.

V. Special Features of Crude Oil Markets

According to Harrington (2005), the true inventories for crude oil should be represented as not just above-ground stocks *but also* spare production capacity.

"[S]pare capacity … [is] 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," according to the U.S. Energy Information Administration [EIA] (2014).

V. Special Features of Crude Oil Markets

In the past, crude oil markets have seemingly been able to tolerate relatively low oil inventories when there was sufficient swing capacity that could be brought on stream relatively quickly in case of any supply disruption or demand shock.

As confirmed by Abu Al-Soof (2007), it has been OPEC's policy to attempt to provide sufficient spare capacity to enhance stability in the oil markets.

The IMF (2005) even referred to the "maintenance of adequate spare capacity as a public good" because of the role that spare capacity plays in reducing the volatility of oil prices.

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

One might expect that if the oil market's excess supply cushion drops to sufficiently low levels that there would be three resulting market outcomes:

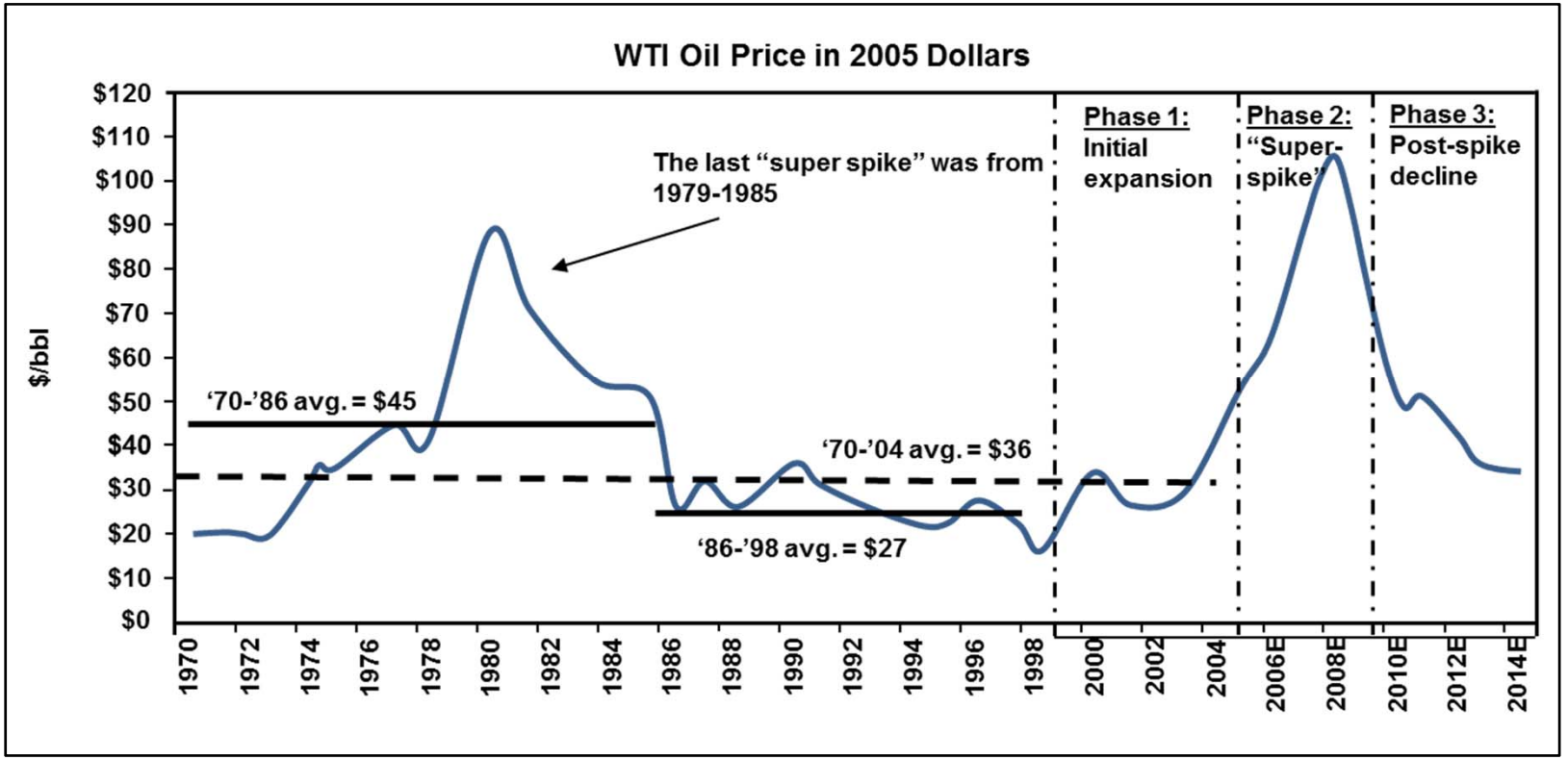
1. **There would be high spot prices to encourage consumer conservation, drawing from Murti *et al.* (2005);**

2. **The markets would undertake precautionary stock building, which would then lead to persistent contangos in the crude oil futures markets, following from Harrington (2005)'s arguments; and**

3. **Any price super-spike would be temporary, once the price level was discovered that would result in demand destruction, as was essentially argued in Murti *et al.* (2005). Please see next slide.**

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

Super-Spike Prediction in 2005



Graph based on Murti et al. (2005), Exhibit 2.

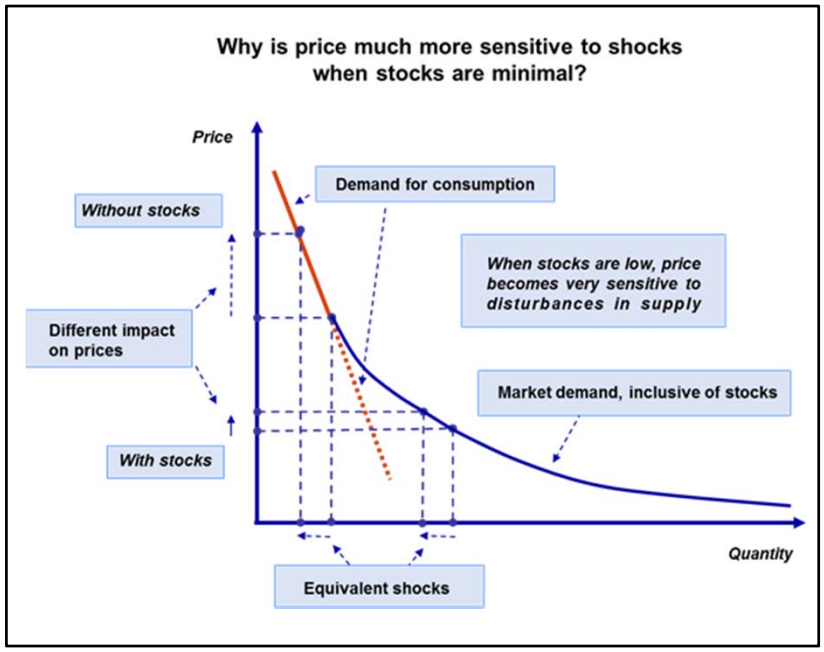
VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

1. High Spot Prices

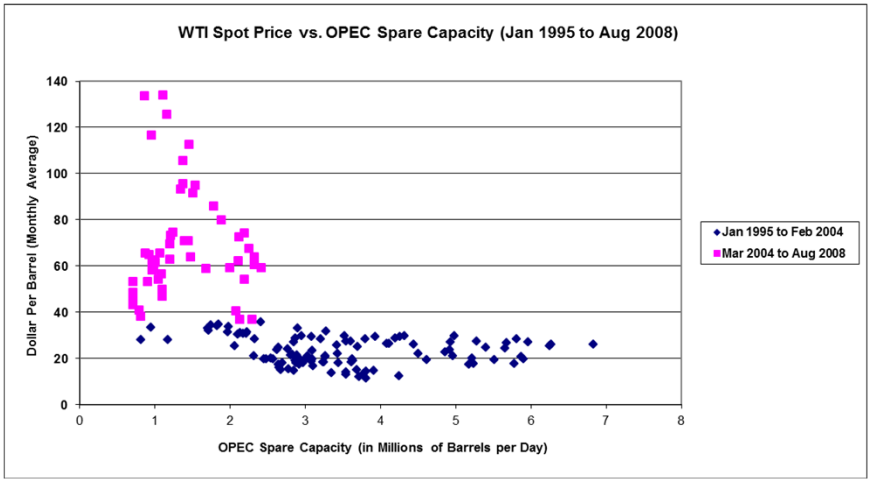
Crude oil prices did explode when OPEC spare capacity collapsed (see right-hand graph of next slide), as might be expected, *by analogy*, from Wright's work on the economics of grain price volatility (see left-hand graph of next slide).

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

1. High Spot Prices



Source: Wright (2011), Slide 39, on "the economics of grain price volatility."



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 OPEC Spare Capacity data is from the U.S. Energy Information Administration's website.

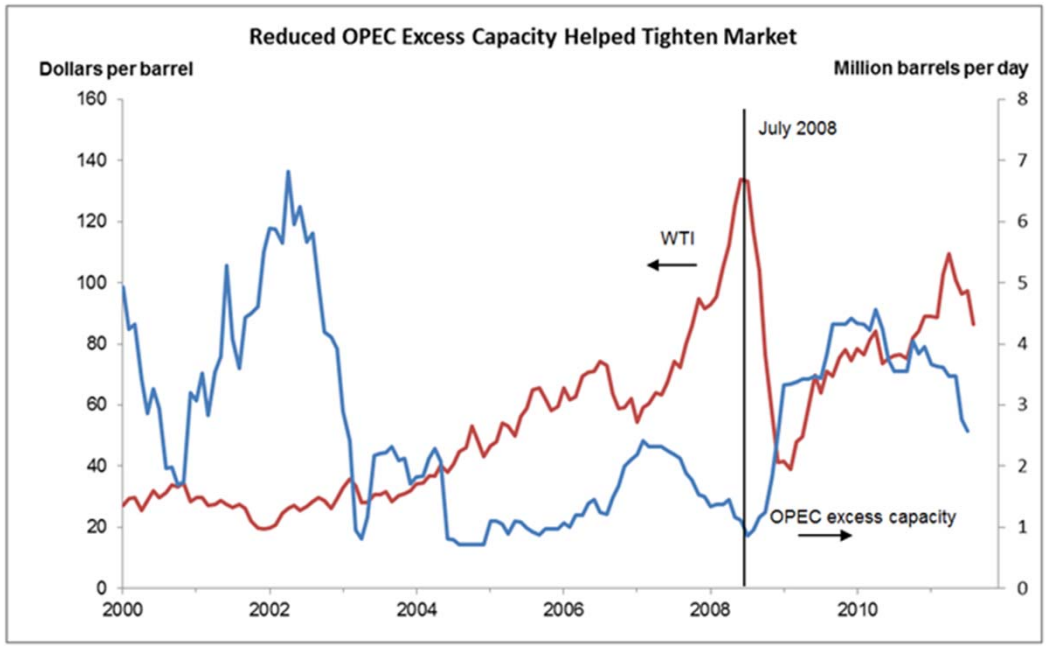
Presenting data in this fashion is based on Büyükşahin et al. (2008), Figure 10.

See Till (2014c) for two necessary caveats regarding this graph.

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

1. High Spot Prices

This was also noted by Federal Reserve Bank of Dallas researchers.



Graph based on Plante and Yücel (2011), Chart 2.

[The red line is WTI prices while the blue line is OPEC excess capacity.]

Authors' Notes: Oil prices are monthly averages.
Sources of Data: U.S. Energy Information Administration and the Wall Street Journal.

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

1. High Spot Prices

There were a number of plausible fundamental explanations that arose from any number of *incidental* factors that came into play when supply-and-demand was balanced so tightly, as was the case with light sweet crude oil in 2008, as discussed in Till (2008).

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

1. High Spot Prices

In 2008, these *incidental* factors included:

- **a temporary spike in diesel imports by China in advance of the Beijing Olympics;**
- **purchases of light sweet crude by the U.S. Department of Energy for the Strategic Petroleum Reserve;**
- **instability in Nigeria; and**
- **tightening environmental requirements in Europe.**

One should add that this is not an exhaustive list.

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

2a. Precautionary Stock-Building: Data Problems

At sufficiently low levels of OPEC spare capacity, it would be logical for oil consumers to undertake precautionary stock building, which would then lead to persistent contangos in the crude oil futures markets.

But how does one prove this?

"Reliable inventory data outside the OECD is often absent. … This is worrying because it is the non-OECD that currently provides almost all demand growth globally. The data is worst where it is needed most," explained McCracken (2014).

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

2b. Precautionary Stock-Building: Persistent Contangos

Given the transparent commodity futures markets, we can examine whether there were persistent contangos in the crude oil futures curves during 2004 through mid-2008.

From 3/1/04 to 7/31/08, the WTI front-to-back spread averaged -44c while the Brent front-to-back spread averaged -30c.

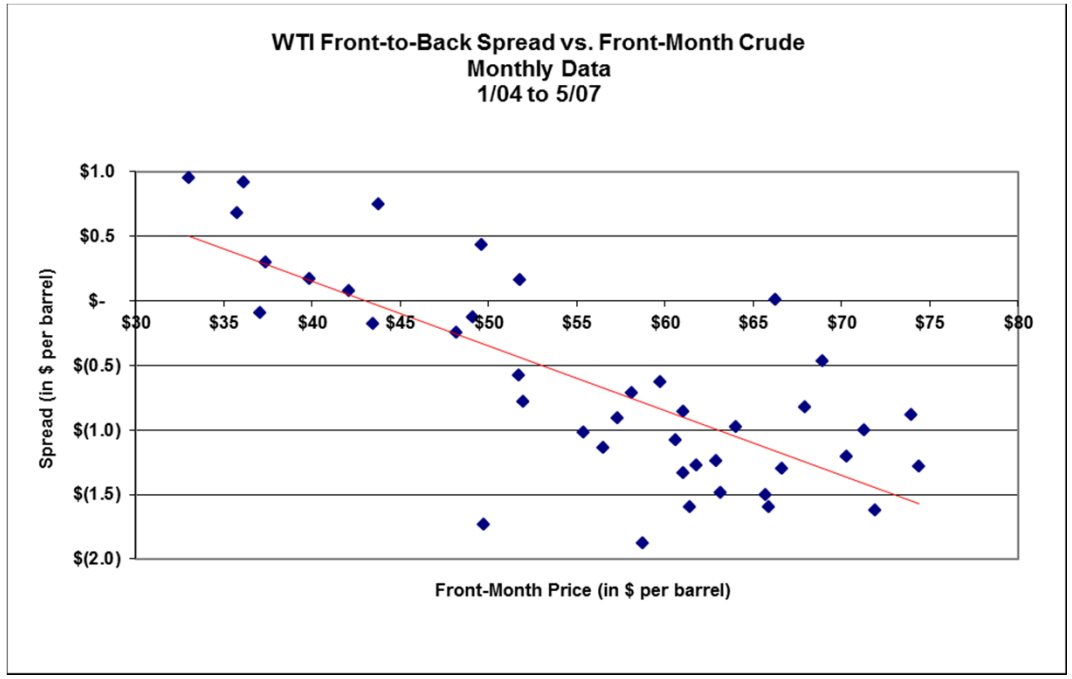
During this time period, the WTI front-to-back spread traded in contango 68% of the time while the Brent front-to-back spread traded in contango 65% of the time.

Each crude oil futures market provided persistent, but not continuous, opportunities for earning a return-from-storage.

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

3. Structural Deficiency

In hindsight, we can point out the structural deficiency in the crude oil price rally.



Source: Till (2008), Figure C-2.

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

3. Structural Deficiency

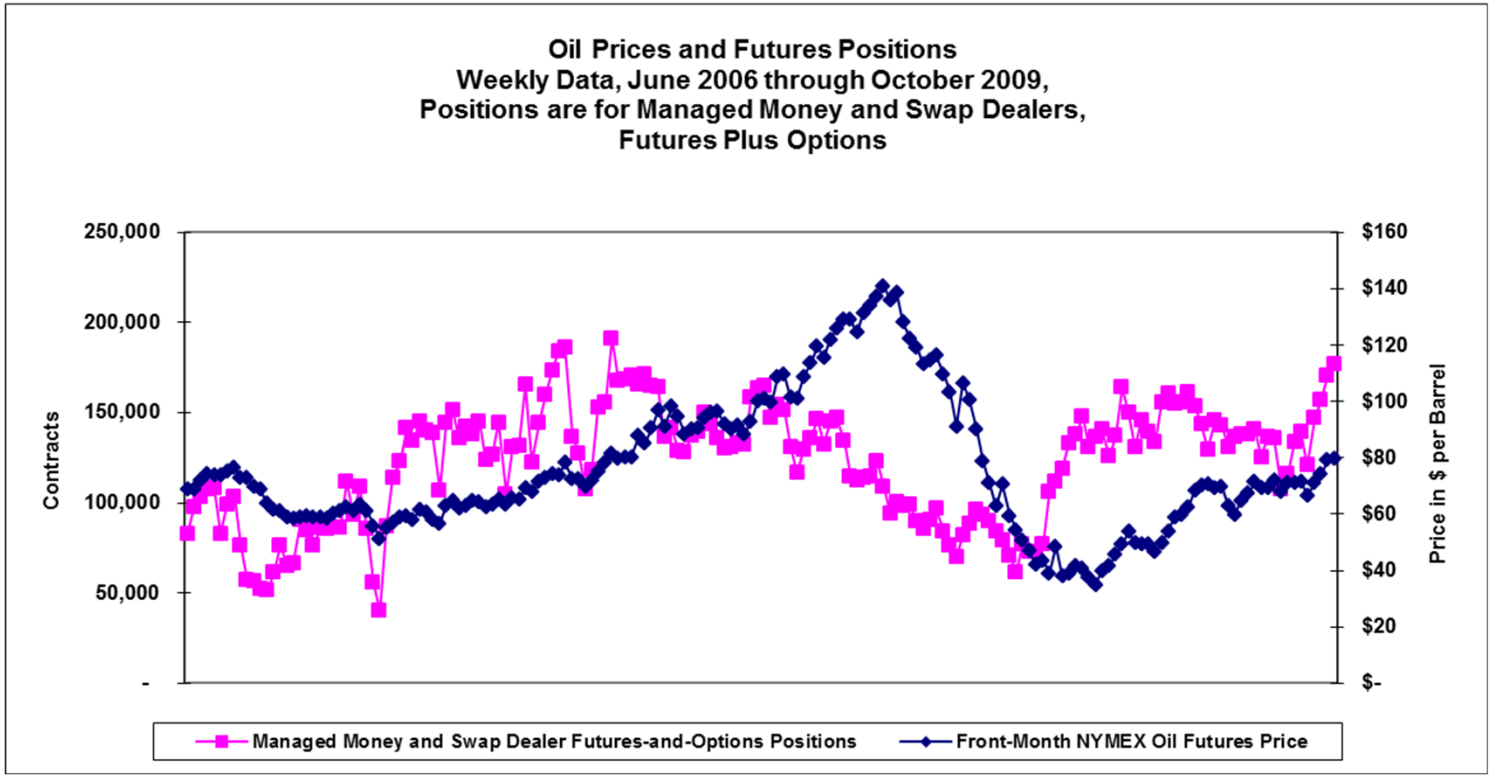
It is plausible that there were perceptive crude oil traders who were aware of the structural deficiencies in the oil price rally that culminated in the July 2008 price spike.

As evidence, the next slide shows that according to Commodity Futures Trading Commission (CFTC) data, market participants, who were classified as "managed money" and "swap dealers," *did* reduce their positions in the oil market in the months preceding the July 2008 price peak.

For these two classes of traders, one advantage of having reduced their positions, as the market was dramatically rallying, is that one could not logically refer to their trading strategies as "predatory."

VI. What Happens When OPEC Spare Capacity Becomes Quite Low?

3. Structural Deficiency



Graph based on Ribeiro et al. (2009), Chart 1.

VII. The Plausible Link Between OPEC Spare Capacity and a Crude Oil Futures Curve Shape

With sufficient OPEC oil spare capacity, there would not be as much of a need for prohibitively expensive precautionary inventories.

And with sufficiently low inventories, we would expect that an oil market's futures curve would tend to trade in backwardation.

Is there direct *empirical* support for linking the amount of OPEC spare capacity to the structural shape of a crude oil futures curve?

Again, the short answer is yes.

VII. The Plausible Link Between OPEC Spare Capacity and a Crude Oil Futures Curve Shape

For a longer term study of this issue, one needs to focus on the Brent crude oil futures markets.

At this point, it is only the Brent contract that has been consistently connected to the global oil market.

As discussed by Blas (2011), "From time to time, the [WTI] contract [had] disconnect[ed] from the global oil market due to logistical troubles at its landlocked point of delivery in Cushing, Oklahoma."

VII. The Plausible Link Between OPEC Spare Capacity and a Crude Oil Futures Curve Shape

This had meant that as compared to the Brent futures contract, the WTI futures contract had a greater propensity to trade in contango, as surplus inventories built up in the U.S.

That said, due to the "ingenuity of logistical engineers," the WTI oil futures market has now effectively reconnected to the global oil marketplace, quoting Platts (2013), and as further explained in Fenton *et al.* (2013).

Because the WTI market is now reconnected to the global oil marketplace, we expect that our Brent results would now apply to WTI as well.

VII. The Plausible Link Between OPEC Spare Capacity and a Crude Oil Futures Curve Shape

Using EIA monthly data since 1995, we find that once OPEC spare capacity became lower than 1.8 million barrels per day for longer than a quarter, then the Brent front-to-back spread has traded in contango, on average, for the next two years.

Till (2014a) includes an additional analysis that is consistent with these historical results.

That said, one must be very careful with back-tested results in making future predictions, but at least these historical results add evidence to our line of argument.

Further caveats are in Appendix B: "Month-to-Month Factors Influencing a Crude Oil Futures Curve."

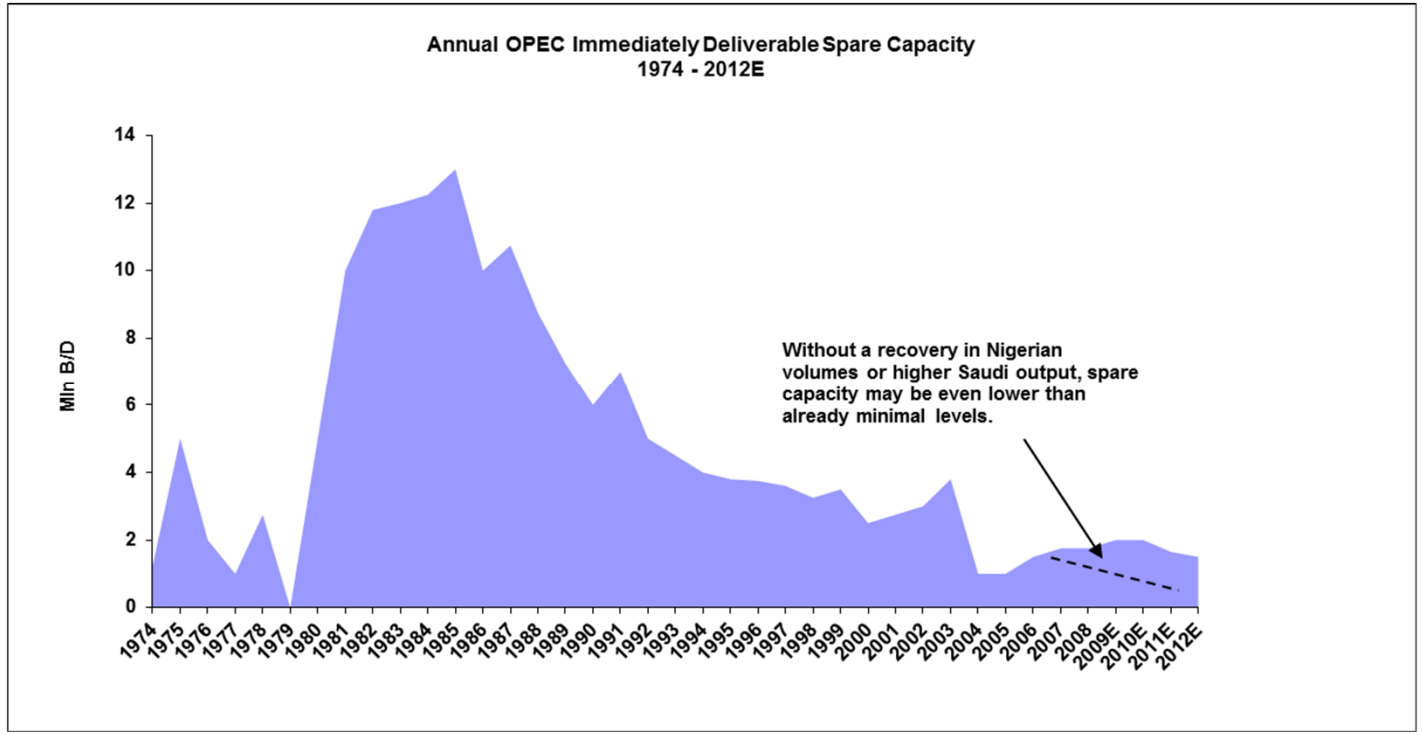
VIII. Current (Official) Expectations on OPEC Spare Capacity

What are the current expectations for OPEC spare capacity going forward?

There is definitely *not* universal agreement on this topic, but BP's January 2014 *Energy Outlook 2035* included a (base-case) forecast that by 2018, OPEC spare capacity would increase to levels last seen in the late 1980s.

VIII. Current (Official) Expectations on OPEC Spare Capacity

Historical Spare Capacity Figures Since 1974

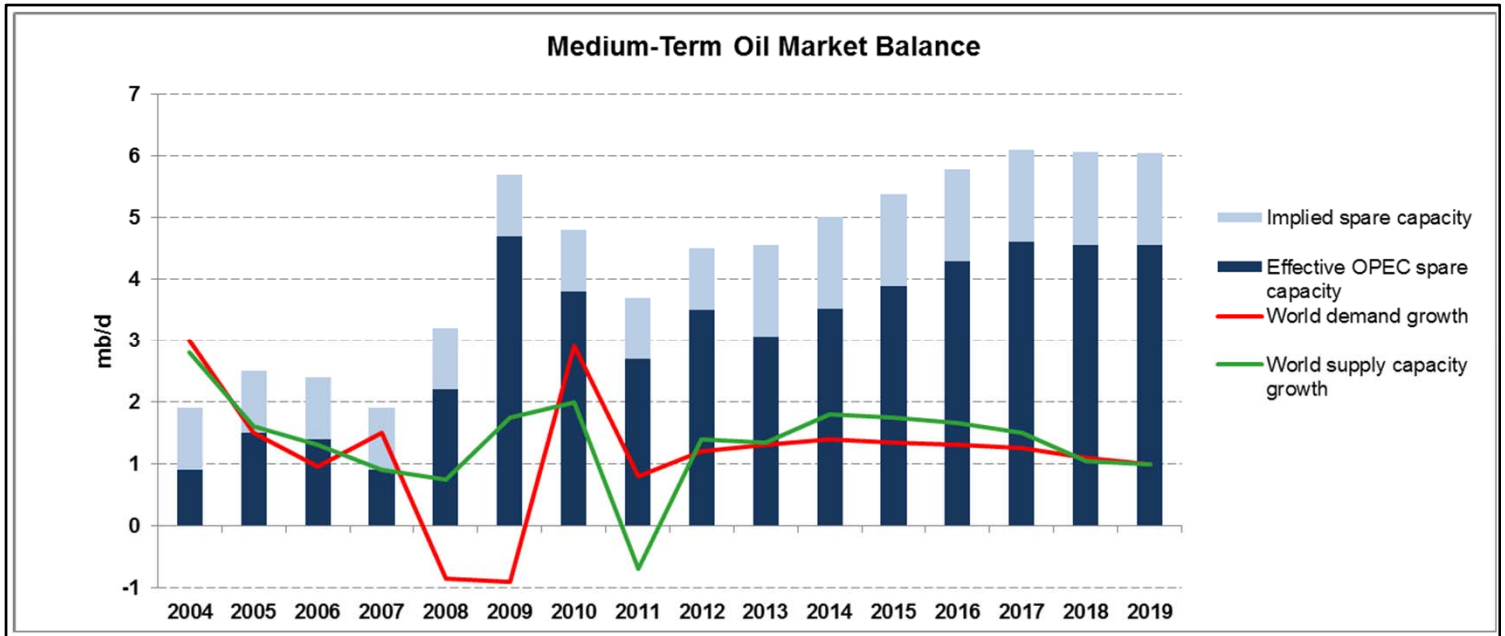


Graph based on Murti et al. (2008), Left-Hand-Side of Exhibit 3.

Authors' Note with Sources of Data: International Energy Agency (IEA) and Goldman Sachs Research Estimates.

VIII. Current (Official) Expectations on OPEC Spare Capacity

Spare Capacity Projections as of 2014



Graph based on IEA (2014), Figure ES.1.

The IEA's *Medium-Term Oil Market Report 2014*, though, heavily caveated their projections, including that nearly all "effective" spare capacity is in Saudi Arabia.

IX. Trading and Investment Conclusion

If the IEA's projections for "effective" spare capacity do turn out to be correct, then OPEC spare capacity would not be at pinch-point levels for the foreseeable future.

Further assuming that Saudi Arabia remains the "reliable 'central banker' of the oil market," quoting *Reuters* (2014), then it is plausible that crude oil futures curves will *on average* trade in backwardation.

IX. Trading and Investment Conclusion

What does this mean for commodity indices and oil-futures trading strategies?

Crude oil futures curves could become persistently backwardated again, which, in turn, would mean that commodity indices and trading strategies that capitalize on this structure may become popular again.

One caveat to this conclusion is that a structural holding in crude oil futures contracts makes most sense in a diversified investment portfolio. This is one obvious conclusion from considering the 1986 scenario, as covered in Appendix C.

Appendix A:
Portfolio-Level Returns from Rebalancing

There is an additional return opportunity at the portfolio level, which can potentially be earned even if the geometric average returns of individual futures contracts are zero, as demonstrated by Sanders and Irwin (2012).

Time	Price Asset 1	Price Asset 2	Return Asset 1	Return Asset 2	Equal Weighted Return
1	10	10			
2	20	30	100%	200%	150%
3	30	40	50%	33%	42%
4	40	50	33%	25%	29%
5	50	60	25%	20%	23%
6	50	40	0%	-33%	-17%
7	40	10	-20%	-75%	-48%
8	30	20	-25%	100%	38%
9	20	20	-33%	0%	-17%
10	10	10	-50%	-50%	-50%
	Arithmetic Average		9%	24%	17%
	Geometric Average		0%	0%	4%

Table based on Sanders and Irwin (2011), Table 3.

Appendix A:
Portfolio-Level Returns from Rebalancing

The rebalancing effect was explained by Greer (2000), and more recently in Greer *et al.* (2014):

"[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."

Appendix B:
Month-to-Month Factors Influencing a Crude Oil Futures Curve

While historically it is the case that sufficient OPEC spare capacity can be linked to backwardated curve shapes *on average*, this obviously does not mean that both Brent and WTI curves will *always* be in backwardation under this condition.

Geopolitical surprises and seasonal factors can both directly impact month-to-month inventory balances, and therefore, an oil futures contract's curve shape.

Appendix B:
Month-to-Month Factors Influencing a Crude Oil Futures Curve

Geopolitical Surprises: Recent Example

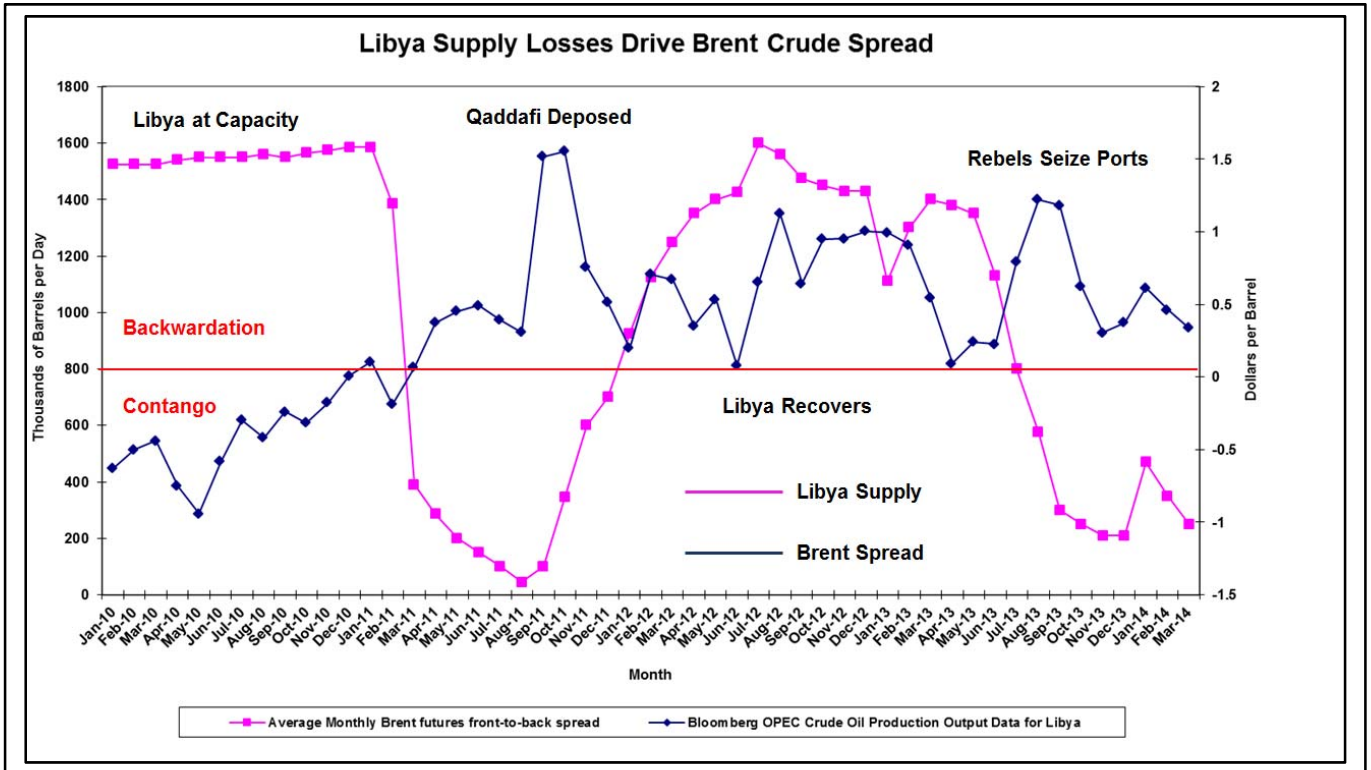
The varying prospects for Libyan exports have influenced Brent timespreads in the recent past.

Even now, "Libyan production … [is] a wild card."

Sources: Currie et al. (2014) and Martin and Kabra (2014).

Appendix B:
Month-to-Month Factors Influencing a Crude Oil Futures Curve

Geopolitical Surprises: Recent Example

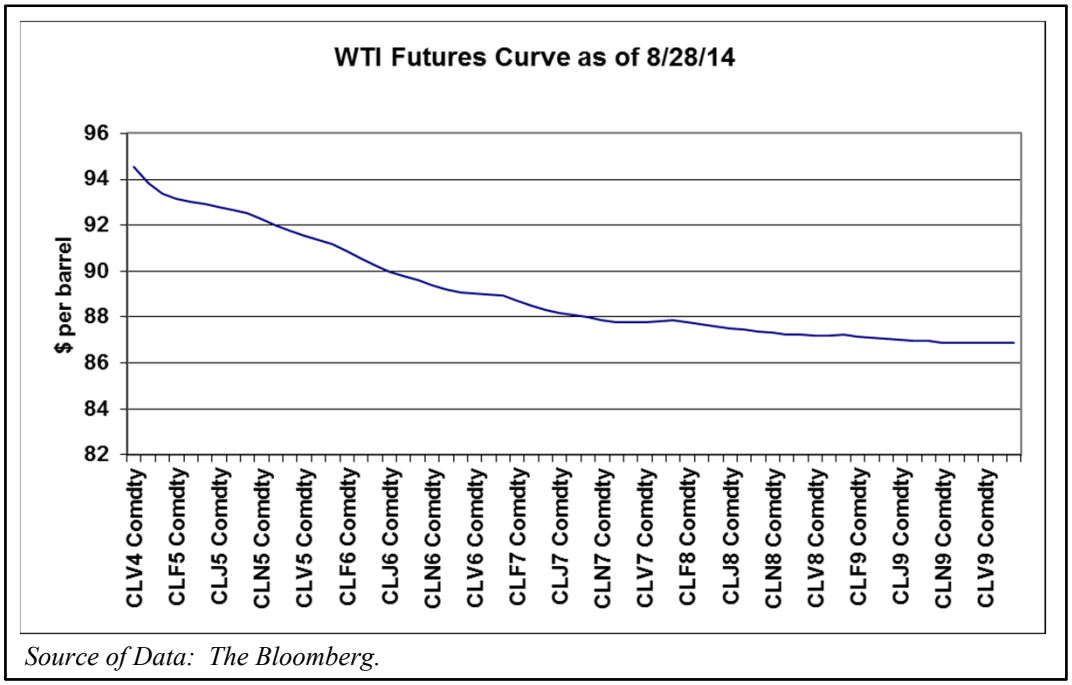


Graph based on Smith (2014), Chart of the Day.

Appendix B:
Month-to-Month Factors Influencing a Crude Oil Futures Curve

Seasonal Factors: Recent Example

"WTI timespreads have increased sharply in recent weeks to reach their most backwardated level since 2008 as Cushing inventories continue to draw as pipeline flows continue to drain Cushing towards the Gulf Coast."



Source of Data: The Bloomberg.

Source: Currie et al. (2014).

Appendix B:
Month-to-Month Factors Influencing a Crude Oil Futures Curve

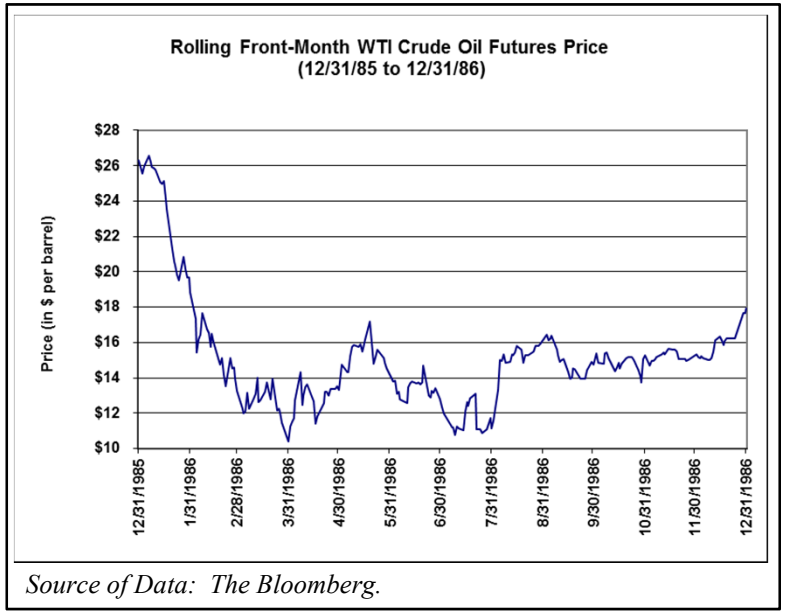
Seasonal Factors: Recent Example

"This strength in spreads will likely ease [though] into the fall as the seasonal refinery maintenance season should help reverse the outflow of Cushing inventories."

Source: Currie et al. (2014).

Appendix C:
Consideration of the "1986 Oil Tactic"

Gately (1986): "The 1986 [oil] price collapse was the result of a decision by Saudi Arabia and some of its neighbors to increase their share of the oil market. Unlike other producers, they did not suffer great revenue losses, because the price declines were offset by their output increases."



Source of Data: The Bloomberg.

Analysts at J.P. Morgan (2014) and Blanch *et al.* (2014) have both discussed the possibility of increased oil supplies from the U.S. (via the Strategic Petroleum Reserve) and from Saudi Arabia (via output increases), respectively, as a potential tactic during current geopolitical confrontations.

Appendix C:
Consideration of the "1986 Oil Tactic"

How did holdings in oil futures contracts perform in 1986?

	1986 Scenario	
WTI Crude Oil Futures-Only Returns:	**-25.5%**	[Calculated using GSCI roll rules]
WTI Crude Oil Futures-Only Returns Conditional on Backwardation:	**-8.8%**	[Enter into WTI crude oil futures if in backwardation the previous trading day]
[By "Futures-Only Returns," one means excluding the returns from collateral holdings.]		[Calculated using GSCI roll rules]

Source of Calculations: Joseph Eagleeye of Premia Capital Management, LLC.

Source of Data: Commodity Research Bureau.

Appendix C:
Consideration of the "1986 Oil Tactic"

Note also the returns of the U.S. equity market in 1986, at the time a demonstrably effective diversifier for oil-futures-contract holdings:

	1986 Scenario	
S&P 500 Futures Excess Returns:	**13.2%**	[Calculated based on rolling the futures contract on its last trading date]

Source of Calculations: Joseph Eagleeye of Premia Capital Management, LLC.

Source of Data: Commodity Research Bureau.

These results are consistent with the findings of Driesprong *et al.* (2008), who generally found across developed markets, "on average, a decrease in this month's oil price indicates a higher stock market return next month. The impact of changes in oil prices on stock returns tends to be economically large."

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