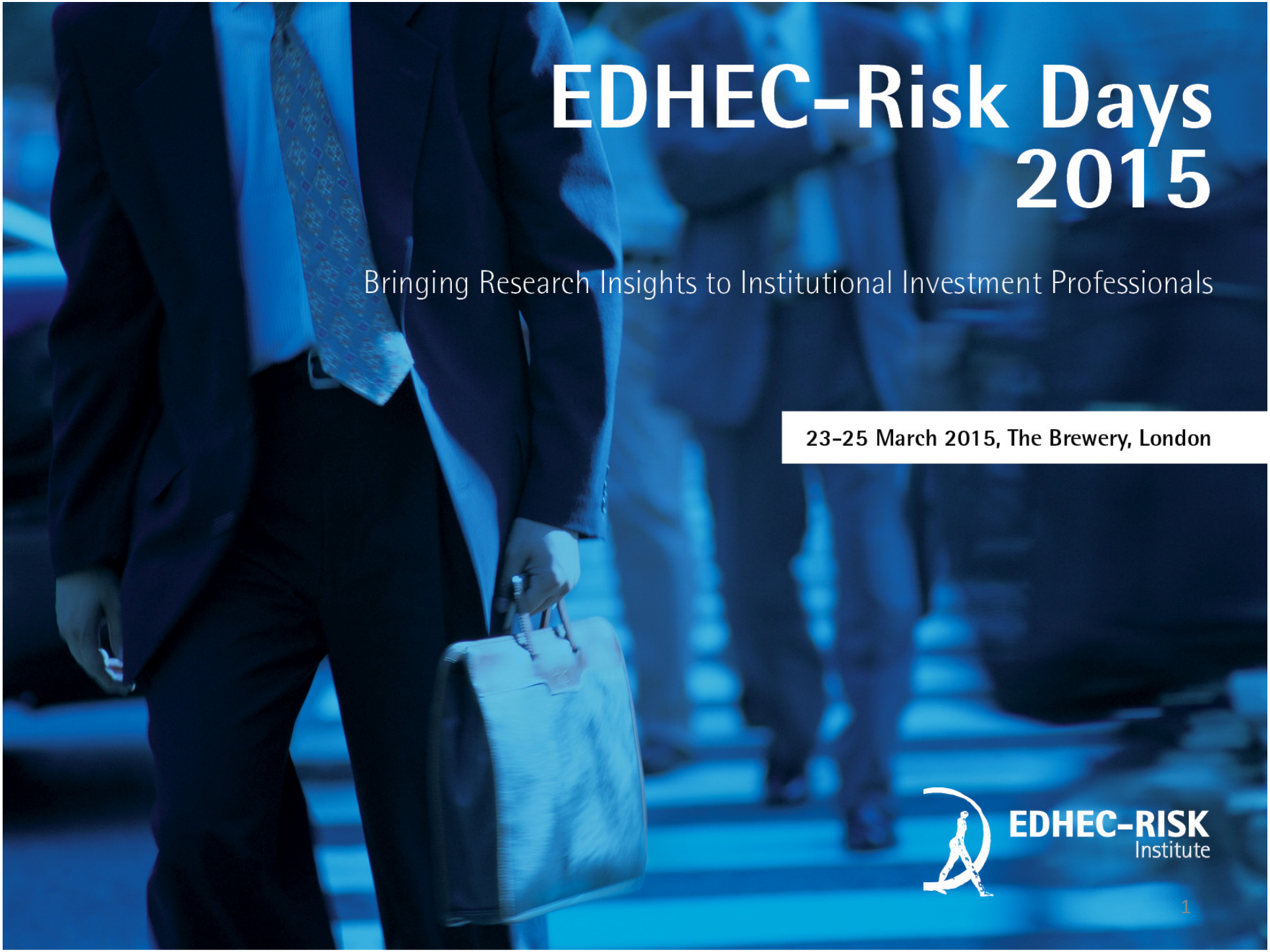

EDHEC-Risk Days 2015

Bringing Research Insights to Institutional Investment Professionals

23-25 March 2015, The Brewery, London

EDHEC-RISK Institute

Do Commodity Index Holdings Still Make Sense for Institutional Investors?
Revisiting the Assumptions

Ms. Hilary Till

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Do Commodity Index Holdings Still Make Sense for Institutional Investors?

I. The Structural Features that Drive Long-Run Returns Amongst Commodity Futures Contracts

II. A Focus on Crude Oil

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IV. Financial Asset Diversification for Downside Hedging

V. Conclusion

Appendix:

Spot Commodities Must Find a Home Here and Now

I. Long-Run Returns

A. At the Portfolio Level:
Mean Reversion and Rebalancing

B. At the Individual-Contract Level:
Structural Curve Shape

I. A. Portfolio Level

Geman (2005): Spot "commodity prices neither grow nor decline on average; they tend to mean-revert to a level which may be viewed as the marginal cost of production. …

Hence, mean-reversion is one of the main properties that has been systematically incorporated in the literature on commodity price modeling."

Could a basket of commodity futures contracts, which each have geometric average returns of zero percent, still have meaningful positive returns? Yes, if the portfolio is rebalanced.

A simplified example of this mathematical property is demonstrated on the next slide for clarity.

I. A. Portfolio Level

The rebalancing effect had also been 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."

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.

I. Long-Run Returns

A. At the Portfolio Level:
Mean Reversion and Rebalancing

B. At the Individual-Contract Level:
Structural Curve Shape

I. B. Individual-Contract Level

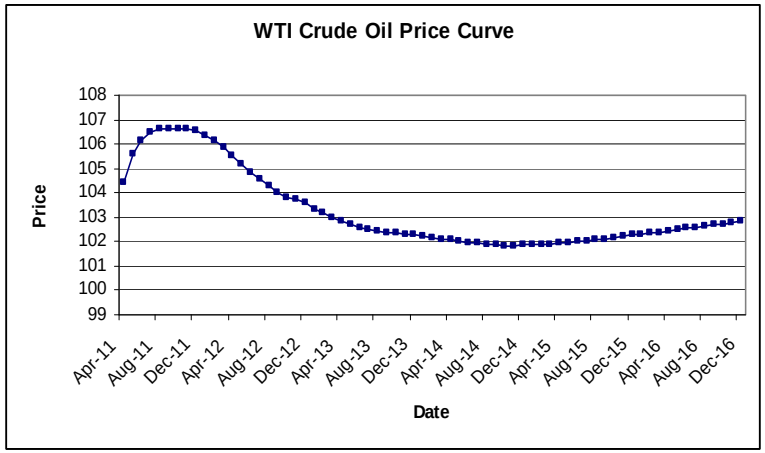
What property seems to have a strong influence on whether an individual futures contract has a positive return over the long-run?

Answer: The structural curve shape.

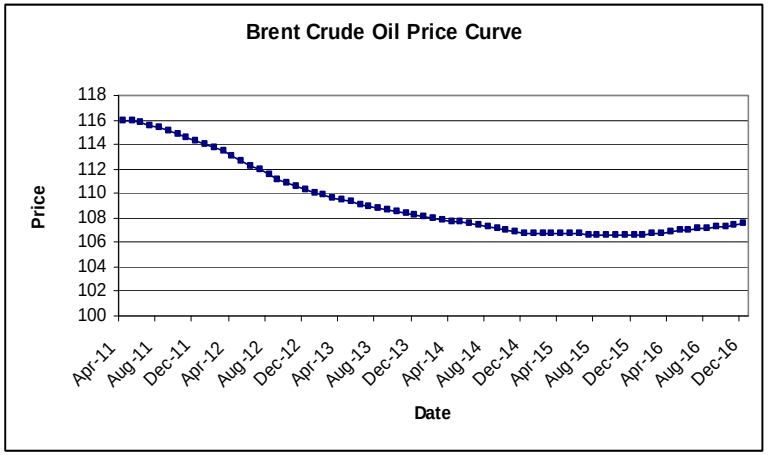
Please see next three slides.

I. B. 1. Definition of Futures Curve Shape

West Texas Intermediate (WTI):
Near-Month Contracts are in "Contango"



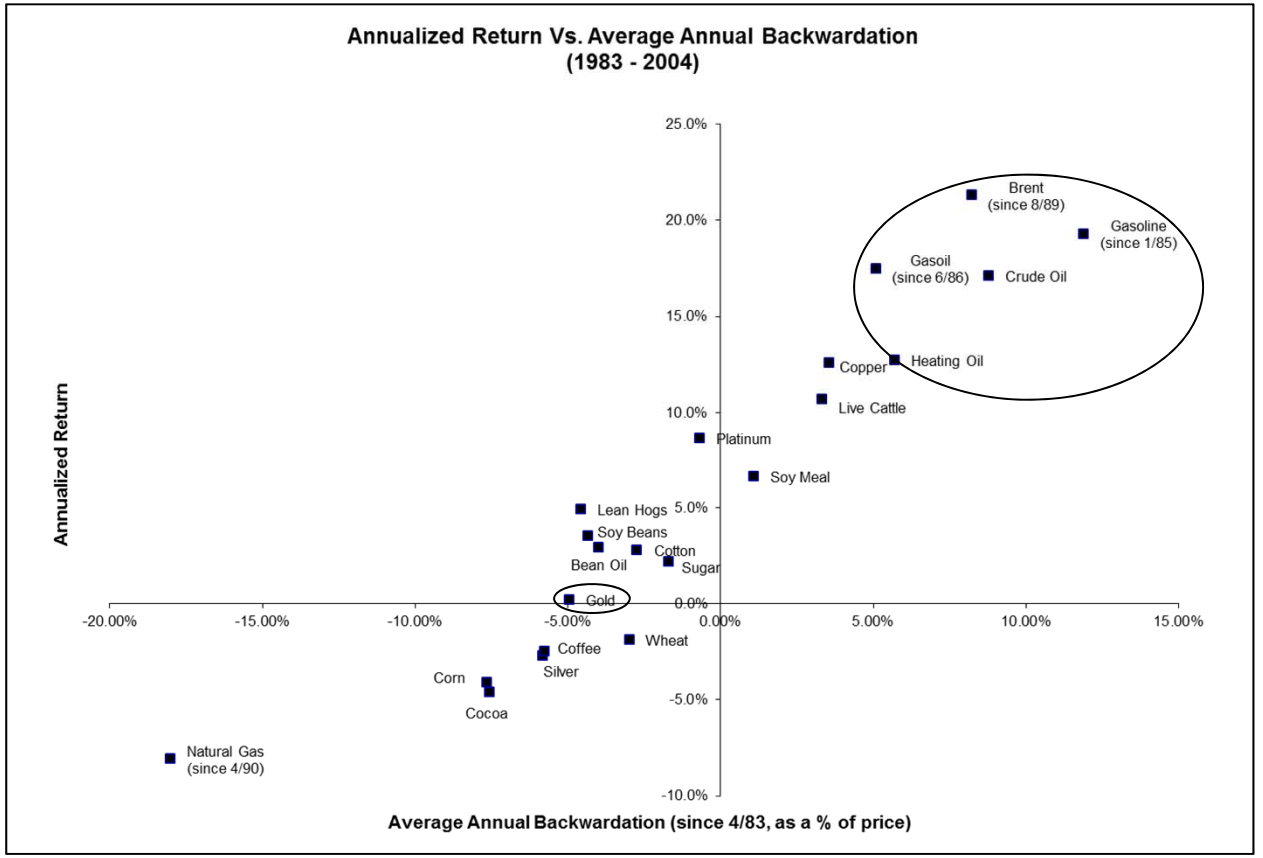
Brent:
Near-Month Contracts are in "Backwardation"



Data Source: The Bloomberg.

Futures Curves as of March 4, 2011.

I. B. 2a. Across Commodities: 1983 to 2004



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

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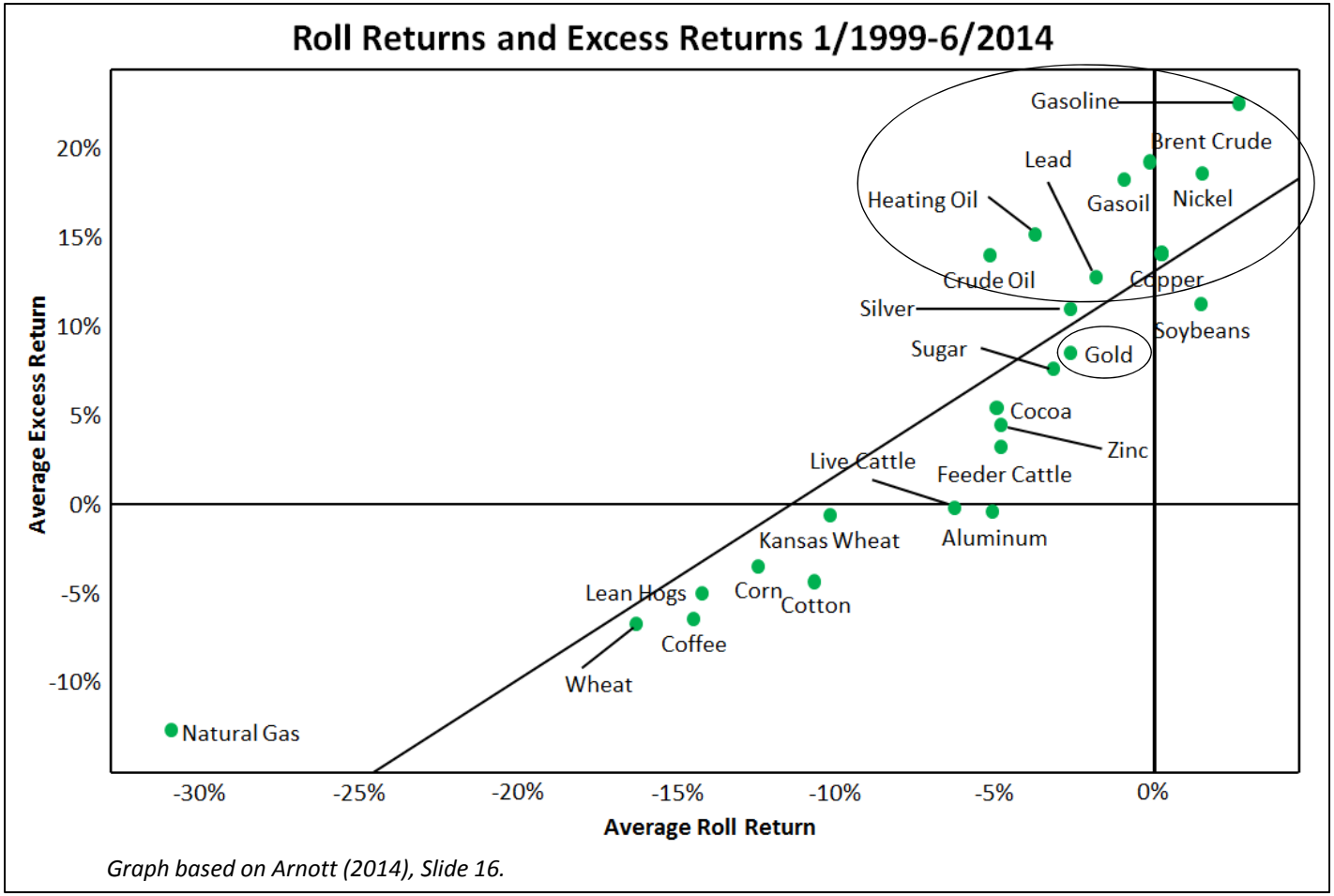
I. B. 2b. Across Commodities: 1999 to 2014



Graph based on Arnott (2014), Slide 16.

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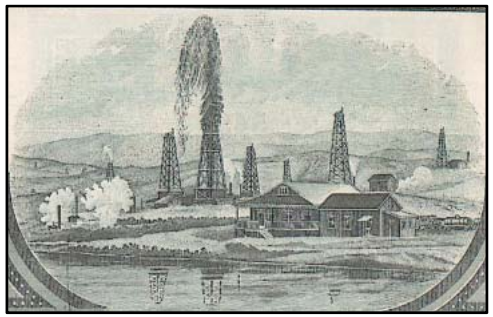
Appendix:

Spot Commodities Must Find a Home Here and Now

II. A Focus on Crude Oil

A. Importance to Commodity Indices

B. How the Futures Curve Shape Matters



II. A. Commodity Indices

In an analysis of commodity index return prospects, why focus on crude oil futures contracts?

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


CME Group

An Update on Empirical Relationships in the Commodity Futures Markets

FEBRUARY 28, 2014

HILARY TILL
Principal, Premia Risk Consultancy, Inc.
till@premiarisk.com

Source: Till (2014a).

II. A. Commodity Indices

For example, when one regresses S&P GSCI Total Returns against WTI Crude Oil's Excess Returns, using weekly data, from 12/30/94 to 8/29/14, the resulting R-squared is 84%.

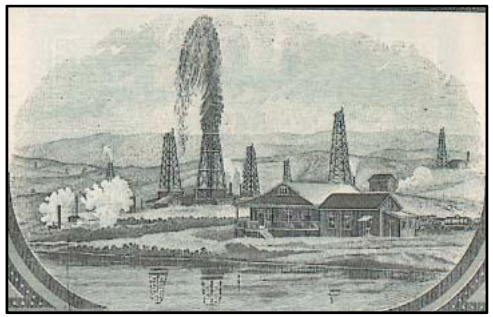
In order for a commodity index to not only hedge bond investments against inflation, but also do so effectively for equity investments, then the index needs to have a concentration in the petroleum complex, according to Froot (1995).

Source: Till (2014a).

II. A Focus on Crude Oil

A. Importance to Commodity Indices

B. How the Futures Curve Shape Matters



II. B. Futures Curve Shape

The first section of the presentation showed that the average returns for a futures contract were related to the average level of backwardation for each contract.

And that the top performing contracts were in the petroleum complex, which had the highest average levels of backwardation.

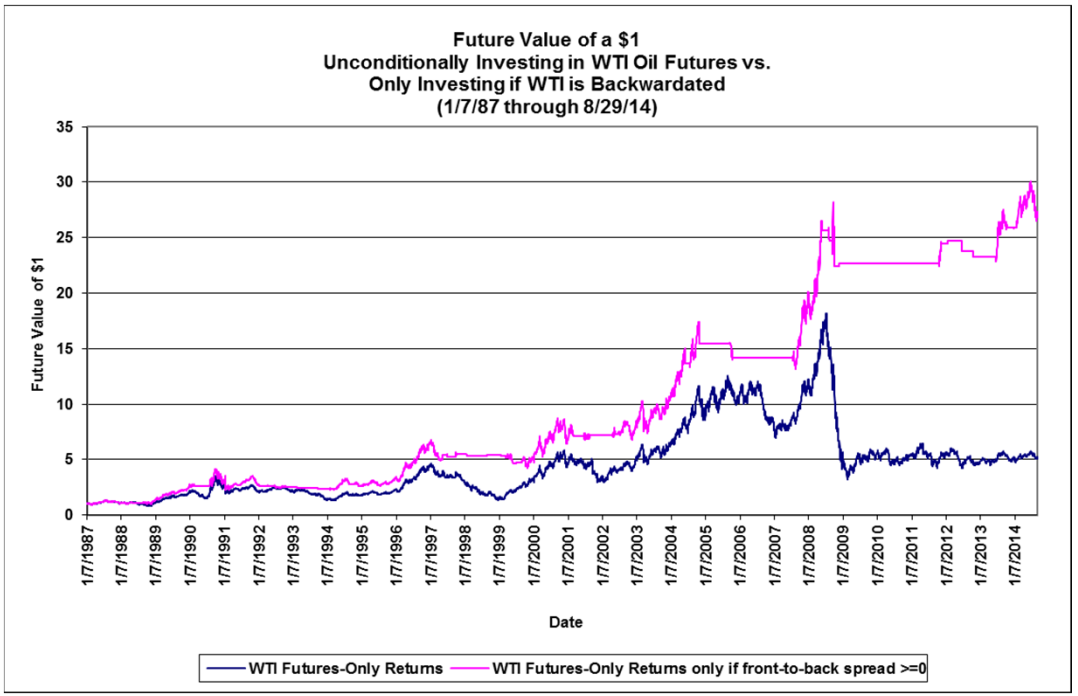
Could deciding upon whether to even enter into crude oil futures contracts, depending on the contract's curve shape, be helpful to a trader or investor?

Answer: Please see the next slide.

II. B. Futures Curve Shape

Reframing the previous slide's question, has the shape of a crude oil futures curve demonstrably mattered for the contract's long-term returns?

Answer: Historically, yes.

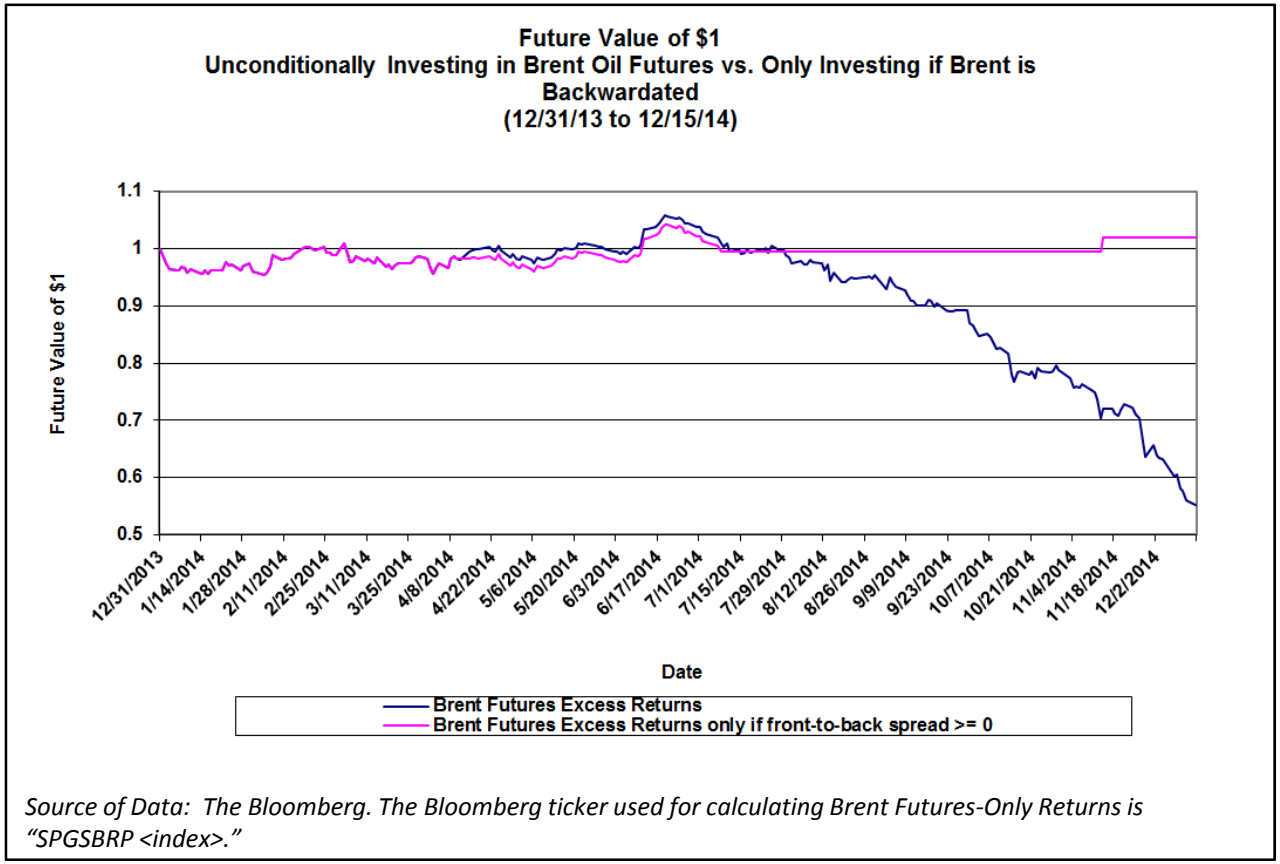


Source of Data: The Bloomberg. The Bloomberg ticker used for calculating WTI Futures-Only Returns is "SPGSCLP <index>."

Source: Till (2015a).

II. B. Futures Curve Shape

What about more recently?



Source of Data: The Bloomberg. The Bloomberg ticker used for calculating Brent Futures-Only Returns is "SPGSBRP <index>."

II. B. Futures Curve Shape

But what is the fundamental reason for the curve shape being useful as a toggle for deciding on whether to enter into crude oil futures contracts or not?

Answer: That is addressed in the next section of the presentation.

Do Commodity Index Holdings Still Make Sense for Institutional Investors?

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Spot Commodities Must Find a Home Here and Now

III. Avoidance of Crash Risk

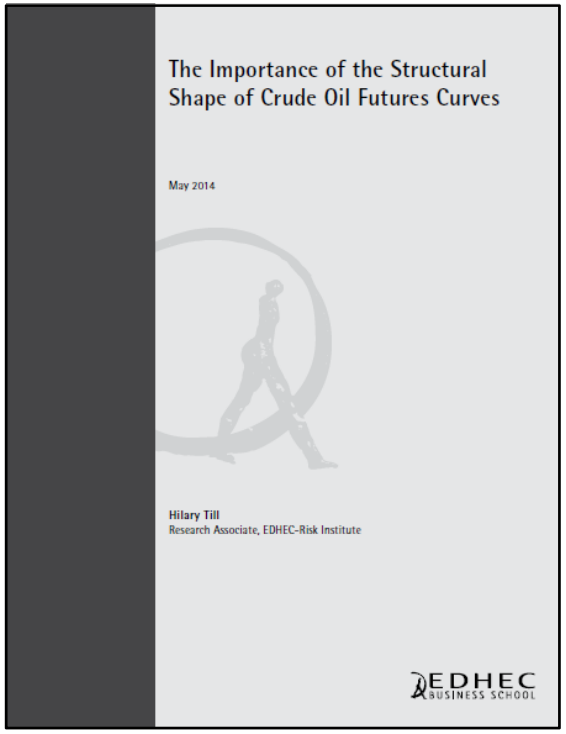
A. During Times of Low Spare Capacity

B. During Times of Ample Supply Relative to Demand

C. In Summary, There are Two States of the World for Crude Prices, Depending on the Spare-Capacity Situation

III. A. 1. Low Spare Capacity: 2008 Scenario

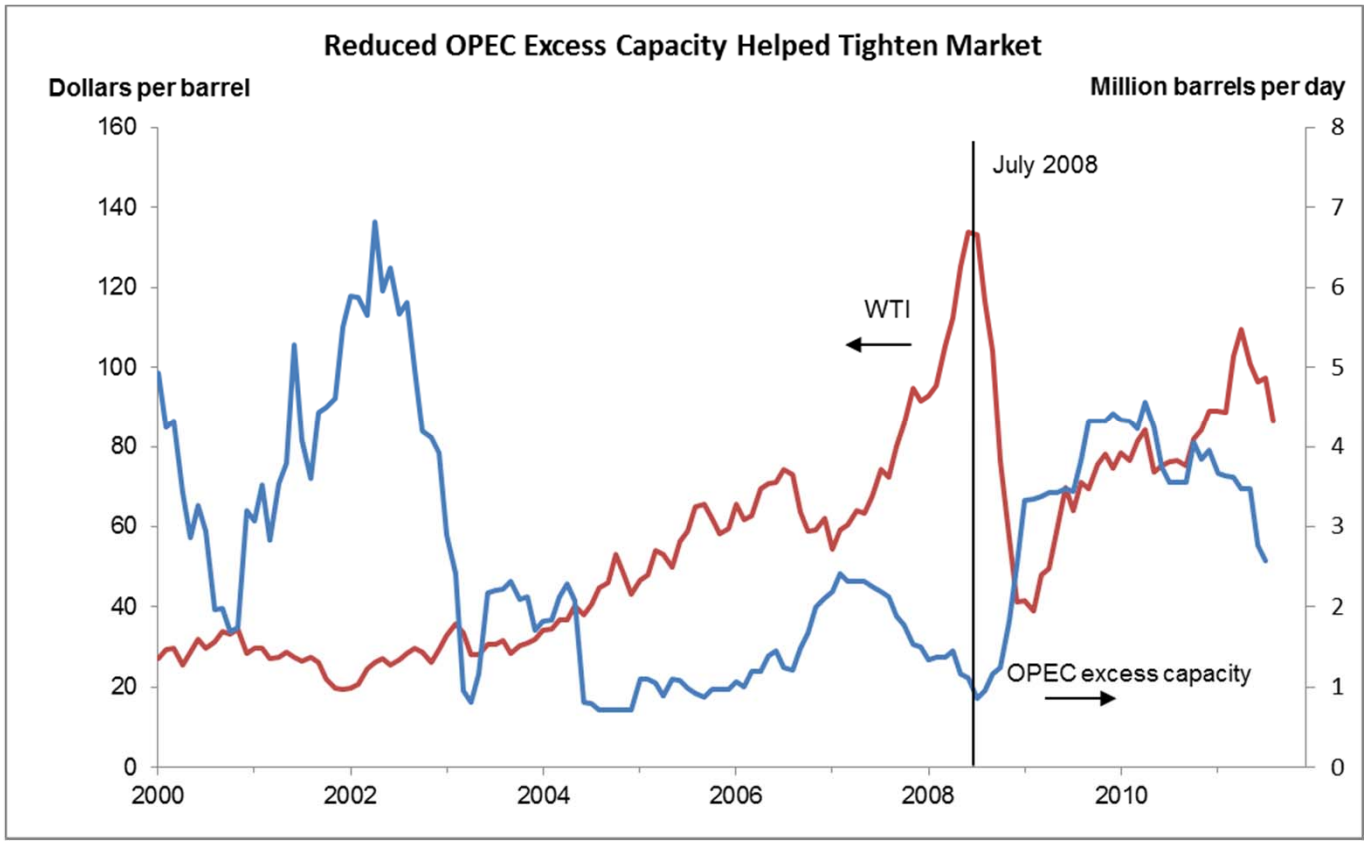
As discussed in Till (2014b), we know from the events of 2008 what happens when the oil excess-capacity cushion becomes sufficiently small.



In July 2008, the role of the spot price of oil was arguably to find a level that would bring about sufficient demand destruction so as to increase spare capacity, after which the spot price of oil spectacularly dropped.

This has been illustrated by researchers from both the Federal Reserve Bank of Dallas and the Commodity Futures Trading Commission.

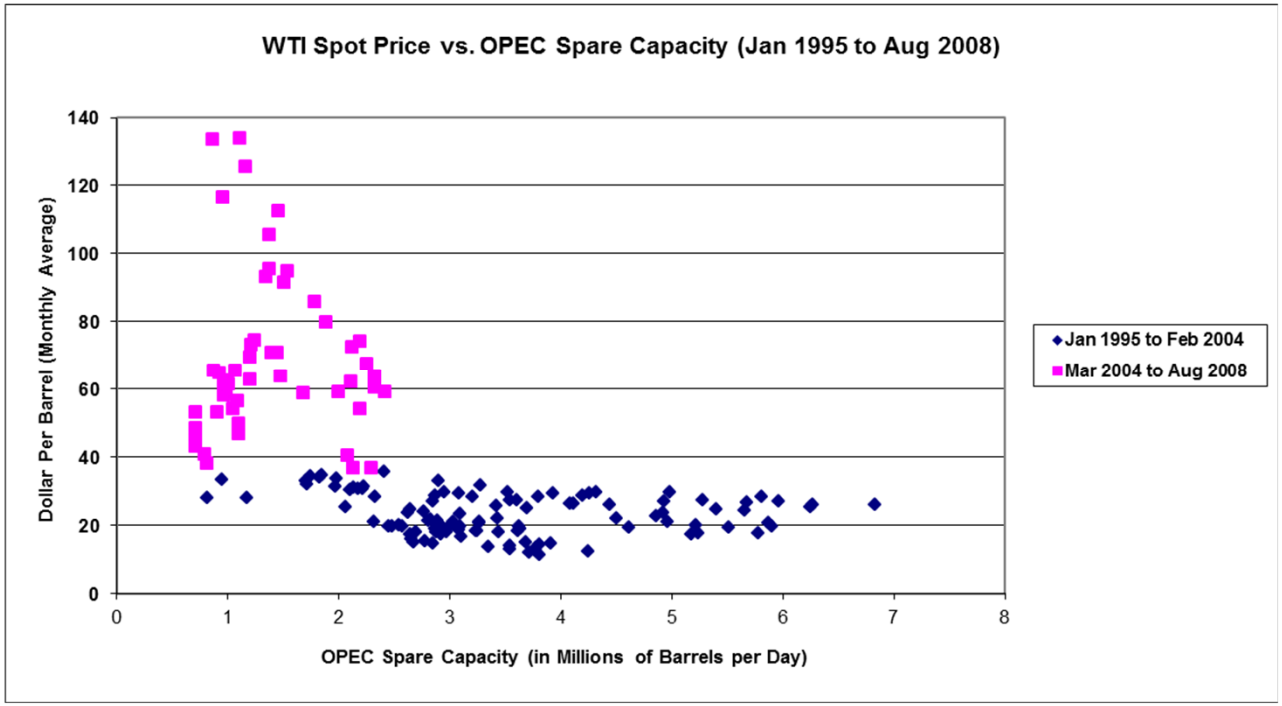
III. A. 1. Low Spare Capacity: 2008 Scenario



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 (EIA) and the Wall Street Journal.

III. A. 1. Low Spare Capacity: 2008 Scenario



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 (2015c) for two necessary caveats regarding this graph.

Source of Graph: Till (2014c), Slide 19.

III. A. 2. Low Spare Capacity: Skewness of Returns

Logically, then, an investor should consider toggling out of an oil futures position when there is an indication of low spare capacity in order to avoid the (likely) eventual crash risk.

How would have the returns from a structural position in oil futures contracts been affected if one used this fundamental variable?

Answer: Negatively skewed returns become positively skewed. Please see next slide.

III. A. 2. Low Spare Capacity: Skewness of Returns

Brent Futures (Excess) Returns
February 1999 through January 2015
Based on Monthly Data

	Unconditional Monthly Returns	Conditional on Previous Month's OPEC Spare Capacity > 1.8 mbd Monthly Returns	Conditional on Previous Month's OPEC Spare Capacity <= 1.8 mbd Monthly Returns
Arithmetic Average:	1.2%	1.7%	-0.2%
Skew:	-0.18	0.42	-0.88
Minimum:	-34%	-19%	-34%

Source of Brent Futures Data: The Bloomberg. The Bloomberg ticker used for calculating Brent Futures-Only Returns is "SPGSBRP <index>."

Source of OPEC Spare Capacity Data: EIA (2015), Table 3c.

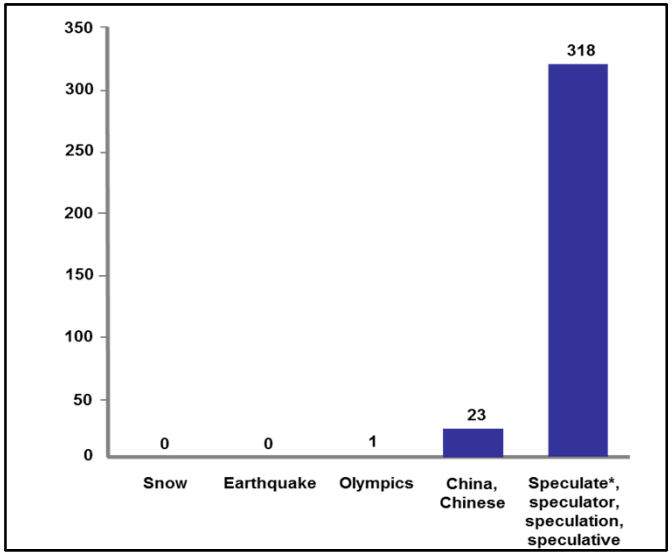
Explanation of Abbreviation: "mpd" stands for million barrels per day.

Necessary Caveats: These results would only be appropriate for trading or investment purposes if (a) the EIA's monthly data has not required substantial revisions after publication; and (b) if the state-of-the-world represented by an empirical analysis over the period, 1999-through-the-present, continues to be the case. Both assumptions cannot be guaranteed.

III. A. 3. Low Spare Capacity: A Predatory Strategy?

One advantage of avoiding crude oil futures exposure when there is minimal global oil spare capacity is that the strategy would likely thereby not be labelled as "predatory."

Times word mentioned in Sept 2008 U.S. Senate Hearing before Subcommittee on Energy, "Speculative Investing in Energy Markets" (88 pgs, 52,935 words)



Note: "The hearing took place before the Subcommittee on Energy of the Committee on Energy and Natural Resource, United States Senate, September 16, 2008. It was entitled 'Speculative Investment in Energy Markets.' *includes 'speculating'"

Source of Graphic: Chaturvedi (2013).

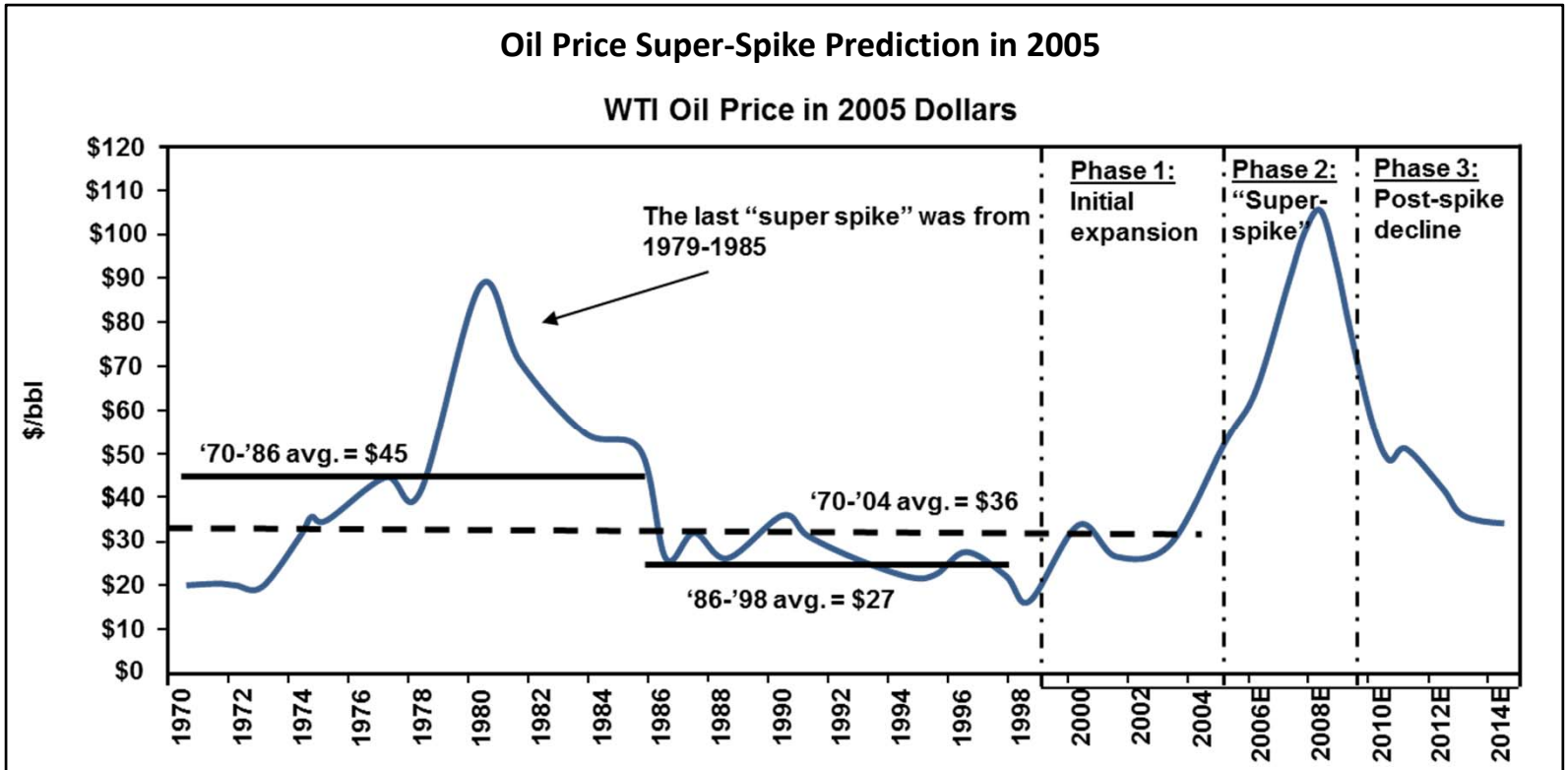
III. Avoidance of Crash Risk

There are two conditions where the petroleum complex may, at times, perform poorly.

The first was covered in the previous slides. When OPEC spare capacity has reached pinch-point levels, then oil prices have spiked higher, creating demand destruction, followed by the price of oil consequently crashing.

Interestingly, a Goldman Sachs analyst had predicted precisely this scenario in 2005, which came to pass three years later.

III. Avoidance of Crash Risk



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

III. Avoidance of Crash Risk

A. During Times of Low Spare Capacity

B. During Times of Ample Supply Relative to Demand

C. In Summary, There are Two States of the World for Crude Prices, Depending on the Spare-Capacity Situation

III. B. Ample Supply Relative to Demand

The second condition in which the petroleum complex may fare poorly is during times of ample supply.

As before, an investor should consider toggling out of an oil position when there is evidence of ample supply relative to demand.

III. B. Ample Supply Relative to Demand

Crude oil inventory data is either not timely or in the case of global data, not reliably available. Therefore:

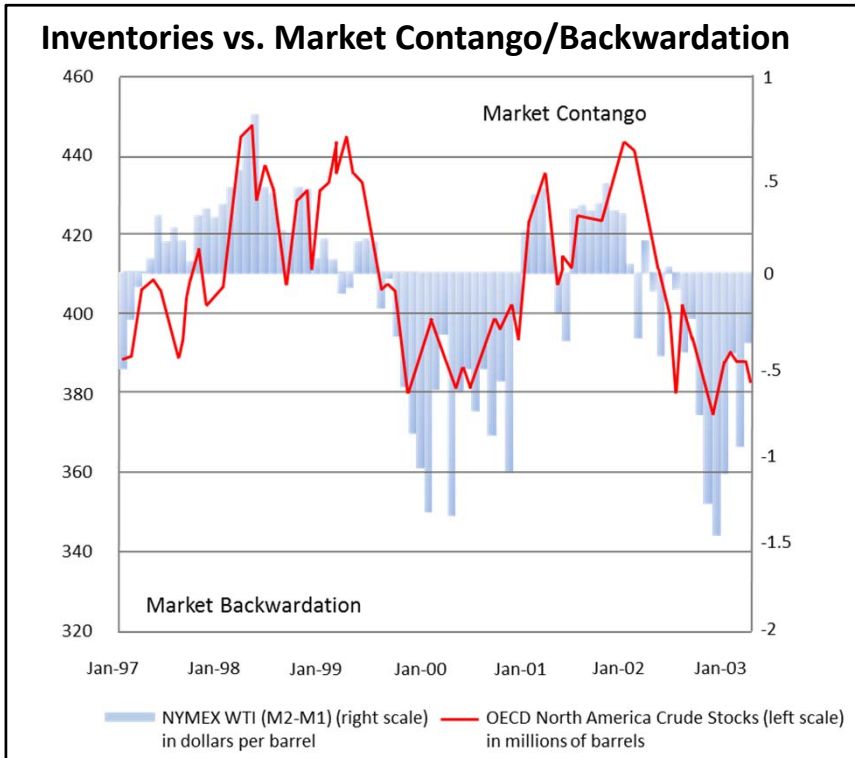
1. Is there a price-relationship variable that indicates ample supply relative to demand?

2. If so, has the use of this price-relationship variable historically improved returns during times of economic downturns and market-share price wars?

Answer: The answer to both questions is yes. Please see next five slides.

III. B. 1. Price-Relationship Variable

When inventories have been ample, the front-to-back spread has been in contango; and when inventories were scarce, the front-to-back spread has been in backwardation.



Source of Graph: 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.

This is the fundamental reason for the usefulness of the curve shape in making decisions on crude-oil positioning.

III. B. 2a. Return Comparison During Past 16 Years

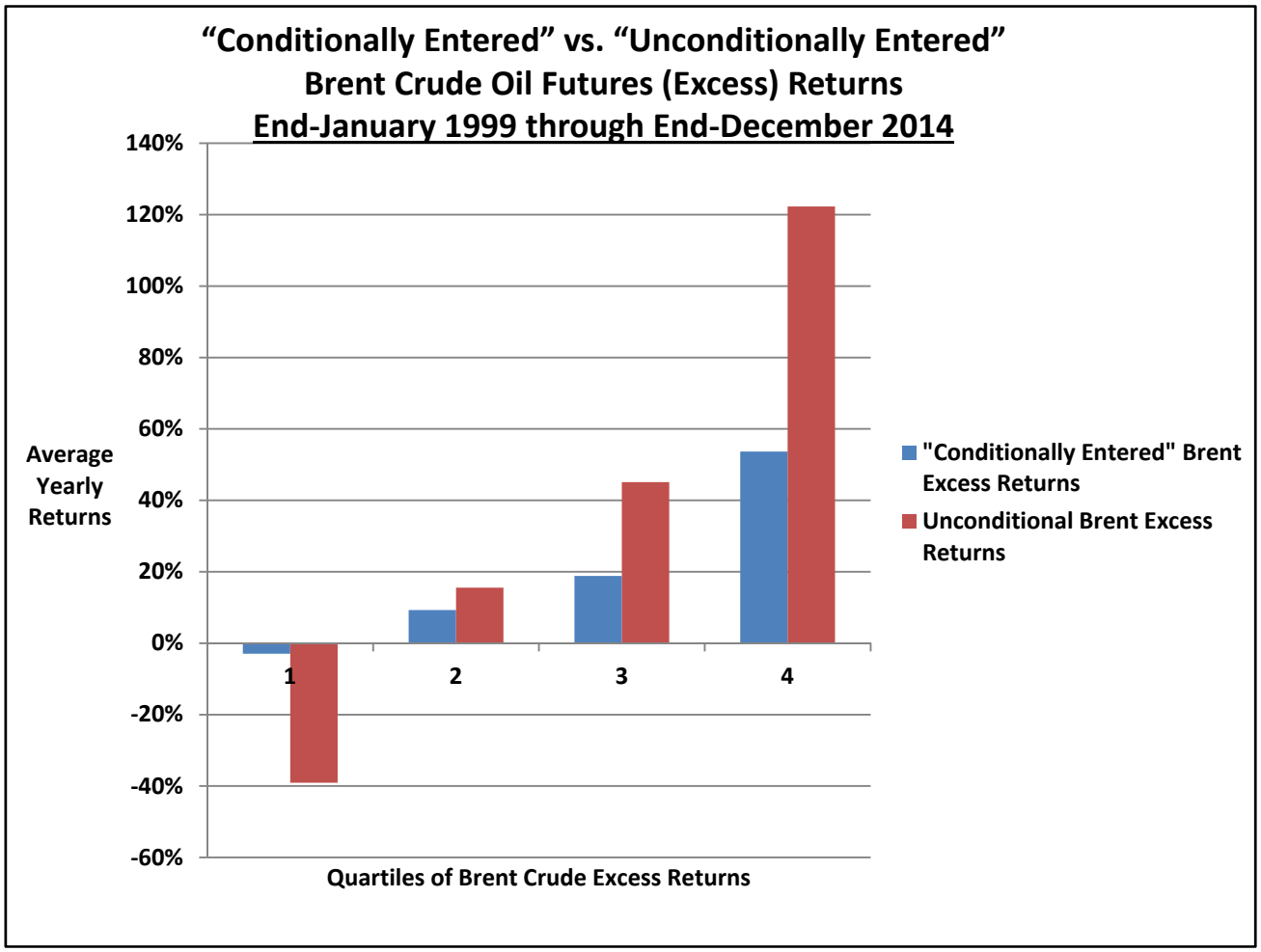
Historically, a toggle based on the front-to-back spread has provided further downside risk protection.

	Conditional Solely on Previous Month's OPEC Spare Capacity > 1.8 mbd	Brent Futures (Excess) Returns February 1999 through January 2015	Conditional on Previous Month's OPEC Spare Capacity > 1.8 mbd AND Brent Front-to-Back Spread > 0
	Monthly Returns	Based on Monthly Data	Monthly Returns
Arithmetic Average:	1.7%	Arithmetic Average:	2.0%
Skew:	0.42	Skew:	0.12
Minimum:	-19%	Minimum:	-15%

The same data sources, explanations of abbreviations, and necessary caveats shown in Slide 28 also apply here.

Regarding the strategy on the right, the next slide shows the option-like characteristics of this dynamic allocation strategy, using a type of graphical analysis that was drawn from Fung and Hsieh (1997).

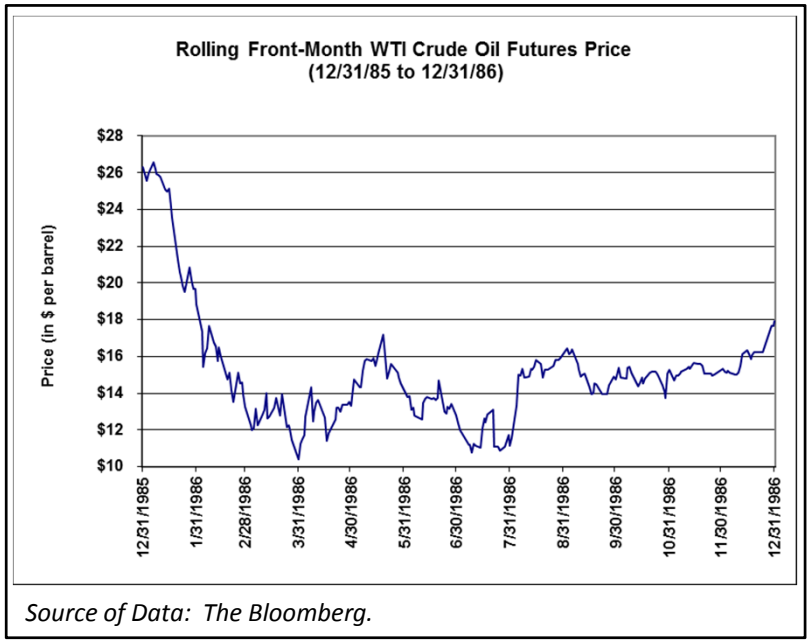
III. B. 2a. Return Comparison During Past 16 Years



The strategy behaves as if it owned collars (short calls and long puts) on crude oil.

III. B. 2b. Return Comparison During a Market-Share Price-War Scenario

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.

How did holdings in oil futures contracts perform in 1986, both unconditionally and when using a curve-shape toggle?

III. B. 2b. Return Comparison During a Market-Share Price-War Scenario

	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 Data: Commodity Research Bureau.
Calculations by Joseph Eagleeye of Premia Capital Management, LLC.

Note that the curve-shape toggle helped to hold the line against losses, but not entirely. For that, other hedging mechanisms must be considered, which will be covered in Section IV of the presentation.

III. Avoidance of Crash Risk

A. During Times of Low Spare Capacity

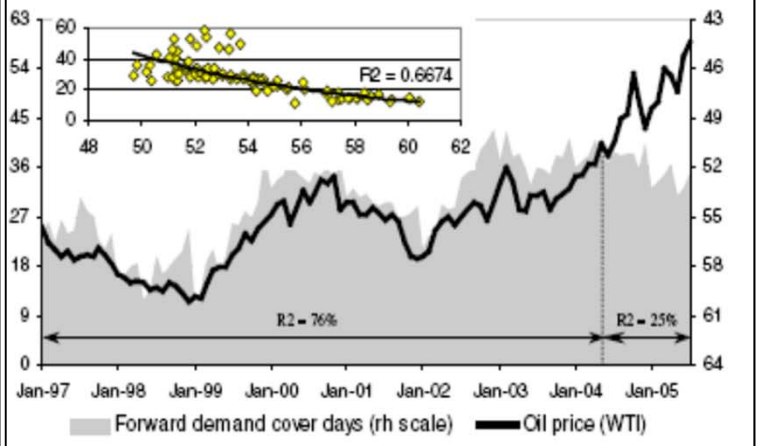
B. During Times of Ample Supply Relative to Demand

C. In Summary, There are Two States of the World for Crude Prices, Depending on the Spare-Capacity Situation

III. C. Two States of the World for Crude Prices: Either There is Sufficient Spare Capacity or There Isn't

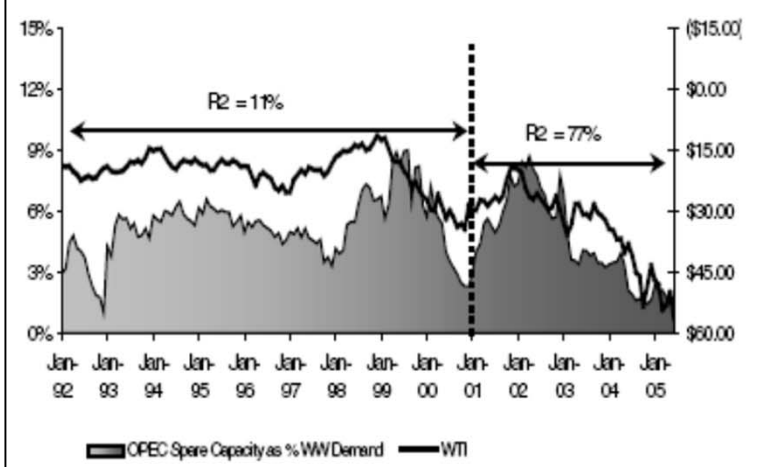
1. From inventory led …

Oil Prices (Highly) Negatively Correlated to Inventories



2. … to capacity driven

Oil Prices (Highly) Negatively Correlated to Spare Capacity



Source of Data: Smith Barney, Bloomberg, CIR.

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

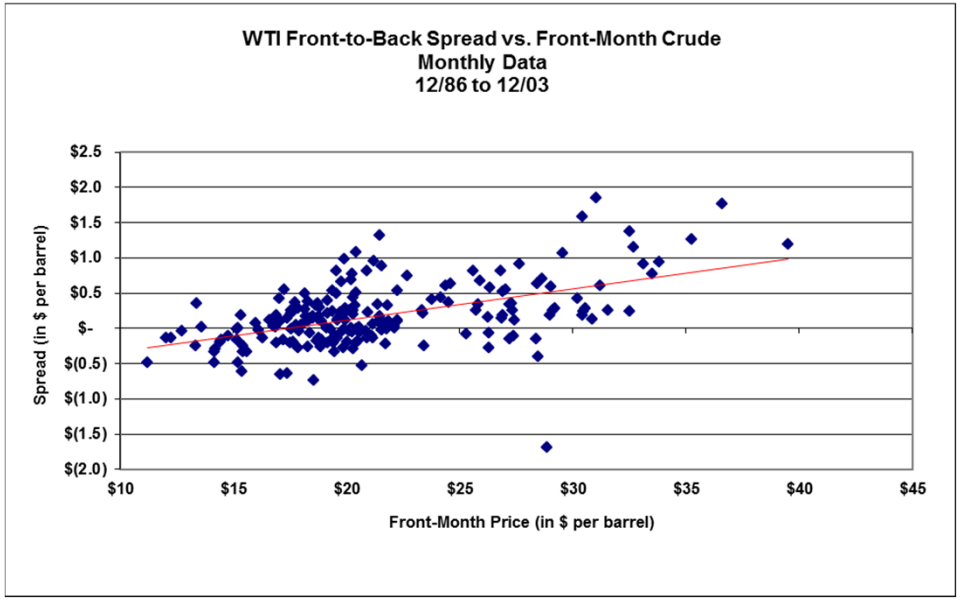
The upper small graph on the left-hand-corner shows Oil prices (y-axis) vs. Forward demand cover in days.

In both states of the world, the futures curve being in contango provides a signal to toggle out of crude oil futures' allocations.

Please see next two slides.

III. C. 1. Sufficient Spare Capacity

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



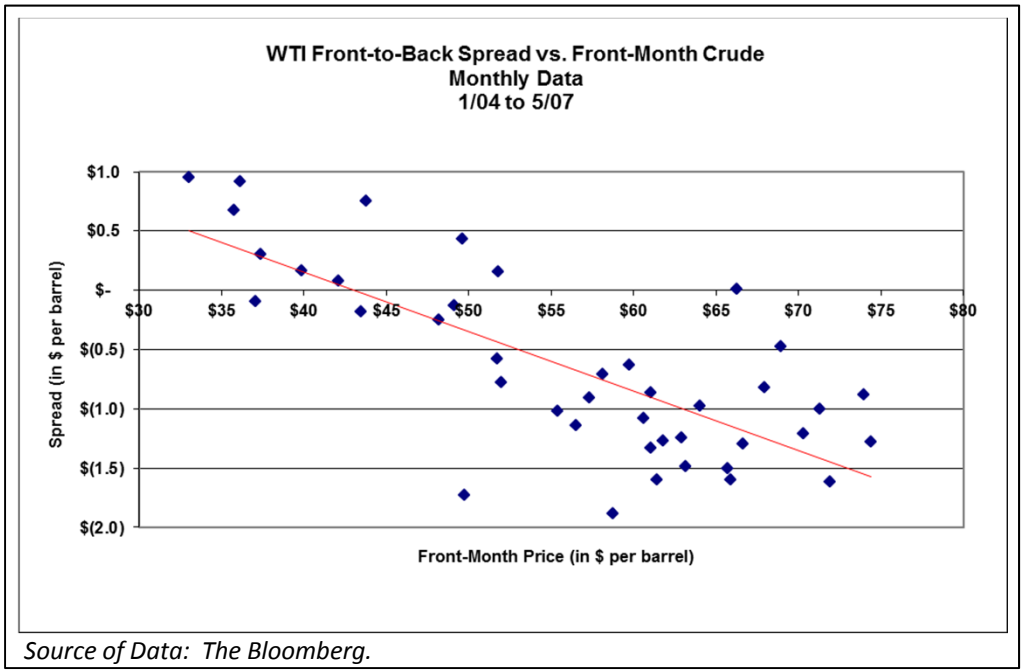
Source of Data: The Bloomberg.

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

Source of Graph: Amenc, Maffei, and Till (2008), Figure C-1.

III. C. 2. Inadequate Spare Capacity

A futures curve needs to be in "contango" since there a pressing need to incentivize precautionary stockholdings in oil.



Source of Data: The Bloomberg.

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.

Source of Graph: Amenc, Maffei, and Till (2008), Figure C-2.

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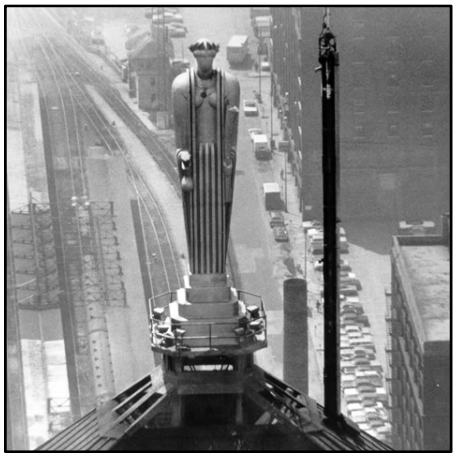
Spot Commodities Must Find a Home Here and Now

IV. Financial Asset Diversification

A. During a Market-Share Price War

B. During Deflationary Times



IV. A. During a Market-Share Price War

1986 Scenario

Note 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 Data: Commodity Research Bureau.
Calculations by Joseph Eagleeye of Premia Capital Management, LLC.

IV. A. During a Market-Share Price War

1986 Scenario

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."

IV. Financial Asset Diversification

Across Time

Evans-Pritchard (2014): "Tumbling oil prices are a bonanza for global stock markets, *provided the chief cause is a surge in crude supply rather than a collapse in economic demand*." [Italics added.]

Falling oil price start date	end date	WTI oil price (% fall)	S&P 500 performance 12M from end date
Dec-1876	Feb-1877	-35%	8%
Sep-1880	Apr-1882	-31%	10%
Nov-1883	May-1884	-33%	2%
Oct-1885	Mar-1886	-33%	12%
Jan-1890	Nov-1890	-38%	16%
Apr-1895	Jul-1895	-34%	-10%
Dec-1895	Dec-1896	-34%	17%
Mar-1900	Sep-1900	-32%	41%
Jan-1904	Apr-1905	-31%	5%
Apr-1909	Jun-1910	-30%	12%
Mar-1914	Jun-1914	-32%	5%
Dec-1920	Feb-1921	-30%	25%
Mar-1923	Jul-1923	-31%	20%
Apr-1924	Aug-1924	-32%	24%
Jun-1929	Mar-1930	-31%	-23%
Jul-1932	May-1993	-32%	1%
Aug-1937	Jun-1938	-32%	0%
Apr-1940	Sep-1940	-32%	-7%
Jun-1980	Apr-1982	-31%	45%
Jul-1987	Aug-1988	-32%	33%
Sep-1990	Jan-1991	-45%	19%
Dec-1996	Dec-1997	-33%	27%
Aug-2000	Sep-2001	-31%	-22%
Jun-2008	Oct-2008	-49%	7%
Average		**-33%**	**11%**

Source of Data: HSBC, Thomson Reuters Datastream, Global Financial Data.

Source of Table: HSBC, as reproduced in Evans-Pritchard (2014).

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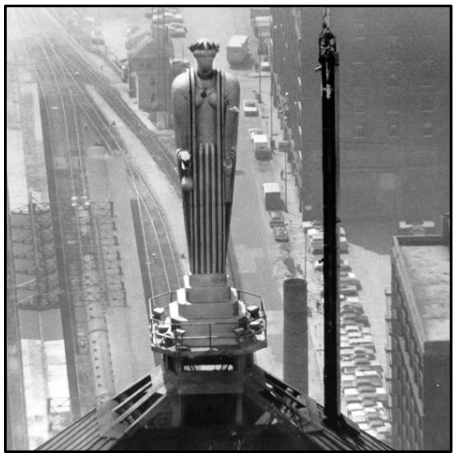
IV. Financial Asset Diversification

A. During a Market-Share Price War

B. During Deflationary Times



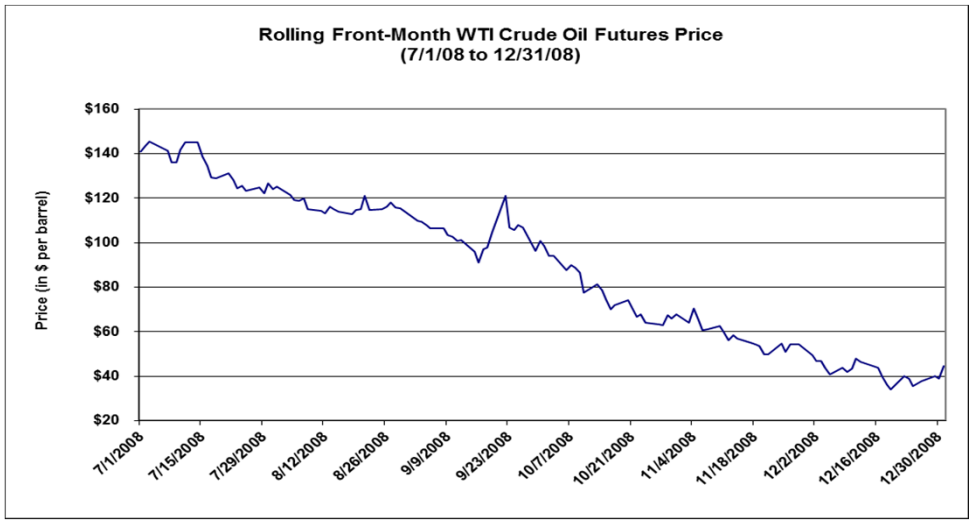
IV. B. During Deflationary Times

Evans-Pritchard (2014): But if oil prices are undergoing a dramatic decline because of "… the forces of global recession[,] … [this can overwhelm] the stimulus or 'tax cut' effect for consumers and non-oil companies of lower energy costs."

Under that scenario, a Treasury hedge has been the most effective hedge for petroleum complex holdings.

Please see next slide.

IV. B. During Deflationary Times



Source of Data: The Bloomberg.

10-Year U.S. Treasury Note Futures Excess Returns:
Under 2H2008 Scenario
13.8%

[Calculated based on rolling the futures contract on the first business day of the first-notice-day month.]

Source of Data: Commodity Research Bureau.
Calculations based on work by Joseph Eagleeye of Premia Capital Management, LLC.

Do Commodity Index Holdings Still Make Sense for Institutional Investors?

I. The Structural Features that Drive Long-Run Returns Amongst Commodity Futures Contracts

II. A Focus on Crude Oil

III. The Avoidance of Crash Risk When Holding Long-Term Positions in Oil Futures Contracts

IV. Financial Asset Diversification for Downside Hedging

V. Conclusion

Appendix:

Spot Commodities Must Find a Home Here and Now

V. Conclusion

Should institutional investors include oil-dominated commodity indices in their portfolios?

Answer: Yes, but only when the following three conditions are met –

(a) The crude oil futures markets are demanding price-risk-bearing services;

(b) Commodities holdings are part of a diversified investment portfolio; and

(c) The states-of-the-world that can be inferred from historical data continue going forward.

V. Conclusion

And finally, the precise mix of oil-dominated commodity positions, equities, and bonds depends on an investor's return expectations, loss aversion, and tolerance to periodically underperforming one's peer group.

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V. Conclusion

Appendix:
Spot Commodities Must Find a Home Here and Now

Appendix

February 10, 2015 11:55 pm

Spot commodities must find a home here and now

Sir, I read with interest your report "BIS says financial flows partly to blame for oil collapse" (FT.com, February 7), on the Bank for International Settlements' preliminary analysis of the oil market rout.

Commodities are different from financial assets. While financial assets are priced according to discounting future cash flows, and therefore anticipate future financial conditions, a spot commodity must find a home in the here and now. If there is surplus production relative to demand, the commodity must be sufficiently discounted to provide a return for storage. If storage is constrained or even full, the spot commodity's price can plummet to extremely low levels, and in the limit can even have a negative price if there truly is extremely limited storage available.

When one reads informed commentaries on the oil markets, one finds the following to be the case for the oil markets:

Appendix

• There has been overproduction relative to demand;

• We are now in a heavy refinery maintenance period, resulting in a seasonal decrease in demand for crude oil, intensifying the recent oil price drop;

• Both onshore and tanker storage for crude oil is being increasingly utilised;

• If demand does not pick up sufficiently or if supply does not adequately rebalance, then storage for oil could actually get full;

• From examining the WTI futures curve, the long-term price of oil is at about $70 per barrel, reflecting the marginal cost of the types of production that would balance the market, and thereby pricing out other types oil production that have higher costs;

• As refineries ramp up again seasonally, this could mark the floor in oil prices because demand would naturally increase; and

• The appropriate analogue for the current environment is 1986, which the BIS authors apparently did not include in their preliminary analysis.

Source: Till (2015b).

Acknowledgements

The presenter wishes to thank Candice Lucas of the CME Group for support of the research that led to the publication of the paper, Till (2014a).

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Additional articles by the presenter can be accessed here:
http://faculty-research.edhec.com/faculty-researchers/alphabetical-list/r-s-t/till-hilary-143898.kjsp?RH=faculty-qb1

Source of Graphics

Graphic on Slides 5 and 8: The constant π is represented in this photograph of a mosaic outside the Mathematics Building at the Technical University of Berlin.

Graphic on Slides 14 and 17: Excerpted from a 1929 stock certificate for a crude-oil-development company in Alberta, Canada.

Graphic on Slides 23, 32, and 40: Rembrandt's *Storm on the Sea of Galilee*, Isabella Stewart Gardner Museum, Boston, and Cover of Against the Gods: The Remarkable Story of Risk by Peter Bernstein, 1996 (New York: John Wiley & Sons).

Graphic on Slide 45 and 49: Photograph of the Ceres statue on top of the Chicago Board of Trade (CBOT) building.

Graphic on Slide 57: Graphic on editorial page of *Financial Times.* The motto of the *FT* is below this graphic; and the motto states, "Without fear and without favour."

Graphic on Slide 58: Photograph of the scale model of the CBOT's Ceres statue at the Art Institute of Chicago.