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An Overview of the Oil Futures Markets

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An Overview of the Oil Futures Markets

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

I. Futures Market Mechanics

II. Emergence of Oil Futures Markets

III. Primary Oil Futures Contracts

IV. Trader Insights

V. Investor Insights

I. Futures Markets Mechanics

A. Overview

B. Market Participants

A. Overview

Definition

- Futures contracts oblige a trader to buy or sell an underlying instrument at a certain price and date.
- A futures contract allows a trader to lock in a commodity's price, either via:
  - Physical delivery of the underlying asset, or via
  - Cash settlement, which is the difference between the spot and the futures price.
- Exchange-traded futures contracts are standardized with the following parameters specified: the quantity and quality of the instrument, the price per unit, and the date and method of delivery (if any).

Based on Ewell (2008), Slide 22.

A. Overview (Continued)

Clearing Houses

- Futures counterparties interact with the exchange's clearinghouse (CH). Clients do not know with whom they have traded.
- A futures trade is really two trades:

Party A $\Longleftrightarrow$ Clearing house $\Longleftrightarrow$ Party B

Source: Ewell (2008), Slide 22.

A. Overview (Continued)

Credit Risk Mitigation

- The agreement will be honored by the CH.
- To protect itself the CH demands that:
  - An initial collateral amount is deposited to cover future losses, and
  - A futures account is marked-to-market daily with margin moving to cover daily market movements.
- No party will incur a big loss at maturity: instead, losses are spread over the duration of the trade.

Based on Ewell (2008), Slide 22.

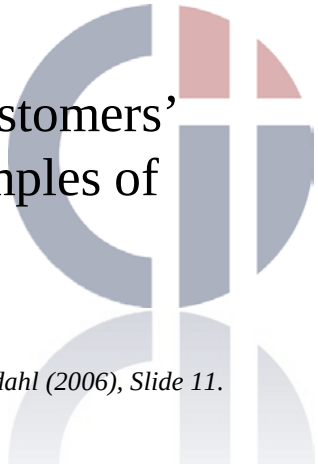
A. Market Participants

Hedgers, Speculators, and Brokers

Speculator
A trader who enters the futures market in pursuit of profit, accepting risk in the endeavor.

Hedger
A trader who enters the futures market to reduce some pre-existing risk exposure.

Broker
An individual or firm acting as an intermediary by conveying customers' trade instructions. Account executives or floor brokers are examples of brokers.



Source: Kolb and Overdahl (2006), Slide 11.

A. Market Participants (Continued)

Examples of Hedgers

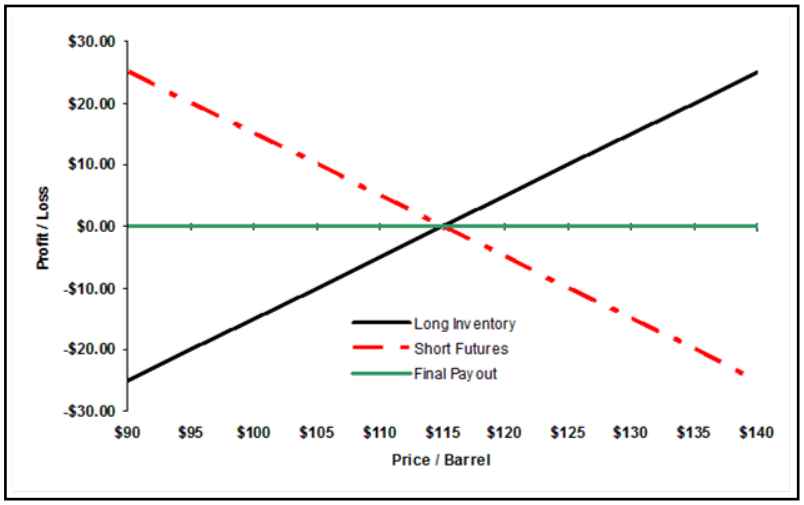
- End users: "SHORT" energy – concerned about rising prices
  - E.g. Airlines, Shippers, Utilities
- Producers: "LONG" energy – concerned about falling prices
  - E.g. Energy Majors and Independents, State Oil Companies
- Refiners and Power-Generators: MARGIN exposure – concerned about relative prices
  - Oil Refiner: Crude oil versus oil products (called "cracks")
  - Power-generator: Coal/Oil/Gas versus Electricity ("Dark/Spark spreads")

Based on Ewell (2008), Slide 20.

A. Market Participants (Continued)

Employing Futures for Hedging

- An oil producer loses out if the price of the commodity drops and gains if the commodity price rises.
- To hedge that position, it can sell exchange-traded futures to lock in the price.
- Therefore, no matter if the price moves up or down, the producer is not exposed to volatility because the gain/loss on the futures contract will offset the gain/loss on the commodity.



Source: Ewell (2008), Slide 27.

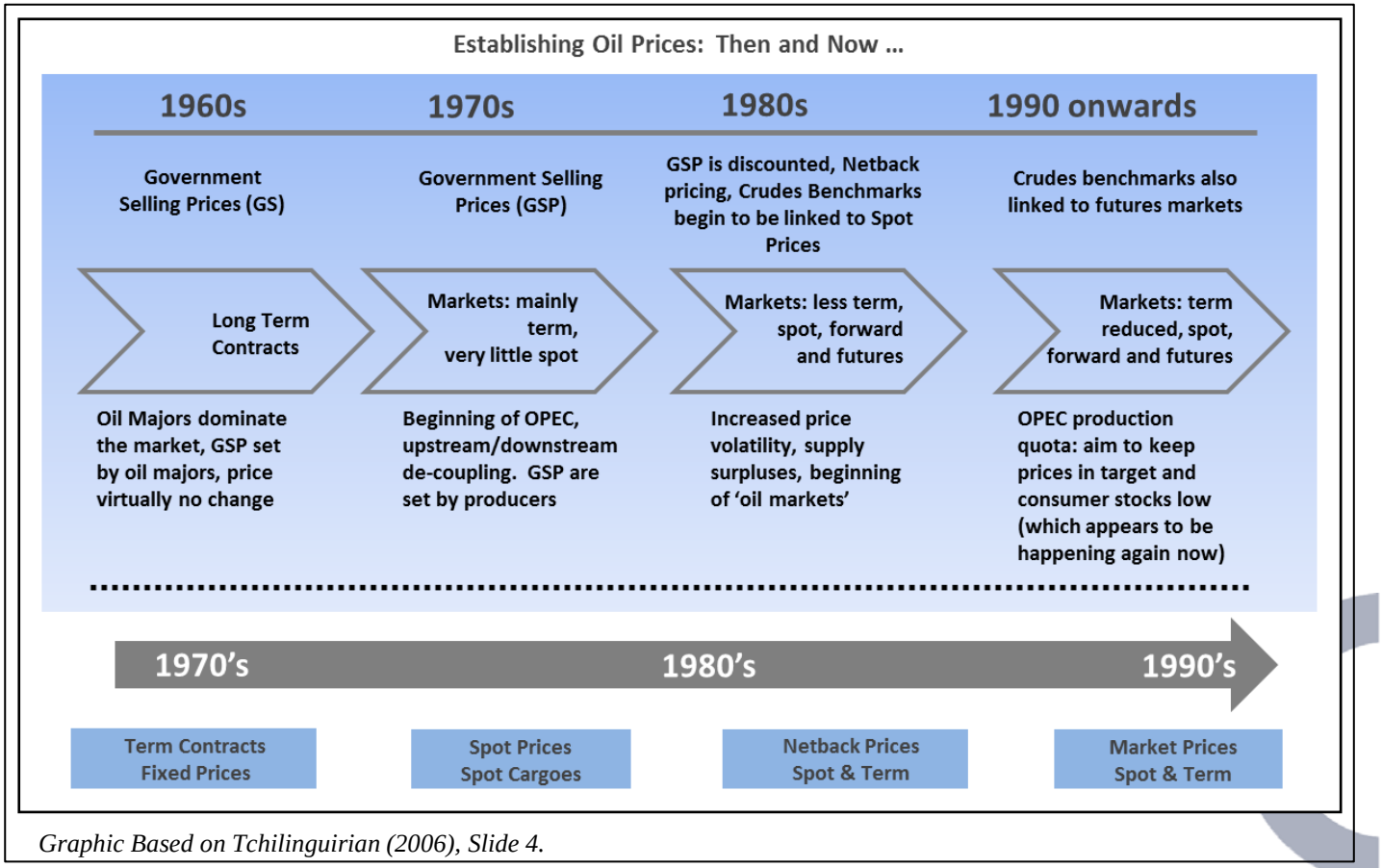
II. Emergence of Oil Futures Markets

A. Evolution of Pricing in the Oil Markets

B. Emergence of Need for Hedging

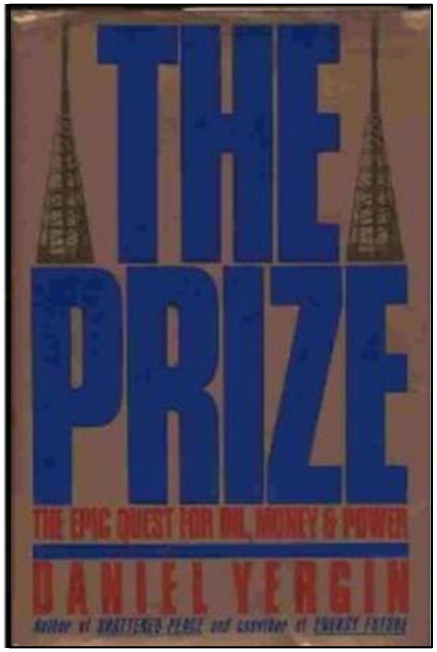
C. Consequent Institutional Development

A. Evolution of Pricing in the Oil Markets



Graphic Based on Tchilinguirian (2006), Slide 4.

B. Emergence of Need for Hedging



- The structure of the oil industry changed after numerous nationalizations in oil-producing countries in the 1970s.
- This forced oil companies to shift from long-term contracts to the spot oil market, according to Pulitzer Prize winner, Daniel Yergin, in his 1992 book, The Prize.

B. Emergence of Need for Hedging (Continued)

- Verleger (2012) added that the U.K. government's choice of how to tax North Sea oil, starting in the 1970s, contributed to the development of spot oil markets.

- "[T]he U.K. Treasury granted itself the right to decide the value of any oil processed by the company that produced it.

- Exxon, for example, would have been at the mercy of U.K. tax authorities had it processed crude from its fields."

C. Consequent Institutional Development

- “Rather than take such a risk, producers chose to sell their crude and then buy crude for processing from others. Their transactions created the first observable spot market for crude,” according to Verleger (2012).

- An economic need for hedging volatile oil price risk thereby emerged, which the NYMEX responded to with a suite of energy futures contracts, starting with the heating oil contract in 1978.

III. Primary Oil Futures Contracts

A. CME Group’s NYMEX WTI Futures Contract

B. ICE Brent Futures Contract

A. CME Group's NYMEX WTI Futures Contract

Contract Specifications

Contract Size	1000 Barrels of Light Sweet Crude
Contract Notional Value (12/7/17)	$56,690 (1000 bbls x $56.69/bbl)
Minimum Tick Size	$0.01
Dollar value of 1 tick	$10.00
Ticker Symbol	CL
Trading hours	Sunday - Friday 5:00 p.m. - 4:00 p.m. CT with 60 minute break each day at 4:00 p.m. CT
Contract months	All months
Open Interest (12/7/17)	2,574,834
Aggregate Volume (12/7/17)	1,056,406
Delivery	Physical Delivery

Based on Lerman (2017).

A. CME Group's NYMEX WTI Futures Contract (Continued)

Benefits of WTI Futures

Reasons to Trade WTI Crude Futures	
Deep, liquid market	Nearly 1-2 million contracts trade daily with 2 million+ in open interest
Global benchmark	WTI is the go-to measure of world's oil prices due to the rise in U.S. production. Asian usage and liftoff of U.S. export ban
Futures leverage	Control a large contract value with a small amount of capital. Used properly, it's a powerful way to increase capital efficiency and exposure
Safety and security	Central clearing helps mitigate counterparty credit risk
60/40 U.S. tax treatment	Enjoy 60% long term, 40% short term treatment on capital gains
Nearly 24-hour electronic access	Manage positions around the clock and react as global events occur
≥80% margin offsets	Trade with other NYMEX oil contracts for significant savings and precise exposure
Physical settlement	NYMEX WTI is closely connected to the spot market, reducing costs

Based on Lerman (2017).

B. ICE Brent Futures

Contract Specifications

Contract Size	1000 Barrels of Light Sweet Crude	
Contract Notional Value (12/7/17)	$62,200 (1000 bbls x $62.20/bbl)	
Minimum Tick Size	$0.01	
Dollar value of 1 tick	$10.00	
Ticker Symbol	CO (Bloomberg symbol)	
Trading hours	Trading	Pre-Open
New York	8:00 p.m. - 6:00 p.m.*; 20:00 - 18:00	7:55 p.m. - 19:55
London	1:00 a.m. - 11:00 p.m.*; 01:00 - 23:00	12:55 a.m. - 00:55
Singapore	9:00 a.m. - 7:00 a.m.*; 09:00 - 07:00	8:55 a.m. - 08:55
Contract months	All months	
Open Interest (12/7/17)	2,364,046	
Aggregate volume (12/7/17)	682,206	
Delivery	The ICE Brent Crude futures contract is a deliverable contract based on EFP delivery with an option to cash settle against the ICE Brent Index price for the last trading day of the futures contract. The Exchange shall publish a cash settlement price (the ICE Brent Index price) on the next trading day following the last trading day for the contract month.	

*Next Day

Note: DST in the US will be different than BST time. See Circular 17017 (https://www.theice.com/publicdocs/circulars/17017.pdf) and the associated attachment (https://www.theice.com/publicdocs/futures/Futures_Europe_TemporaryTradingHours.pdf) for temporary trading hour changes.

London: Sunday Pre-Open 10:55 p.m.; Sunday Open 11:00 p.m.

Based on https://www.theice.com/products/219/Brent-Crude-Futures, accessed on 3/1/18.

B. ICE Brent Futures (Continued)

Brent's Link to the Rest of the Oil Complex

Region	Global			Asia		US		
Primary Crude (*Future)	(ICE) Brent Crude *			Dubai		WTI *		
				Sweet/sour diff				
Ancillary crude			Urals		ESPO			LLS, Mars, ASCI
Price/liquidity Link				Cracks to..				
Primary product (*Future)	ICE Gasoil* (EU)	Euro-Bob Gasoline Barges	Fuel Oil 3.5% Rdam Barge	Singapore 0.5% Gasoil	Singapore 180CST FO	NYH RBOB*	NYH Heat*	USGC 3% FO
Price/liquidity Linkage		Spreads/diff		(including some cracks) to...				
Secondary product examples Price/liquidity Linkage up/down and across chains/regions and via cracks to crudes	10p pm Diesel barges Rdam -------- 0.1% NWE Cargoes Jet CIF NWE -------- Jet Cargo CIF NWE	Naphtha CIF NWE -------- Gasoline FOB NWE Cargoes	FO 1% Cargoes NWE -------- FO 1% CIF MED Cargoes	Jet (Regrade) FOB Sing --------- Singapore 0.05% Gasoil	Singapore 380CST Fuel Oil	RBOB to Euro Oxy Gasoline	USGC Jet ------- NYH Heat Barge	USGC 1% FO

Source: Davis (2015).

IV. Trader Insights

A. Sources of Fundamental Data

B. Inferring Fundamentals through Price Data

C. Risk Tolerance and Investment Discipline

A. Source of Fundamental Data

- Oil data is “opaque and incomplete because [numerous] countries … [hold on to] their data tightly for competitive and national security reasons.

- The US, via the Energy Information Agency (‘EIA’), is perhaps the best source with weekly releases of petroleum status reports that track the US market, and provide useful data on supplies, demand and inventory.”

Source: Open Square Capital (2017).

A. Source of Fundamental Data (Continued)

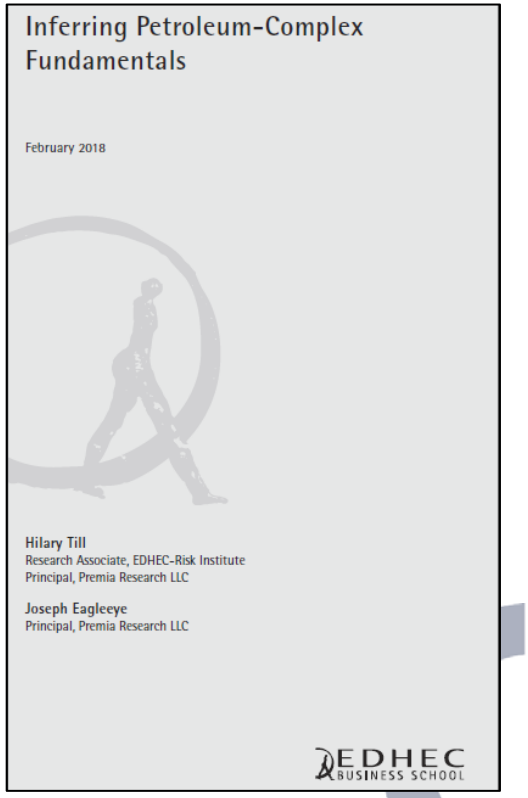
- "For worldwide data, the International Energy Agency ("IEA") and OPEC are great sources, and include data from OECD countries (e.g., US, Canada and much of Europe) and non-OECD countries (e.g., China and India).

- No matter the source, frequent 'true-ups' are made to the data when new information is available or when … [statistics] need to balance properly."

Source: Open Square Capital (2017).

B. Inferring Fundamentals through Price Data

1. The Reality of “Black Holes”
2. The Wealth of Futures Price Data
3. What Futures Prices Reveal about Petroleum Complex Fundamentals
4. Caveats on the Use of Price Data



Based on Till and Eagleeye (2018).

1. The Reality of “Black Holes”

In Emerging Markets

- 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).

1. The Reality of "Black Holes" (Continued)

In Emerging Markets (Continued)

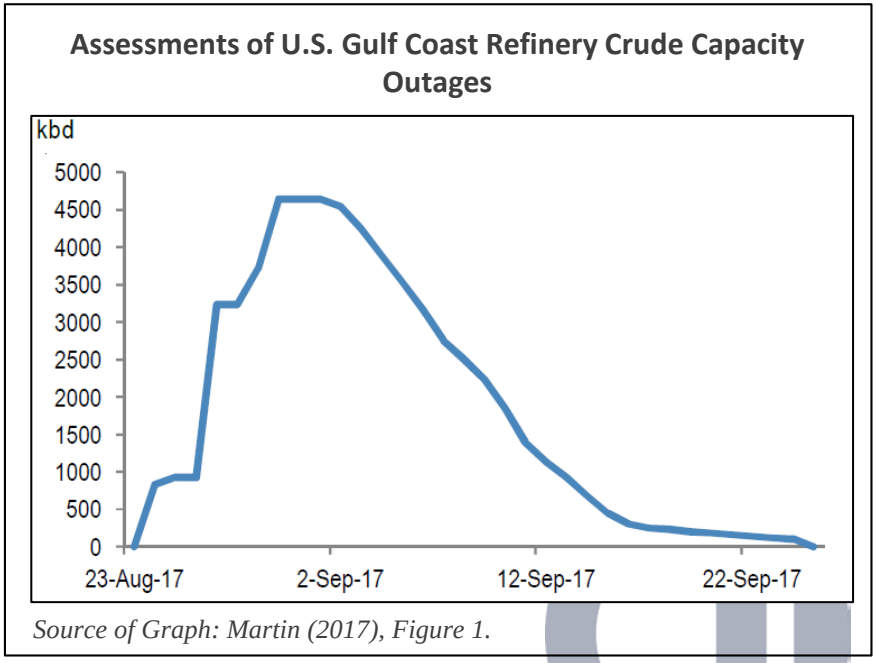
With data "black holes are getting larger and larger … [this is] impacting our understanding of [commodity] fundamentals," stated Morse.

Source: CFTC (2017).

1. The Reality of "Black Holes" (Continued)

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.

1. The Reality of "Black Holes" (Continued)

Even in Some Markets in the U.S. (Continued)

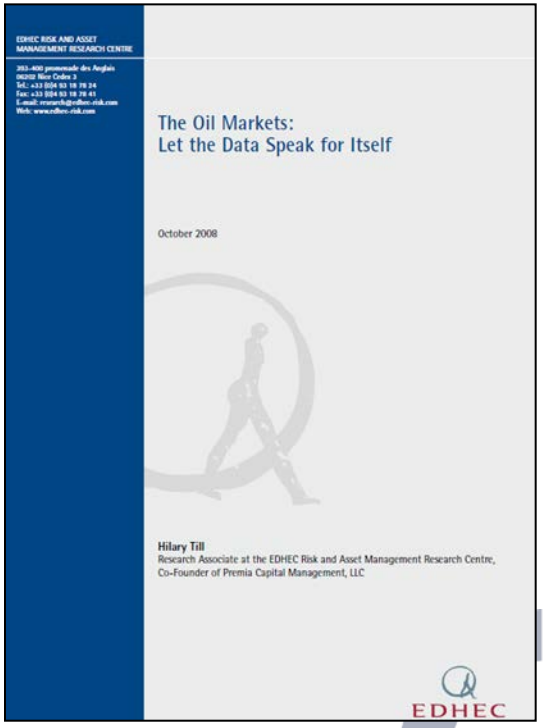
- "The majority of this shortfall will turn up in [U.S.] PADD 3 inventory levels in future weeks' [Energy Information Administration] EIA reports.

- 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.)

2. The Wealth of Futures Price Data

- 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).

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

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

a. Incentivizing Fundamental Behavior

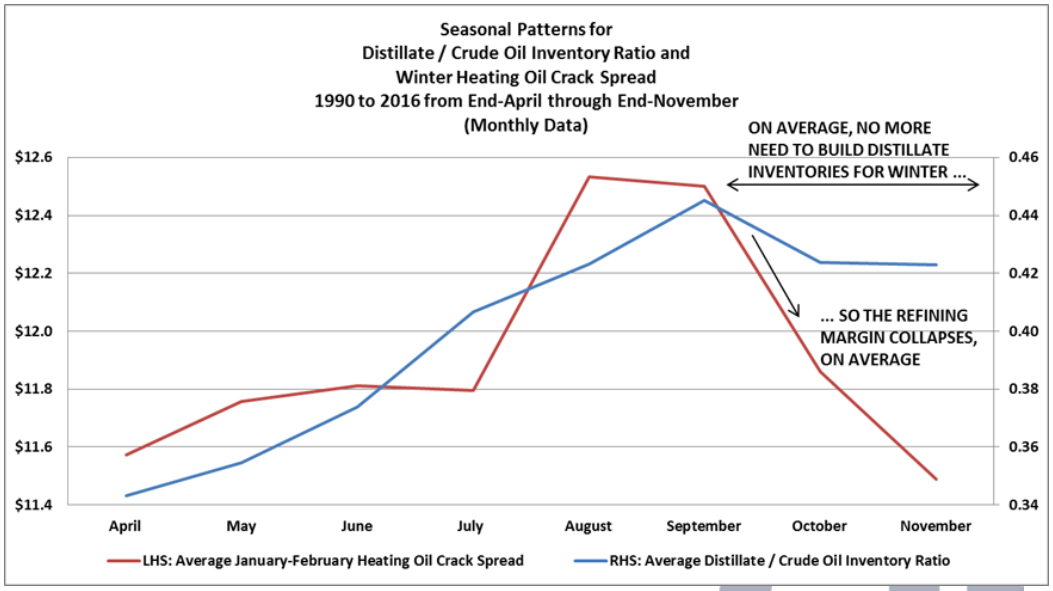
- A futures trader interprets a commodity's price as part of a dynamic process. A commodity's price moves in whatever direction is needed in order to elicit a supply or demand response that will balance a commodity market.

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

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

a. Incentivizing Fundamental Behavior (Continued)

Building Distillate Inventories Before Winter (1990 to 2016)



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.]

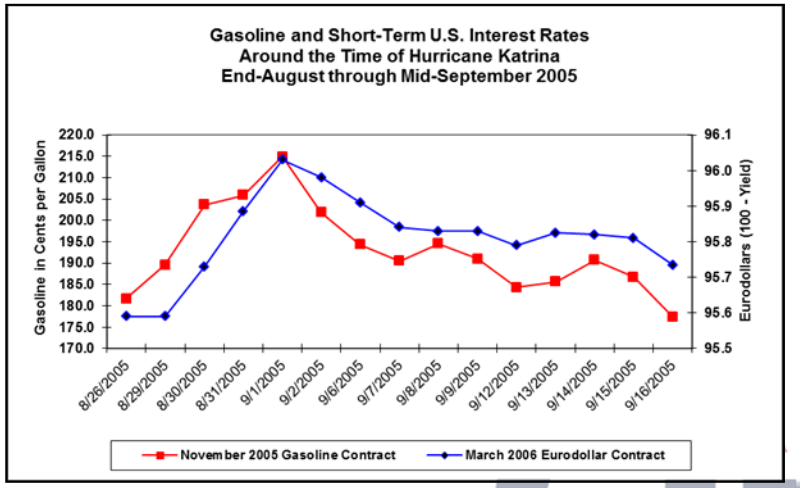
3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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.

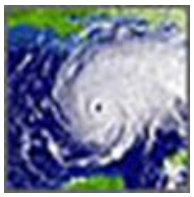


Source: Till (2008).

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

a. Incentivizing Fundamental Behavior (Continued)

Hurricane Katrina (2005)

(Continued)

- Further, and as also illustrated in the graph on Slide 34, with that response, fears of an economic slump diminished, which in turn caused deferred interest-rate contracts to decline, …

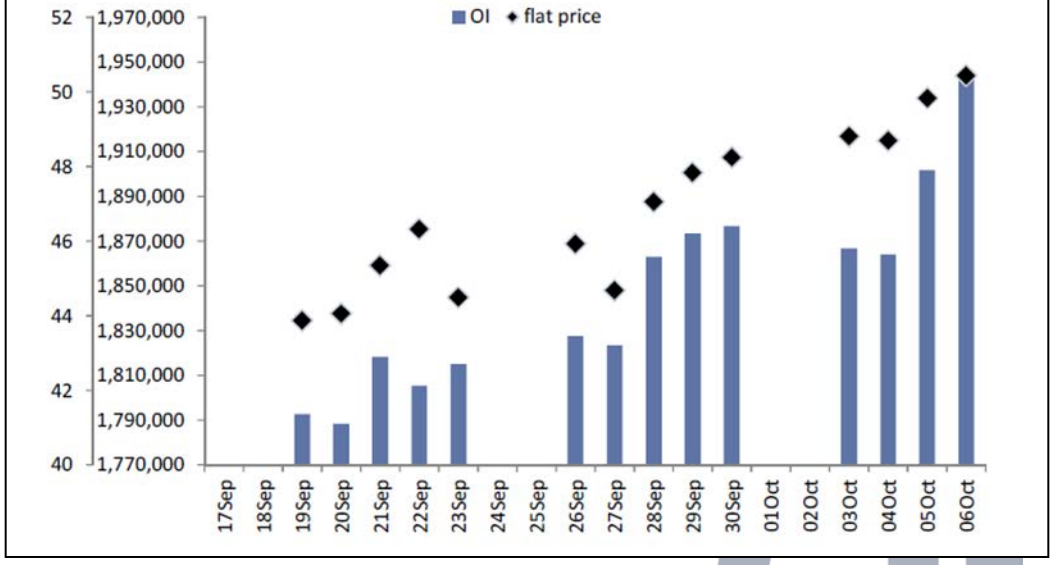
- … as the market resumed pricing in the expectation that the Federal Reserve Board could continue tightening interest rates at the time.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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."



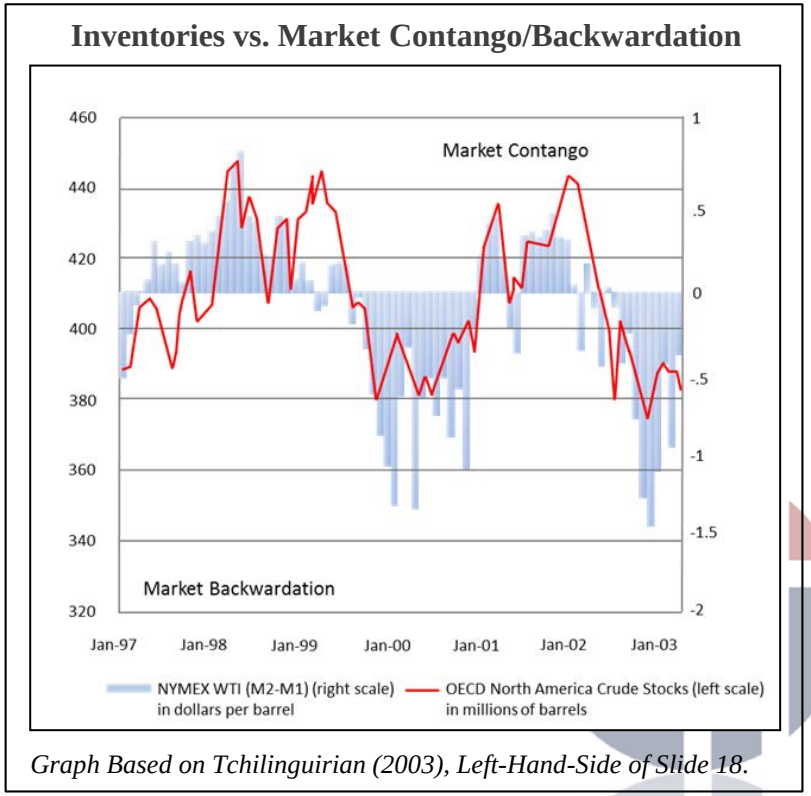
Source of Chart: Goldman Sachs Equity Research (2016), Exhibit 19.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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."



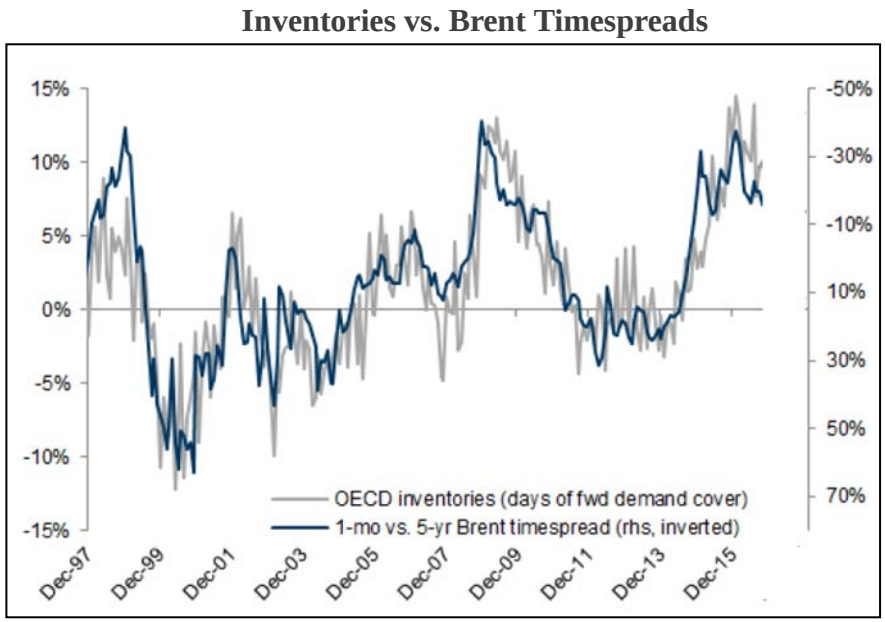
Graph Based on Tchilinguirian (2003), Left-Hand-Side of Slide 18.

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.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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).

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

d. 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.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

d. 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.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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

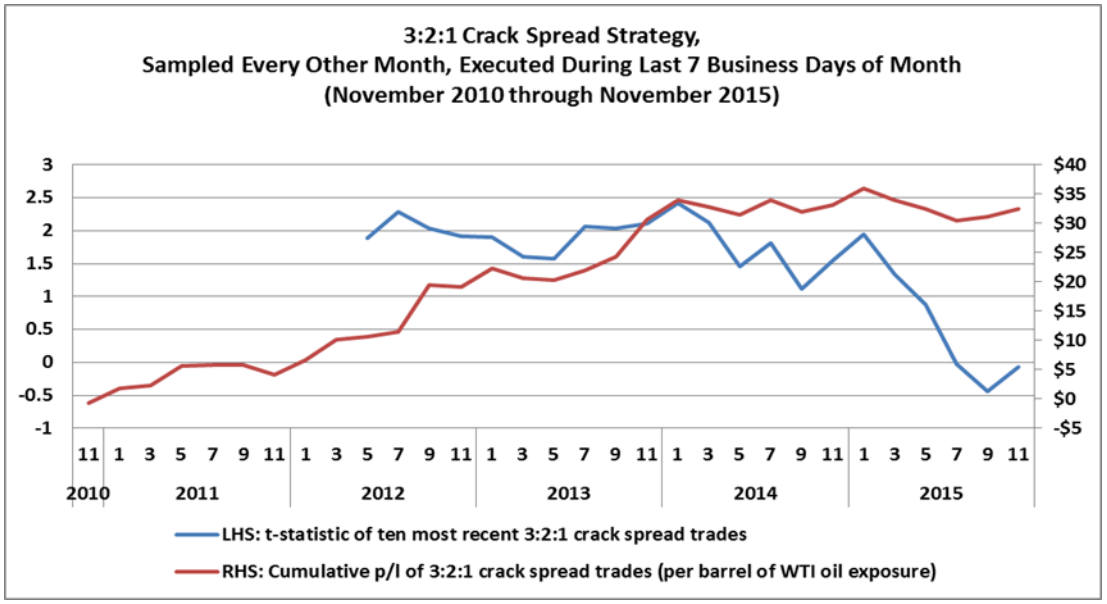
- At the end of 2013, alert futures traders had an early signal that "the boom in … [domestic oil] production ha[d] been well absorbed by existing U.S. infrastructure."

- 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.

3. What Futures Prices Reveal about Petroleum Complex Fundamentals (Continued)

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



Source of Graph: Premia Research LLC.

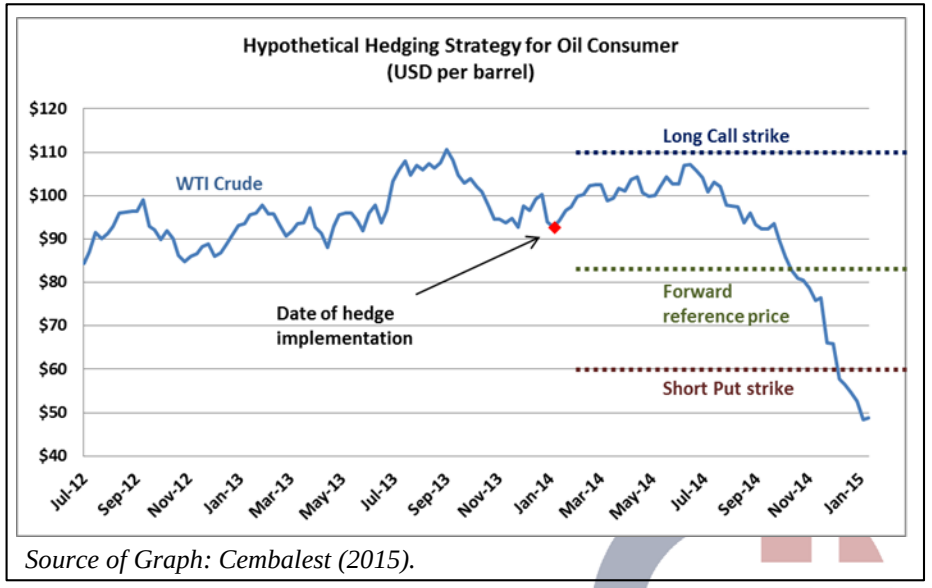
Notes on Graph: "A 3:2:1 crack spread reflects gasoline and distillate production revenues from the U.S. refining industry, which generally produces roughly 2 barrels of gasoline for every barrel of distillate. The 3:2:1 crack spread is calculated by subtracting the price of 3 barrels of oil from the 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.

4. 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."

Cembalest (2015) and Ngai (2014).

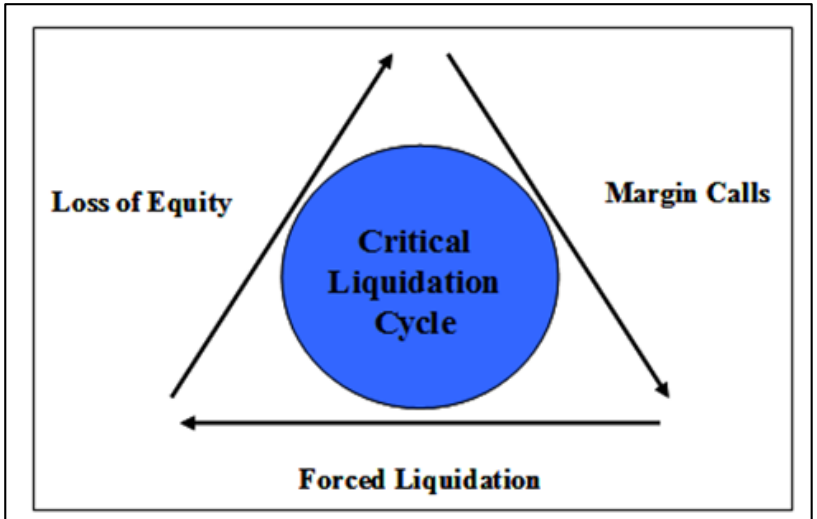
4. Caveats on the Use of Price Data (Continued)

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.

- This scenario illustrates another interaction effect between trades and price.

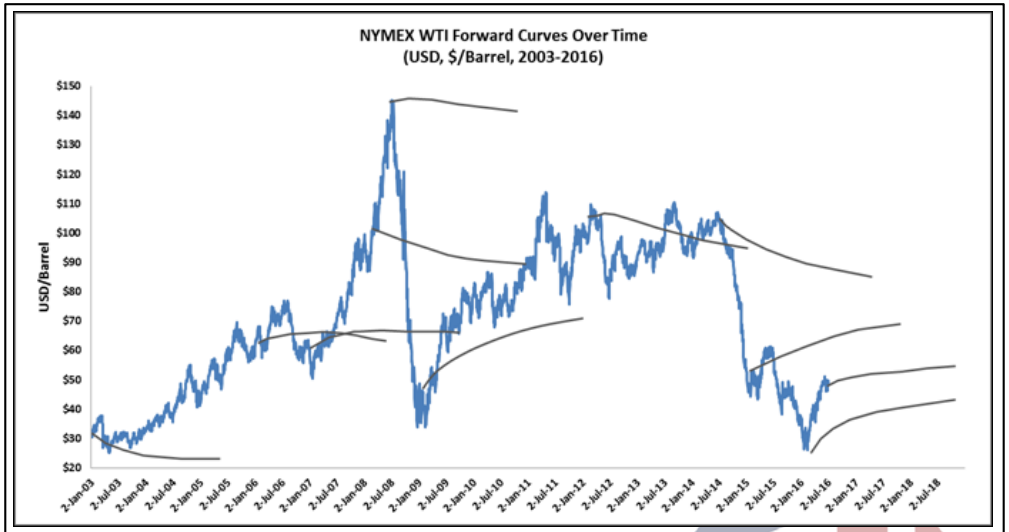


Source of Graph: de Souza and Smirnov (2004).

4. Caveats on the Use of Price Data (Continued)

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

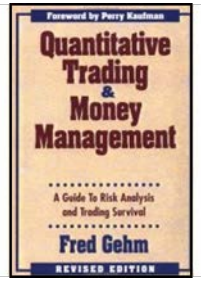
C. Risk Tolerance and Investment Discipline

1. Introduction
2. Taleb’s Example
3. Heating Oil Example
4. Gasoline vs. Heating Oil Spread Example

1. Risk Tolerance and Implementation Discipline Introduction (Continued)

a. Gehm's Advice

- Gehm (2004) lays down a challenge to financial-market writers and presenters.



- This author of Quantitative Trading & Money Management said that most financial literature is unrealistic.

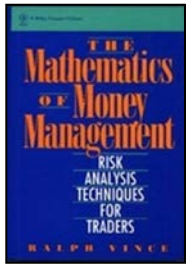
- If financial articles were realistic, they would include both the joys and tears of trading.

Source: Till and Eagleeye (2006).

1. Risk Tolerance and Implementation Discipline Introduction (Continued)

b. Vince's Warning

- We will now provide a small window into what Gehm is referring to.
- In discussing the crucial elements of an investment process, we have left out one vital aspect of trading, and that is a manager's risk tolerance.



- Vince (1992) states that monetizing market inefficiencies "requires more than an understanding of money management concepts. It requires discipline to tolerate and endure emotional pain to a level that 19 out of 20 people cannot bear."

Source: Till and Eagleeye (2006).

1. Risk Tolerance and Implementation Discipline Introduction (Continued)

b. Vince's Warning (Continued)

- "Anyone who claims to be intrigued by the 'intellectual challenge of the markets' is not a trader.
- The markets are as intellectually challenging as a fistfight. …
- Ultimately, trading is an exercise in self-mastery and endurance."

Source: Till and Eagleeye (2006).

2. Taleb's Example

a. Question: Why Is Implementing a Trading Strategy So Difficult?

- Taleb (2001) explains why "implementation discipline" is difficult.
- He provides an example of a return-generating process that has annual returns in excess of T-bills of 15% with an annualized volatility of 10%.
- At first glance, one would think it should be trivial to carry out a trading strategy with such superior risk and return characteristics.

Source: Based on Till (2004).

2. Taleb's Example (Continued)

b. Answer: Because It Can Be Exhausting

- But Taleb also notes that with such a return-generating process, there would only be a 54% chance of making money on any given day.

Probability of Profit at Different Time Scales

Scale	Probability
1 year	93%
1 quarter	77%
1 month	67%
1 day	54%
1 hour	51.30%
1 minute	50.17%
1 second	50.02%

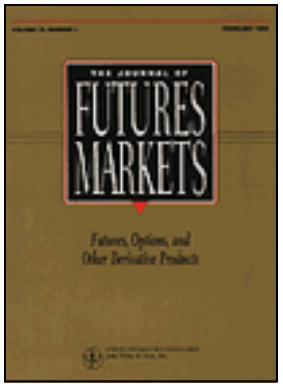
Source: Taleb (2001).

- If the investor felt the pain of loss say 2.5 times more acutely than the joy of a gain, then it could be potentially exhausting to carry out this superior investment strategy.

Source: Till and Eagleeye (2006).

3. Heating Oil Example

- A number of authors have confirmed that backwardation has historically provided an effective signal for profitability over lengthy timeframes.

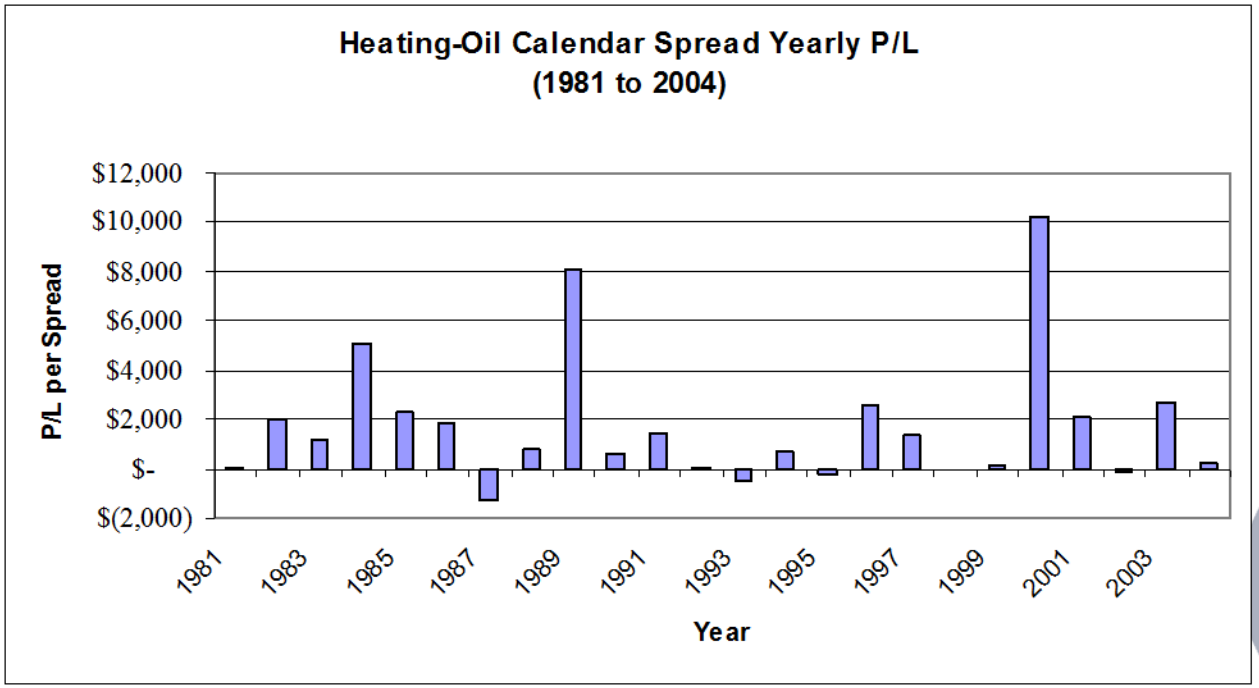


- Abken (1989) showed that going long heating-oil calendar spreads during the times of the year when heating oil tends to trade in backwardation had yielded statistically significant profits from January 1980 through December 1987.

Source: Till and Eagleeye (2006).

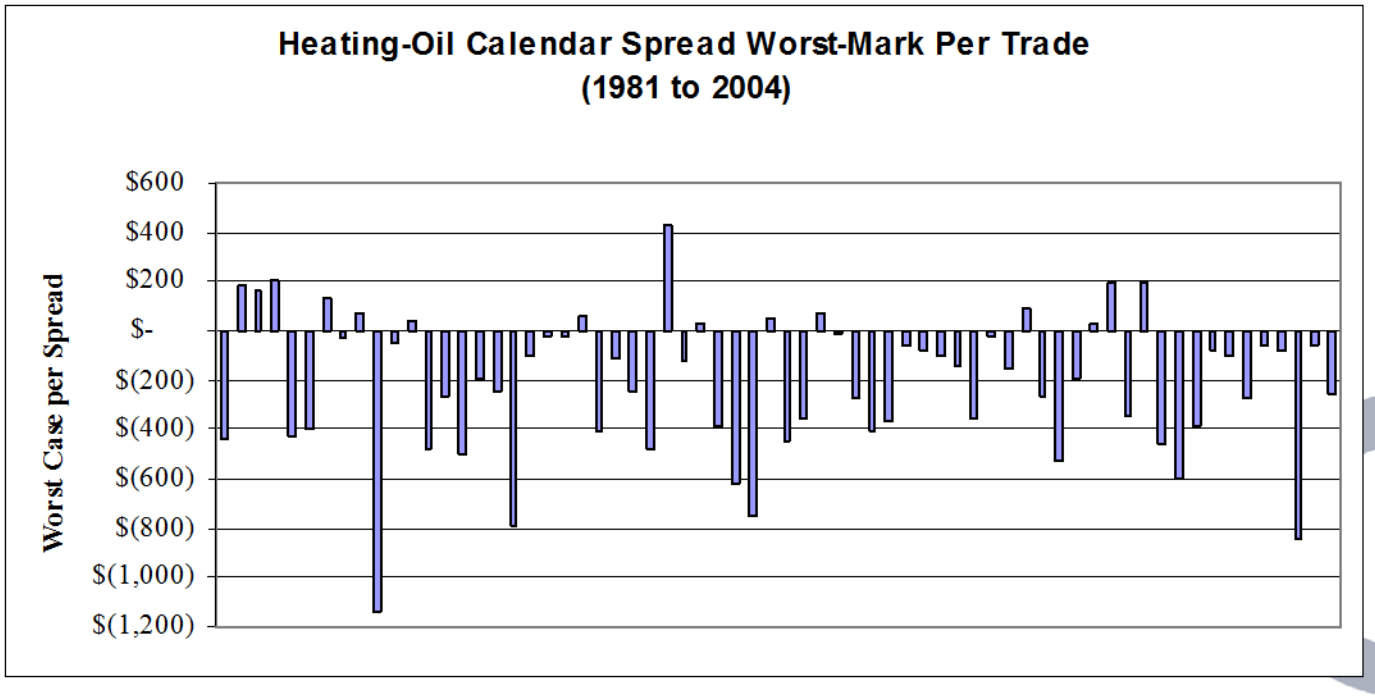
3. Heating Oil Example (Continued)

This strategy continued to work in some form after Abken's 1989 paper was published.



3. Heating Oil Example (Continued)

But while this strategy has been demonstrably statistically significant, its maximum loss has been such that this loss could erase the previous year and a half of the strategy's profits.



3. Heating Oil Example (Continued)

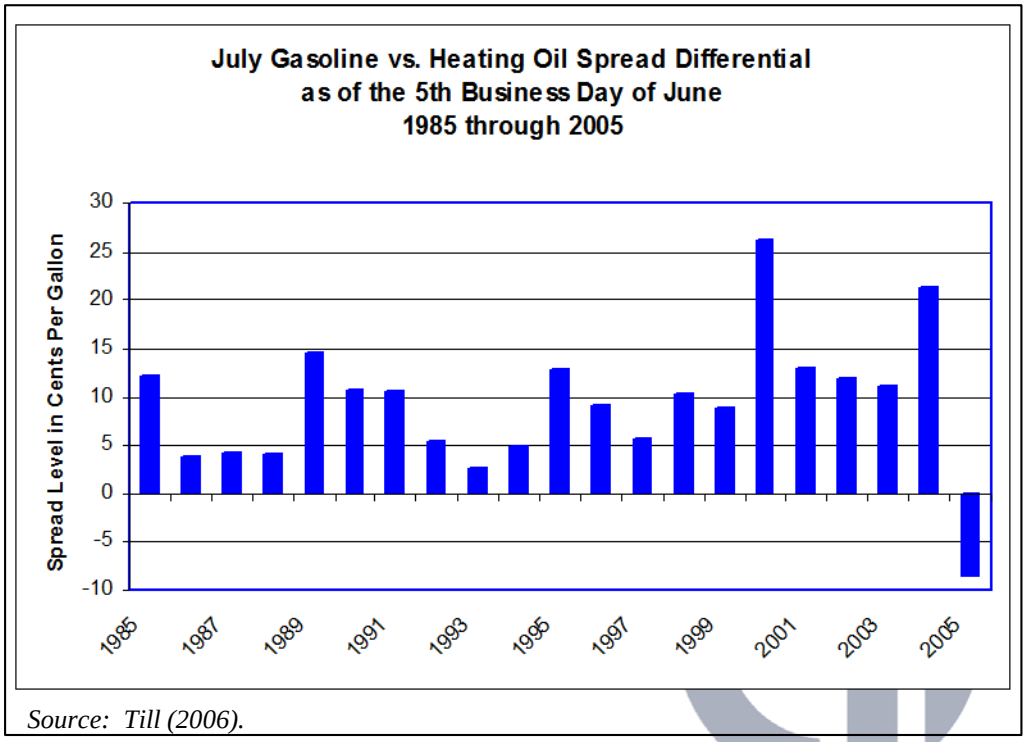
The result is that if a manager experienced a loss of this magnitude, both the manager (and his or her investors) would need to be quite disciplined to continue carrying out this strategy.

4. Gasoline vs. Heating Oil Spread Example

Historical Worst-Case Loss

- Fusaro (2005): In the summer of 2005, "the big Wall Street houses and some other hedge funds lost many … hundreds of millions [of dollars] on gasoline/heating oil spreads.

- They could not imagine that heating oil would go higher than gasoline in June. It just never happened before."



Source: Till (2006).

4. Gasoline vs. Heating Oil Spread Example (Continued)

Historical Worst-Case Loss (Continued)

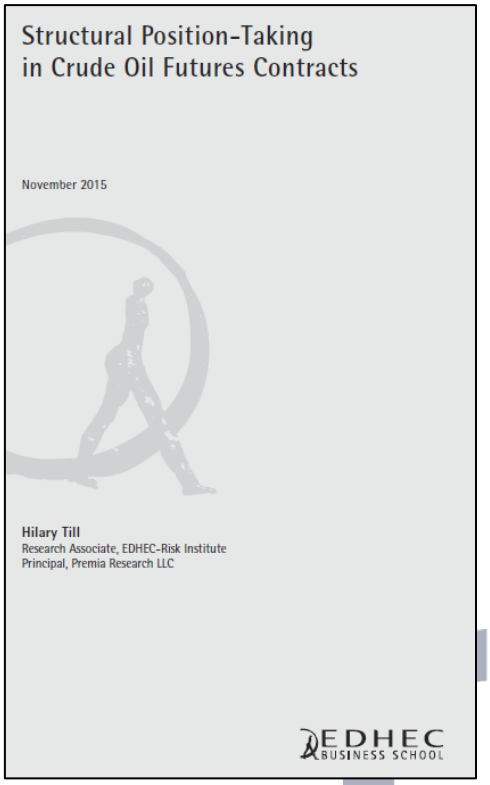
- A trader would have cut down on the maximum realized loss from this previously reliable trade if he or she had stopped out of the trade once it had exceeded its historical worst-case loss.

- This would have required implementation discipline.

V. Investor Insights

A. Portfolio Diversification

B. Useful Indicators for Avoiding Crash Risk

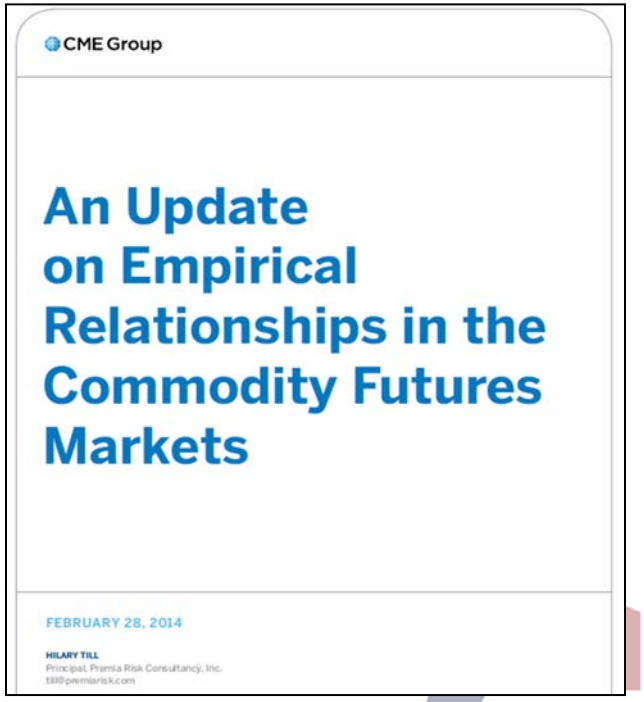


Source: Till (2015).

A. Portfolio Diversification

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

- Accordingly, the main commodity indices tend to be heavily weighted in the petroleum complex.



Source: Till (2014).

B. Useful Indicators for Avoiding Crash Risk

Low Spare Capacity and Ample Supply

Historically, a toggle based on both spare capacity and the crude oil front-to-back spread has provided downside risk protection. The latter variable is correlated to how tight inventories are. (See Slide 38.)

	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%

Source: Till (2015).

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http://faculty-research.edhec.com/faculty-researchers/alphabetical-list/r-s-t/till-hilary-143898.kjsp?RH=faculty-gb1

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