

The Politics and Economics of International Energy

Lecture 4

The functioning of the international oil market

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Outline

- Price formation: past and current regimes
 - Prices, Supply and Demand
 - The Market for Brent
 - Details on the Futures Market
 - The Crude Oil Market: a Broader Picture
 - Causes of volatility
 - Fundamentals or speculation?
 - Better benchmarks?
 - Conclusion
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Price Formation: Past and Current Regimes

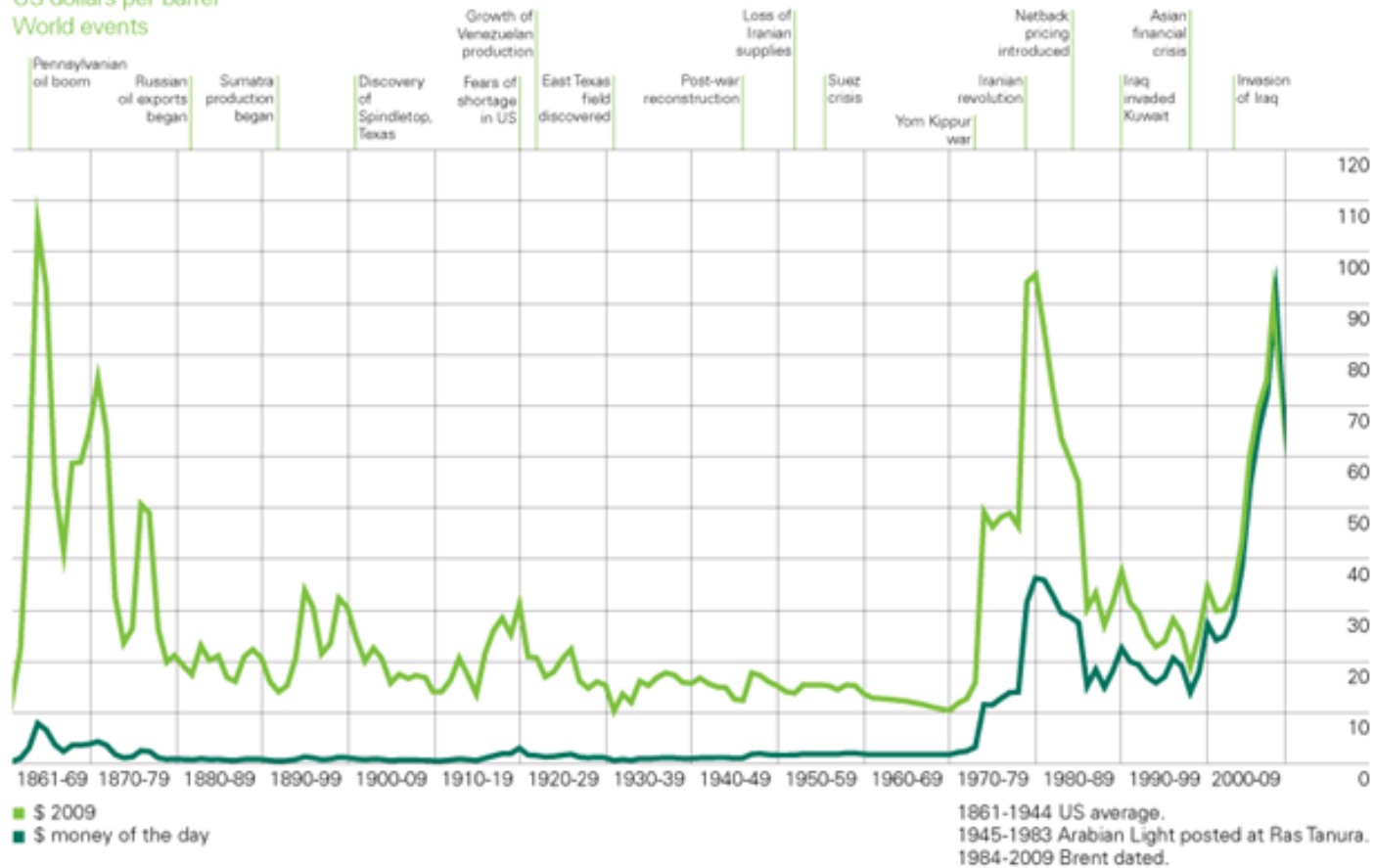
Chart of crude oil prices since 1861



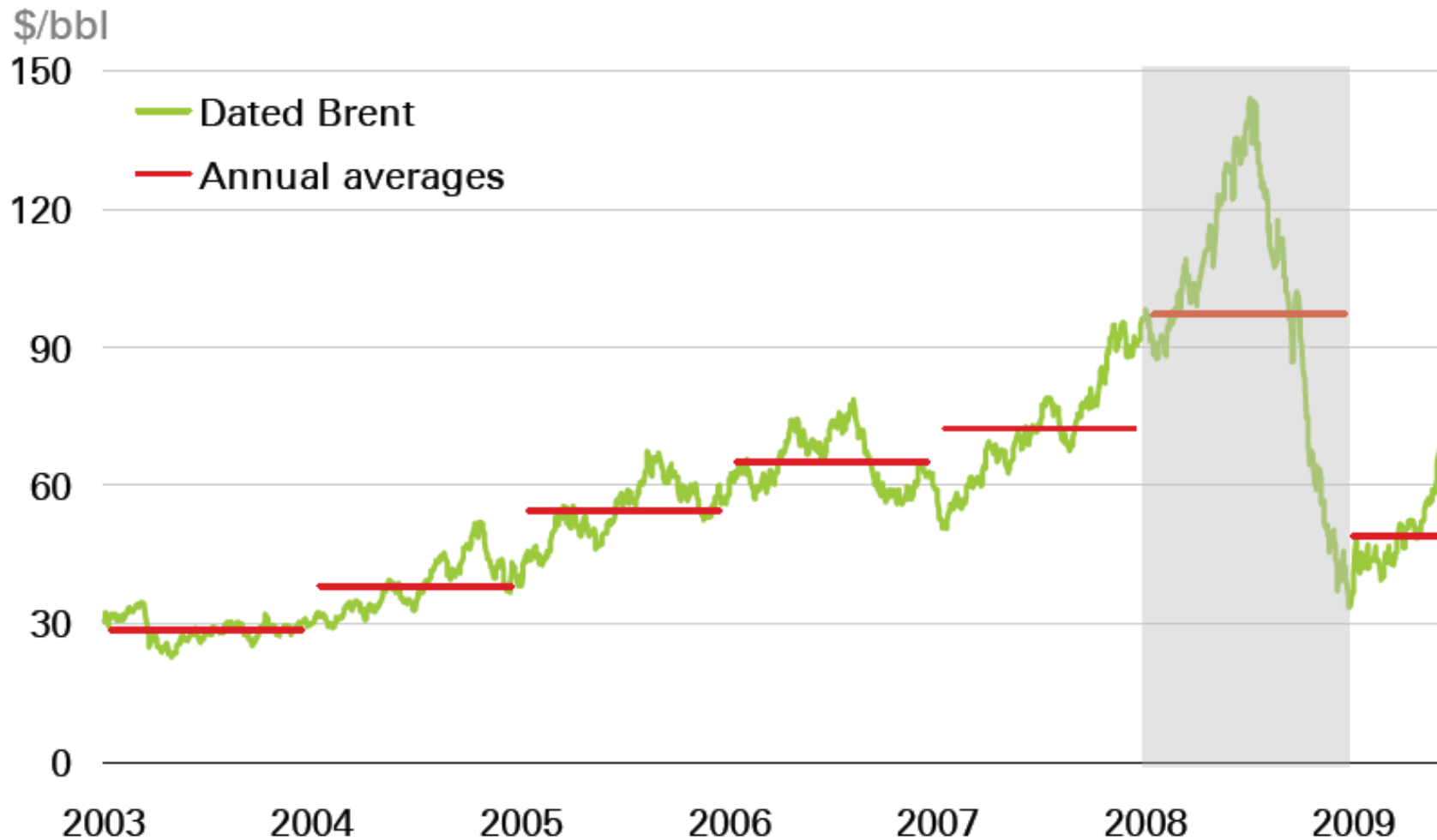
Crude oil prices 1861-2009

US dollars per barrel

World events



Crude Prices: What Happened?



Source: Includes data from Platts

© BP 2009

Successive Price Regimes

- ❑ Before 1880: “Disorder” in the US
 - ❑ 1880-1910: the Standard Oil Trust Regime
 - ❑ 1910-1930: Transition
 - ❑ 1930-1970: the 7 Sisters Pricing Regime:
 - Posted prices controlled by the companies
 - ❑ 1970-1985: the OPEC Pricing Regime:
 - Posted prices controlled by the producing countries
 - ❑ 1985-87: the Netback Pricing Regime:
 - Transition period
 - ❑ 1987 to date: the Reference Pricing Regime
-

1970-85: The OPEC Price Regime

- ❑ In 1970-85, prices were unilaterally determined by producers.
- ❑ In the occasion of political crises, the market (illiquid and opaque) pushed prices higher, and producers consolidated the increases.
- ❑ Saudi Arabia dissented from all others: the quest for a long-run equilibrium price.

Development of the Market in the 1980s

- ❑ The Brent and WTI markets developed in the early 1980s
 - ❑ Non-OPEC supply responded vigorously to higher prices
 - ❑ The OPEC share was eroded, and Saudi production declined to little more than 3 million b/d.
 - ❑ In 1985, Saudi Arabia begins a price war.
-

1985-87: The Netback Pricing Regime

- ❑ Netback pricing means that the price of crude is tied to the price of refined products.
- ❑ Refined product prices are determined by product markets (e.g. Rotterdam).
- ❑ The system lacks transparency and encourages products oversupply.
- ❑ Weak prices – soon abandoned

After 1987: The Reference Pricing Regime

- “Reference pricing” means that the price of a crude which is not freely traded is tied by some formula to the price of another crude which is freely traded.
- The two main reference crudes are Brent and WTI (West Texas Intermediate)

Oil Price Formation

Key Formula

Fixed Price = Underlying + or - Differential

platts

01:00:01 01:02:02 01:02:03 01:02:04 01:02:05 01:02:06 01:02:07 01:02:08 01:02:09 01:02:10 01:02:11 01:02:12

Prices, Supply & Demand

The roots cause of oil price instability

- ❑ Why are oil prices so unstable? (At times, because at other times they were “kept” very stable)
- ❑ The key reason is that both supply AND demand are rigid to price changes in the short term.
- ❑ (Demand appears to be more responsive to income than to price shifts)

Non-OPEC Supply

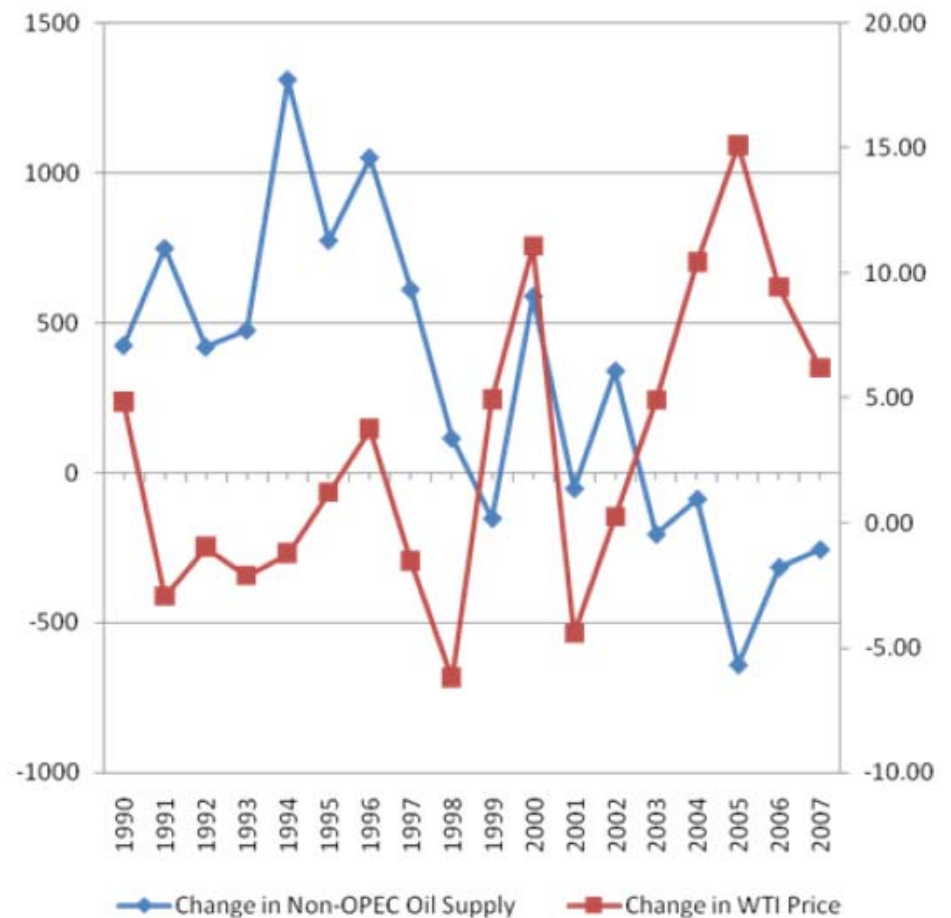
- ❑ Non-OPEC supply is competitive and price responsive.
- ❑ However:
 - Production requires huge up front investment
 - Direct costs are a small component of total costs
 - As long as direct costs are paid, producers are best off maximizing production
- ❑ In actual practice, non-OPEC production cannot satisfy global demand and producers always maximize production.
- ❑ OPEC must provide the difference – this is the “call on OPEC”.

OPEC Supply

- ❑ OPEC supply is limited by quotas, first established in the 1980s.
 - ❑ OPEC supply does not respond to prices (except for “cheating”, which occurs anyway but is more tolerated if prices are high).
 - ❑ In fact, OPEC quotas are (unpredictably) modified to pursue a revenue or price objective.
 - ❑ If prices are high, production may be reduced because revenue targets are met anyhow – and vice versa.
-

Supply Response

- Response of non-OPEC production to oil prices low
 - Producers do not increase production in face of a price rise
 - A reduction in oil prices does not induce producers to reduce production
 - Krichene (2006): long run price elasticity of 0.08
 - Gately (2004) reports a wide band of price elasticity varying from 0.15 to 0.58 by 2020
- Other factors affect investment and supply
 - Sanctions (Iran, Libya, Sudan)
 - Political instability (Iraq, Nigeria)
 - Access to reserves and hardening of contractual terms (Venezuela, Algeria, Russia)
 - Uncertainty and the option to wait
 - Rising costs
 - Shortage of human capital



Global Demand

- Demand too is price inelastic:
 - Oil satisfies essential needs
 - Higher per capita income
 - Concentration in transportation
 - Taxes isolate consumers from the impact of price changes.
 - Demand is influenced primarily by macro trends (income effect) and the weather.
-

Oil Demand Price Elasticity

- Oil demand price elasticity is close to zero in short run
- Price elasticity of demand is higher in long run due to substitution and energy conservation but elasticity still quite low
- Declining over time
 - Hughes, Knittel and Sperling (2008): US short-run price elasticity has declined
 - 0.21 to 0.34 over 1975-1980
 - 0.034 to 0.077 for 2001-2006

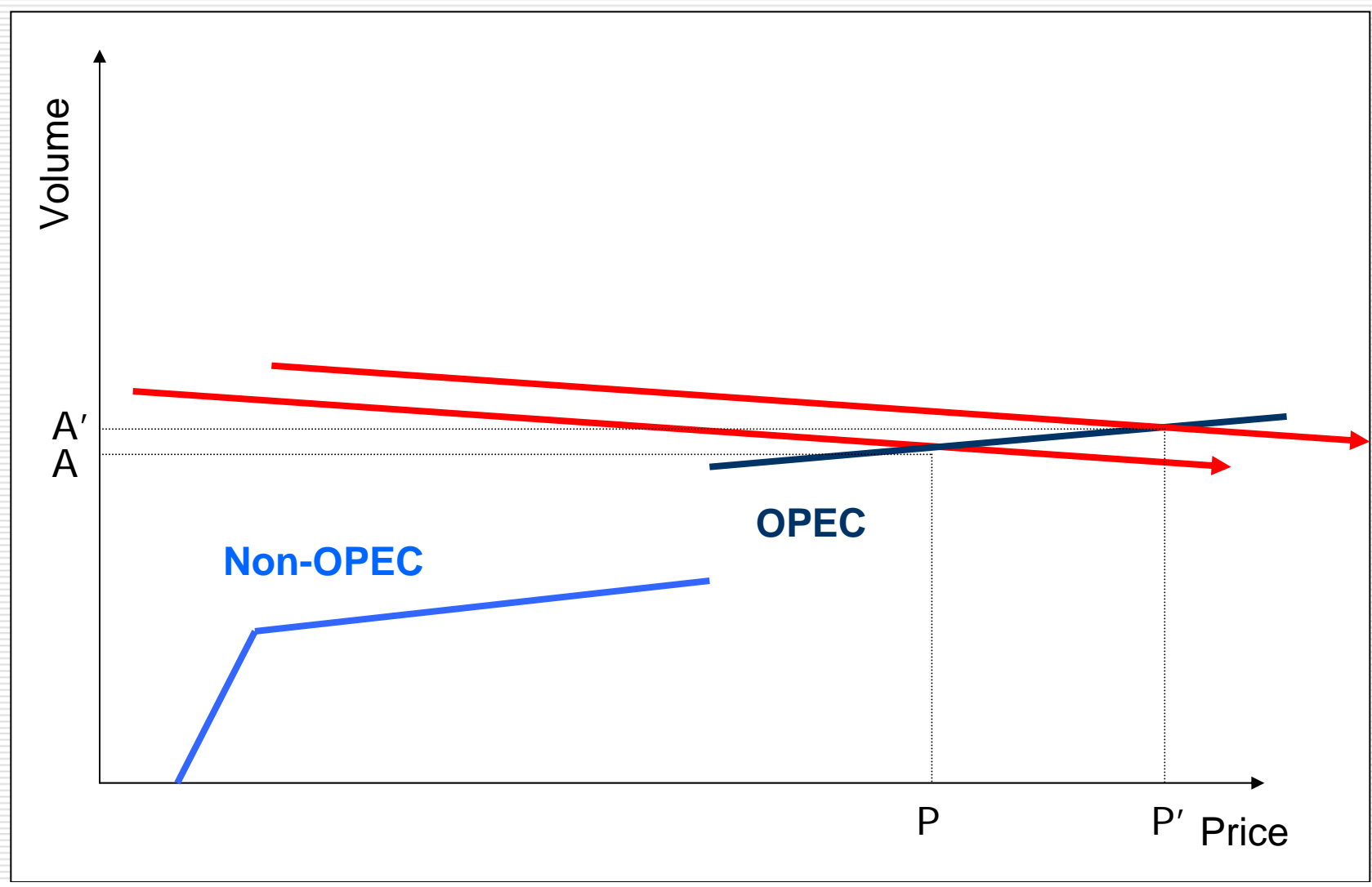
Studies	Short run	Long run	Sample
Dahl, 1993	-0.05 to -0.09	-0.13 to -0.26	Developing countries
Pesaran <i>et al.</i> , 1998	-0.03	0.0 to -0.48	Asian countries
Gately and Huntington, 2002	-0.05 -0.03	-0.64 -0.18 -0.12	OECD Non-OECD Fast growing non-OECD
Cooper, 2003	0.001 to -0.11	0.038 to -0.56	23 countries
Brook <i>et al.</i> , 2004		-0.6 -0.2 -0.2	OECD China Rest of World
Griffin and Schulman, 2005		-0.36	OECD
Krichene, 2006	-0.02 to -0.03	-0.03 to -0.08	Various countries

Oil Demand Income Elasticity

- Oil demand more responsive to income than prices
- Responsiveness of oil demand to income been declining over time in OECD
- Developing countries exhibit higher income elasticity than OECD
 - Do not expect income elasticity of oil demand to fall in developing countries very soon

Studies	Long run income elasticity	Sample
Ibrahim and Hurst, 1990	> 1.0	Developing countries
Dahl, 1993	0.79 to 1.40	Developing countries
Pesaran <i>et al.</i> , 1998	1.0 to 1.2	Asian countries
Gately and Huntington, 2002	0.56	OECD
	0.53	Non-OECD
	0.95	Fast growing non-OECD
Brook <i>et al.</i> , 2004	0.4	OECD
	0.7	China
	0.6	Rest of World
Krichene, 2006	0.54 to 0.90	Various countries

Demand and Supply are Rigid in the Short Term



However, in the longer run...

- ❑ Demand and (less so) supply are price elastic.
 - ❑ Consumers will make the investment required to reduce fuel consumption or switch to a different fuel.
 - ❑ On the supply side, companies' cash flow improves, investment increases, new fields are developed.
 - ❑ However, higher prices may also encourage resource nationalism and slow down investment/production
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The Market for Brent

The Market for Brent

- Brent is a field in the UK North Sea.
- The market consists of:
 - A “spot” market;
 - A “physical forward” market;
 - A “futures” market – based at the International Petroleum Exchange (IPE) in London

The spot market, or “dated Brent”

- “Dated Brent” refers to the sale of a specific cargo that is either available in a specific loading slot or that is already loaded and in transit to some destination.
 - Main characteristics:
 - Transactions are bilateral,
 - Over the counter (OTC),
 - For variable quantities.
-

The forward market, or “15-day Brent”

- ❑ The 15-day cargo is a standard parcel (500,000 barrels) that will be made available by the seller to the buyer on an unspecified day of the relevant month.
 - ❑ The clearing involves book-outs or seller’s nominations, which can take place on any day in the period starting fifteen days before the beginning of the relevant month and closing eighteen days before its end.
 - ❑ As dated Brent, 15-day Brent is bilateral and OTC – but it is standardized.
-

The futures market

- ❑ The futures market was launched by the International Petroleum Exchange (IPE – today International Commodity Exchange - ICE) in 1988
 - ❑ 1 contract = 1000 barrels
 - ❑ Contract based on cash settlement and not on physical delivery
 - ❑ If a contract is allowed to expire the settlement price is the Brent index
 - ❑ Central exchange and clearing house rather than bilateral trades
 - ❑ Several months traded
-

Details on the Futures Market

Options

- ❑ Launched by the IPE in 1989
- ❑ A call option gives the holder the right to buy the underlying futures contract, and a put option the right to sell.
- ❑ Call and put options may be combined to design complex risk management strategies.

What are options for?

- Any buyer or seller on the petroleum market faces a price risk.
- Options and futures allow parties facing a structural risk to limit that risk, “selling” it to speculators (or “insurers”).

Hedging

- ❑ A producer can sell futures or buy put options to ensure a minimum level of prices.
 - ❑ A large consumer can buy futures or a call option to ensure against very high prices
 - ❑ Major companies are on both sides of the market and may be doing both things at the same time.
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Why so many Paper Barrels?

- Most participants in the futures market are there to manage their risk, not to acquire Brent crude.
- Buying and selling Brent futures and options is an effective strategy because other crude prices follow Brent movements.

The Structure of the Oil Market

- ❑ At the center, we find the market for Brent and WTI, which influence each other
- ❑ Brent and WTI trade few physical and lots of paper barrels
- ❑ Paper and wet barrels influence each other, but paper barrels are more important
- ❑ Smaller markets, such as ANS and Dubai, are influenced by Brent and WTI

Other Crudes

- ❑ All other major crudes are priced on the basis of formulas which tie them to Brent or WTI
- ❑ The producing countries oppose the free trading of their crudes, and restrict destination and secondary trading
- ❑ Formulas are modified from time to time, but the essence remains

Over the past two decades, global crude markets have relied on benchmarks as the predominant price discovery tools

What is a crude oil benchmark?

- A defined grade/stream of crude oil that is used as a basis for pricing other crude streams (e.g., West Texas Intermediate (WTI), Brent, Dubai and Oman)

Why are crude oil benchmarks used?

- Crude oil streams significantly vary in their characteristics (e.g., gravity and sulphur content). There are more than 160 unique crude streams.
- Benchmarks facilitate market price discovery by representing the market value of the “marginal barrel” against which other crudes can be priced.

How are benchmarks used?

- A benchmark price is used as the basis for pricing other crudes sold in a given region, adjusted for quality variability and other market factors
- E.g., Canadian exports to US = WTI +/- monthly adjustment factor

Example: Saudi Arabia's Prices for 09/10

US (Price Reference ASCI As Of January 2010 / WTI 2009)													
	2010									2009			
	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep
Arab Light (32-36°)	-0.45	-0.40	-0.40	-0.35	-0.40	-0.60	-0.75	-0.60	-0.75	-3.75	-4.60	-2.90	-1.10
Arab Medium (29-32°)	-2.00	-2.10	-2.10	-2.15	-2.20	-2.10	-2.20	-2.20	-1.95	-5.20	-5.70	-4.00	-2.40
Arab Heavy (<29°)	-3.35	-3.50	-3.40	-3.70	-3.60	-3.30	-3.15	-3.45	-3.00	-6.15	-6.20	-4.45	-3.10
Arab Extra Light (36-40°)	+1.15	+1.45	+1.30	+1.70	+1.35	+0.95	+0.80	+1.00	+0.80	-2.10	-3.35	-1.75	+0.25
North West Europe (Price Reference Brent Weighted Average)													
	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep
Arab Light (32-36°)	-2.40	-1.40	-2.15	-3.55	-3.75	-2.30	-1.65	-1.80	-2.30	-1.80	-1.60	-1.80	-2.30
Arab Medium (29-32°)	-3.90	-3.05	-3.90	-5.45	-5.45	-3.70	-2.65	-3.00	-3.40	-3.00	-2.65	-2.95	-3.40
Arab Heavy (<29°)	-4.60	-3.90	-4.85	-6.55	-6.25	-4.25	-3.10	-3.65	-3.90	-3.45	-2.80	-3.20	-3.65
Arab Extra Light (36-40°)	-1.70	-0.35	-1.10	-2.20	-2.40	-1.65	-1.00	-1.00	-1.65	-1.05	-1.10	-1.35	-1.60
Mediterranean (Price Reference Brent Weighted Average)													
	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep
Arab Light (32-36°)	-2.95	-2.25	-2.10	-4.00	-3.90	-2.65	-1.90	-1.80	-2.25	-1.80	-1.90	-1.90	-1.55
Arab Medium (29-32°)	-4.65	-4.00	-3.95	-6.15	-5.95	-4.15	-2.70	-3.00	-3.25	-2.80	-2.80	-3.25	-2.65
Arab Heavy (<29°)	-5.40	-4.90	-4.90	-7.25	-7.10	-4.80	-3.25	-3.45	-3.95	-3.60	-3.25	-3.70	-3.20
Arab Extra Light (36-40°)	-1.70	-0.60	-0.40	-2.35	-2.25	-1.05	-0.75	-0.70	-1.40	-0.85	-1.00	-1.00	-0.80
Far East (Price Reference Oman/Dubai)													
	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep
Arab Light (32-36°)	-0.65	-0.15	-0.20	+0.20	-0.10	-0.45	-0.15	+0.10	+0.45	+0.50	+0.15	+0.60	-0.25
Arab Medium (29-32°)	-2.15	-1.75	-1.75	-1.60	-1.70	-1.60	-0.95	-0.85	-0.45	-0.55	-0.45	-0.30	-1.20
Arab Heavy (<29°)	-3.40	-3.00	-2.95	-2.90	-2.90	-2.50	-1.65	-1.65	-1.25	-1.45	-1.05	-0.90	-1.85
Arab Extra Light (36-40°)	+0.20	+0.80	+0.65	+1.35	+1.15	+0.55	+0.70	+0.90	+1.25	+1.25	+0.40	+0.85	-0.05
Arab Super Light (>40°)	+0.25	+1.10	+1.25	+2.20	+2.10	+1.10	+0.90	+1.40	+1.70	+1.30	+0.40	+1.10	+0.10

To accurately represent fair value a crude benchmark should ideally satisfy a comprehensive set of criteria



1. Robust long-term production levels (300,000-400,000+ bpd)
2. Relatively stable daily production levels (e.g., not subject to OPEC cuts, location away from regional hurricane centers)
3. Quality indicative of other regional/substitute crudes*
4. Availability of liquid, freely-traded secondary market (e.g., no destination restrictions)
5. Multiple production/access rights, ensuring market access by numerous players

* As a measure of the marginal barrel, a benchmark should preferably be marginally higher quality, in order to ensure ease of substitution

How is the Market Cleared?

- ❑ Brent/WTI are not the marginal crudes that balance demand and supply.
- ❑ Yet, it is Brent/WTI that make the price.
- ❑ The implication is that demand and supply are not necessarily balanced: OPEC and other operators manage supply and/or stocks, given the price.

The Feedback Issue

- Given this market structure, operators that have no interest in Brent crude trade in Brent futures and options, to manage their risk
- In this way, a certain feedback is obtained between the global physical oil market and Brent
- However, such feedback is limited and partial
 - The feedback would be greater if all operators hedged systematically; in that case, an excess of demand would raise the price of calls, financial intermediaries would lower the price of puts, producers would be incentivated...

OPEC and Brent/WTI prices

- ❑ OPEC has no direct control on Brent/WTI prices. It attempts to exert an influence through signaling and decisions on quotas.
 - ❑ But quotas are never fully implemented, and in any case are but one of the elements at play: Brent's price response to quota shifts is unpredictable.
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Other influences

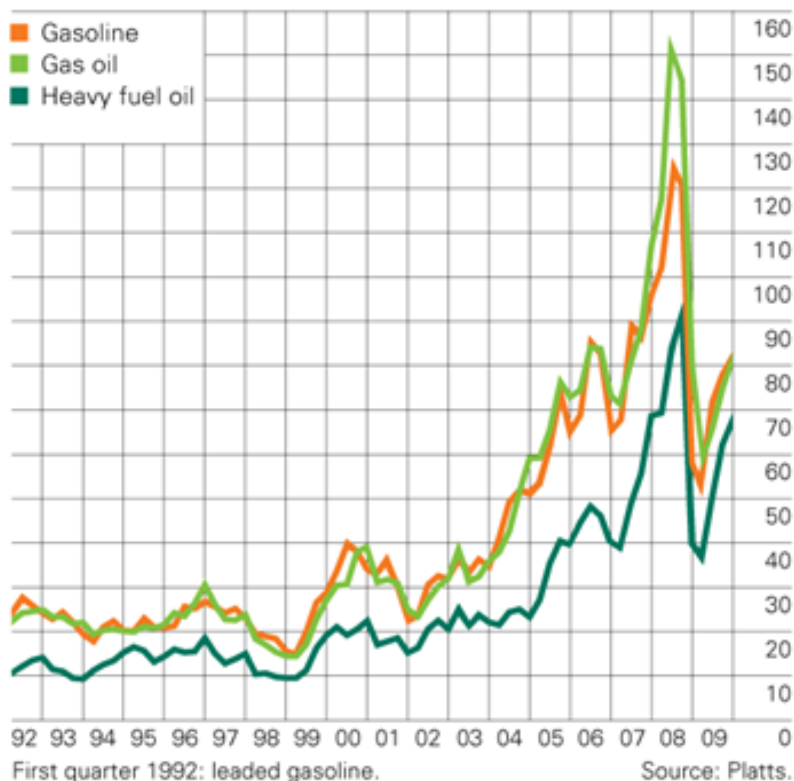
- ❑ Refined products markets also have a feedback on Brent and WTI, but the prevailing influence is in the opposite direction.
 - ❑ Except in the US and UK, the price of natural gas is also indexed to crude or products prices
 - ❑ Only the price of coal is truly independent of Brent and WTI
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Chart of Rotterdam & Gulf Coast product prices



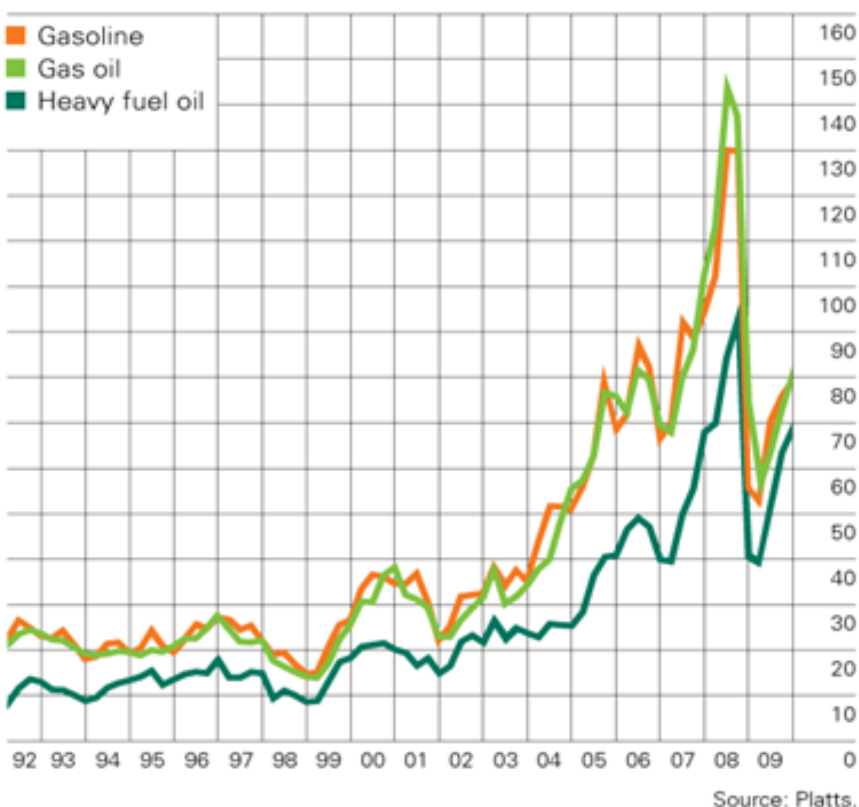
Rotterdam product prices

US dollars per barrel

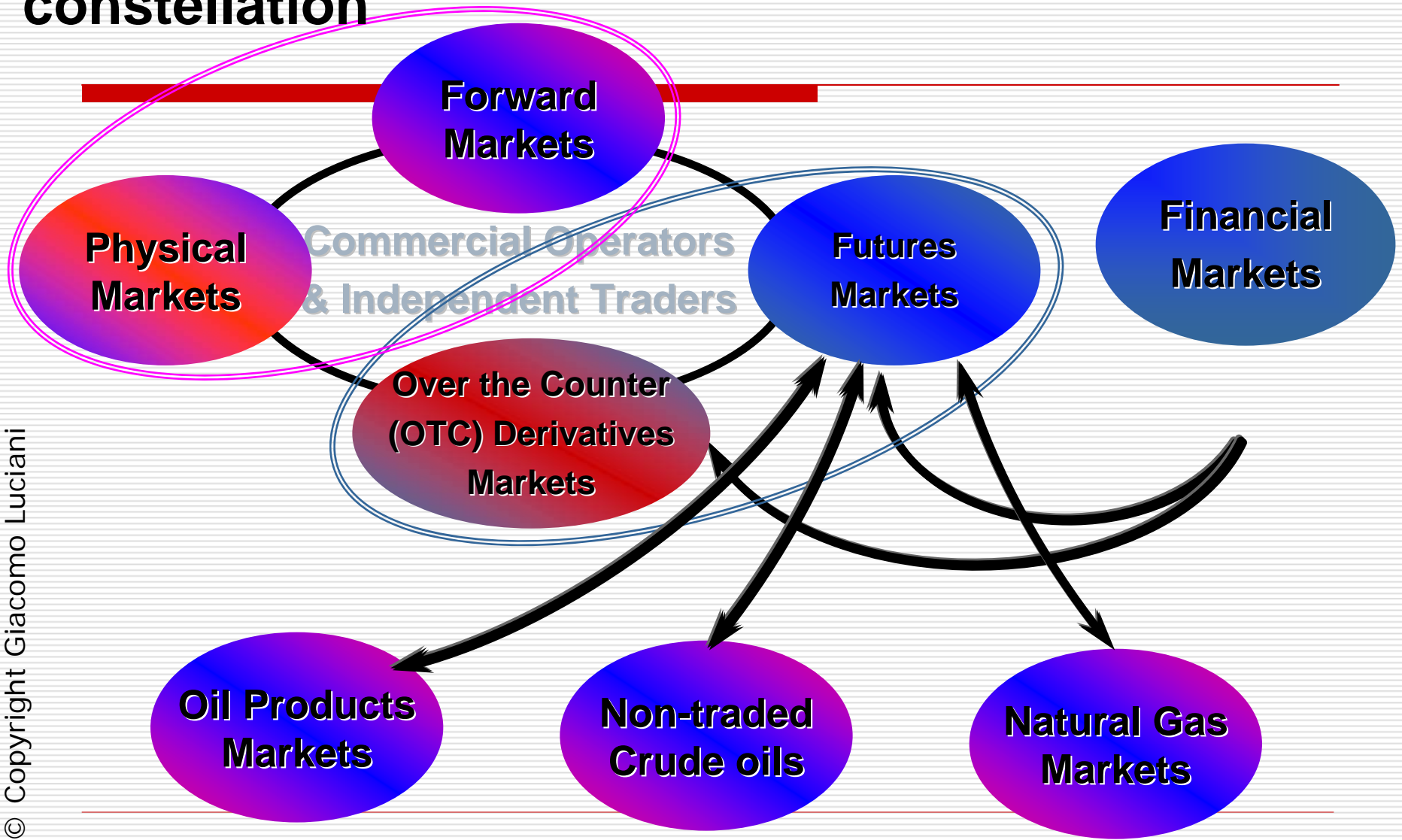


US Gulf Coast product prices

US dollars per barrel

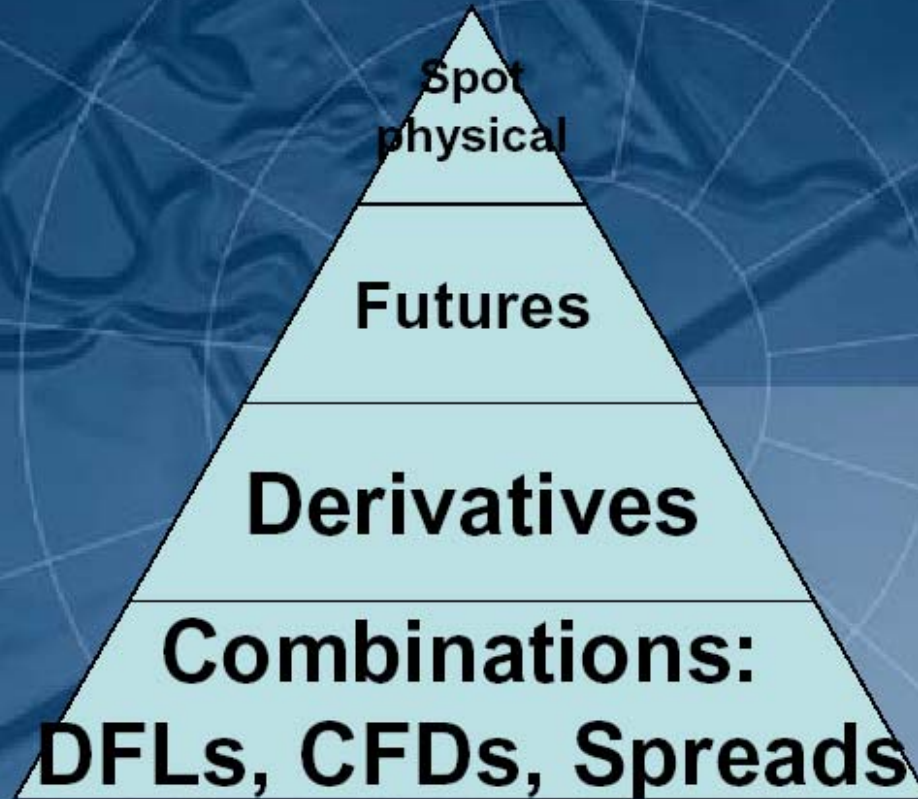


Oil Prices - a increasingly complex market constellation



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Price Pyramid



platts

Price

DEFS, CDSs, ZIRP, etc.
Combinations:

Derivatives

Futures

Options

Price Premium

Why oil producing countries like reference pricing?

- ❑ Accepting pricing out of a market implies that producers are giving up on an important role
 - ❑ They should naturally be price makers, instead are price takers
 - ❑ Why? First and foremost because in the past they failed in the management of posted prices.
-

Why there is no Arabian Light market?

- Setting up a market for a major crude, such as e.g. Arabian Light, is not easy because there is just one seller
- The seller does not want the responsibility of making prices, because he is afraid of international political pressure or domestic dissension.

Causes of Volatility

How can we explain this?

ICE Brent Crude Oil Front Month



Volatility

- Volatility is a challenge for all:
 - Producing countries face unstable revenues
 - Companies face uncertainty in investment decisions
 - Consumers pay higher prices than would be necessary to stimulate supply
- Volatility is caused by:
 - Price rigidity of oil supply and demand in short term
 - Prevailing influence of futures vs. physical trading
 - Benchmarks shortcomings

Main questions about prices

- Why prices are where they are?
 - Political instability
 - “Paradigm shift”
 - Speculation – flow of funds
 - Unreliable benchmarks -volatility

Political instability

- ❑ Routine explanation
 - ❑ It is normally quite easy to find a political disturbance to which higher prices may be attributed: Iraq, Venezuela, Nigeria, today Turkey/Kurdistan...
 - ❑ But political instability is the norm, not the exception
 - ❑ Therefore, this interpretation is pretty useless ex ante
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Paradigm shift

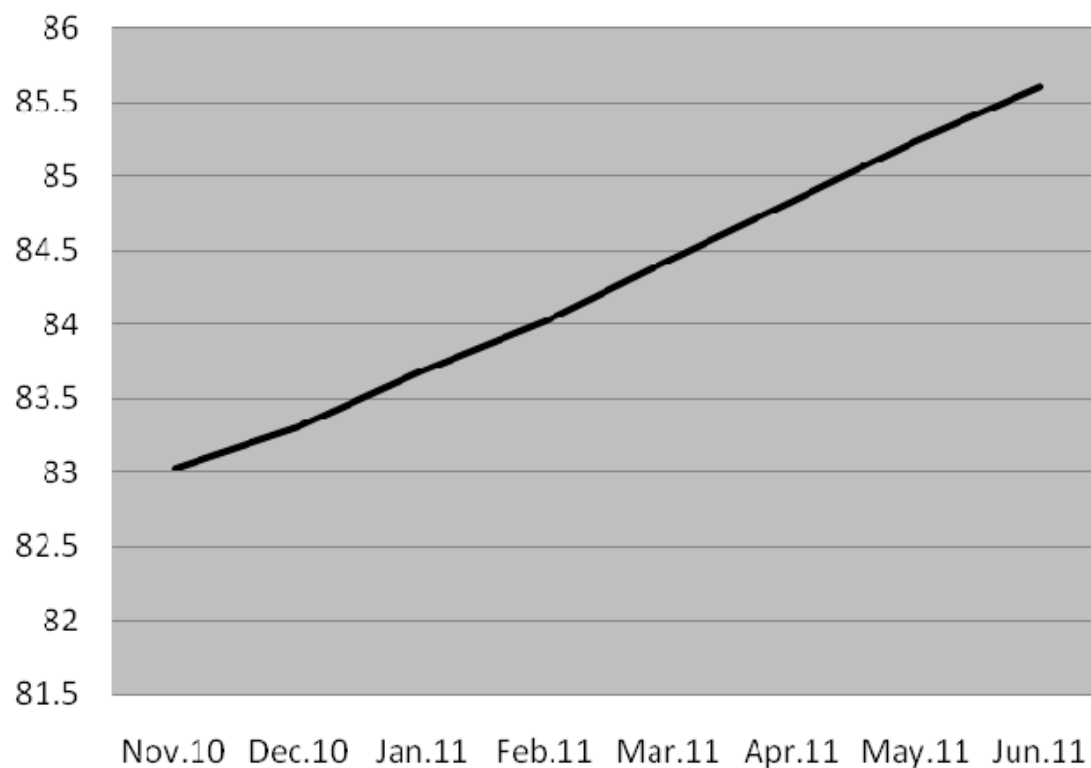
- Prices are high and increasing because oil supply is tight
- Beginning in 2004, markets signaled a paradigm shift by way of a protracted anomalous contango
- Markets went back to backwardation in the summer of 2007

The Forward Curve

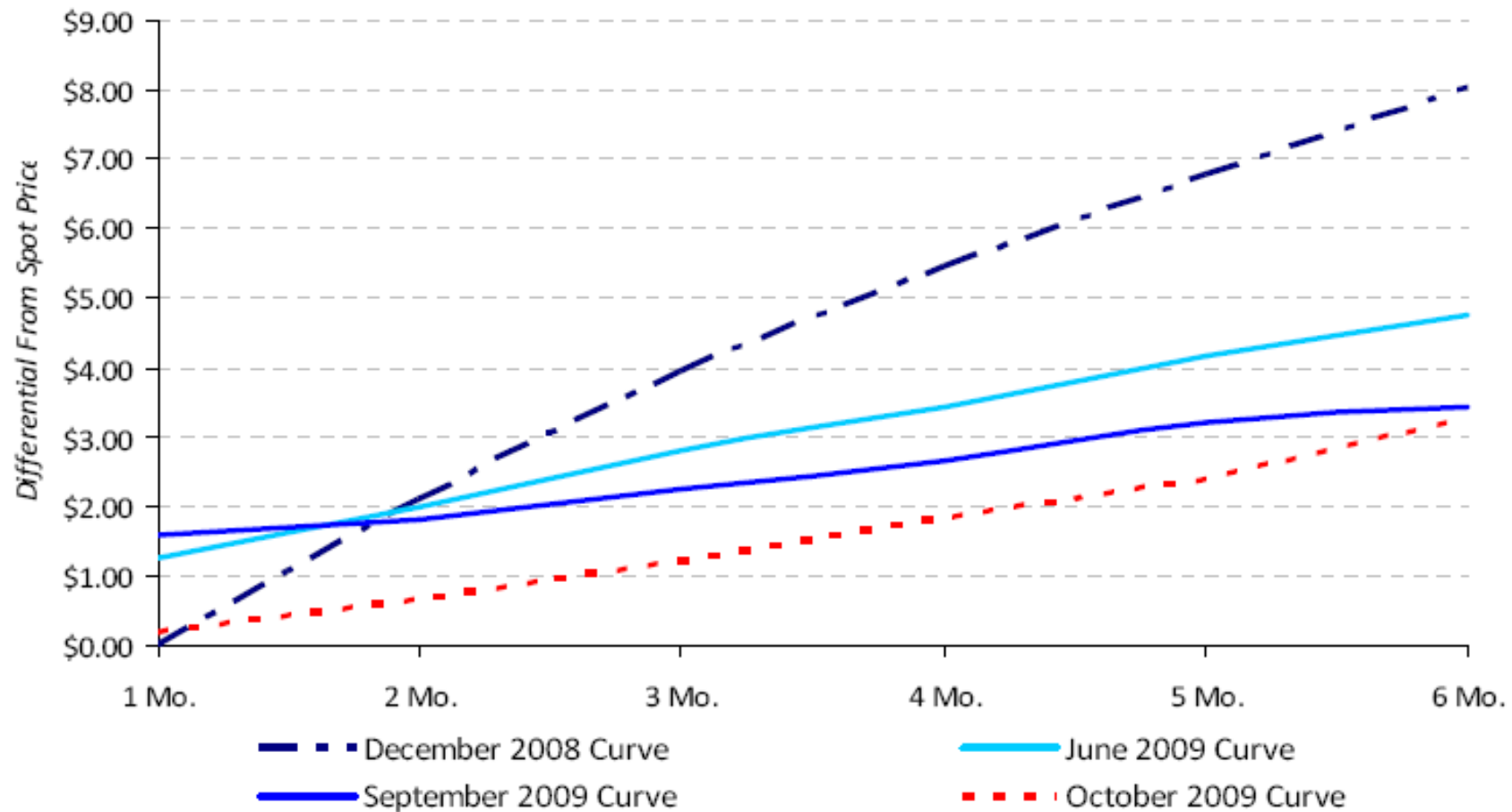
- At any point in time, we have several prices for the same marker for different maturity future contracts.
 - If prices for subsequent months are lower than the closest-month price the market is said to be in backwardation
 - If prices for subsequent months are higher than the closest-month price the market is said to be in contango
-

Presently,
the market
is in
contango

Brent Forward Curve Oct. 4, 2010



Crude Oil (WTI) Spot vs. Future Prices



Source: *Barchart/NYMEX*

Meaning of contango

- ❑ A contango occurs when the market expects future prices to be higher than today's
- ❑ Normally, a contango occurs when prompt prices are low, backwardation when they are high
- ❑ Backwardation is the "normal state" of a market because holding stocks has a physical and financial cost (interest rate)

What is the impact of backwardation/contango?

- ❑ Contango encourages the buildup of physical stocks (you earn money by buying spot and selling futures, while holding the commodity)
 - ❑ Backwardation encourages financial commodity investors (you make money by buying futures and waiting for futures to converge to spot prices)
-