The Crude Oil Pricing System: Features & Prospects

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Speculation Versus Fundamentals Debate

- Behaviour of oil prices in 2008-2009 polarised views about key drivers of oil prices
  - Fundamentals
  - Speculation
- Empirical evidence so far failed to settle the dispute
  - Data limitations, methodological problems, inter-related determinants, endogeneity issues
- Dichotomy still dominates debate, but is it useful?
  - Assumes a clear dividing line between commercials and non-commercials
  - Financial players don't operate in isolation of physical parameters of the oil market
  - Oil price be sliced into various components reflecting fundamental and non-fundamental factors theoretically weak and empirically can't be implemented
  - Assumes that speculators form a homogenous group
    - Financial players are quite diverse
  - Financialisation of crude oil
  - Two layers of price discovery: paper and physical
    - What are the links between the two?

Wide Range of Financial Players

- **Investment banks**
  - Largest traders of oil since collapse of OPEC administered pricing system in 1986
  - Recently more involved in bridging gaps between producers and a more diverse set of customers some of which are financial players

- **Hedge funds** (leveraged account; allowed to borrow in order to finance activities)
  - Macro hedge funds
    - Trade in a range of markets (not just commodities)
    - Have a top-down approach and take a view on macroeconomic issues
  - Specialist commodity hedge funds
    - Bottom-up approach, use large quantities of data; take a strong view of fundamentals of supply and demand
  - 'Black box' hedge funds
    - Have a view of the oil price based on calculations known only to them

- **Institutional investors** primarily consist of pension funds, insurance companies, sovereign wealth funds
  - Typically put a small share of their funds into commodities for sake of portfolio diversification
  - Tend to sell when prices are high and buy when they are low, stabilising the market, owing to (price-weighted) limits in their portfolios

- **Retail investors**, including private investors and high net worth individuals
  - one of the fastest growing categories

Diverse Strategies

- Many financial investors with very diverse strategies
  - Active vs passive
  - Physical interest vs paper interest
  - Fundamental analysis vs trade on trends
  - Irrational momentum players vs entirely rational momentum players (many physical players)
    - Aware of unsustainable herd effect but rationally decide to ride momentum for a period of time before getting out in time

Is Crude Oil a Financial Asset?

- View that crude oil acquired characteristics of financial assets such as stocks or bonds become popular
- Nature of financialisation and its implications not yet clear
  - Most studies focus on outcomes: correlations between returns and levels of oil prices, financial indexes and exchange rates
- Full understanding of degree of interaction between oil and finance requires, in addition, an analysis of *processes*
  - Investment and trading strategies of distinct types of financial participants
  - Financing mechanisms & degree of leverage supporting those strategies
  - Mechanisms that link the financial and physical layers of the oil market
- Unlike a pure financial asset crude oil market has also a "physical" dimension
  - Crude oil consumed, stored & widely traded with millions of barrels being bought and sold every day at prices agreed by transacting parties
- Prices in the futures market through the process of arbitrage should eventually converge to so-called "spot" prices in physical markets reflecting current market fundamentals
- Story more complex
  - Current market fundamentals never known with certainty
  - Important to understand process of convergence plus what "spot" price, in the context of oil market really means

The International Oil Pricing System

- Collapse of OPEC administered pricing system in 1986 ushered in a new era in oil pricing
  - Power to set oil prices shifted from multinational oil companies in 1950s and 1960s and OPEC from 1973 to 1986 to the so called ‘market’

- Development of a complex structure of interlinked layers which consist of spot and also physical forwards, futures, options and other derivative markets referred to as paper markets

- Most complex structures emerged in the North Sea around Brent, in US around the West Texas Intermediate (WTI), in the Gulf around Dubai
  - International benchmarks of pricing system

- Price of key oil benchmark crudes at heart of pricing system
  - Used by oil companies and traders to price cargoes under long-term contracts
  - Used in spot market transactions
  - By futures exchanges for settlement of their financial contracts
  - By banks and companies for settlement of derivative instruments such as swap contracts
  - By governments for taxation purposes

Physical Benchmarks

- Physical delivery of crude oil
  - Spot market
  - Long-term contracts negotiated bilaterally between parties for delivery series of shipments

- Formula pricing used in calculating price of an oil shipment

- Link price of different varieties of crudes to specific benchmark
  - *Formula pricing:* $P_x = P_R \pm D$
    - where P_x = price of crude *x;*
    - P_R = benchmark crude price;
    - D = value of price differential

- Agreed for price to be set at time or around of time of loading

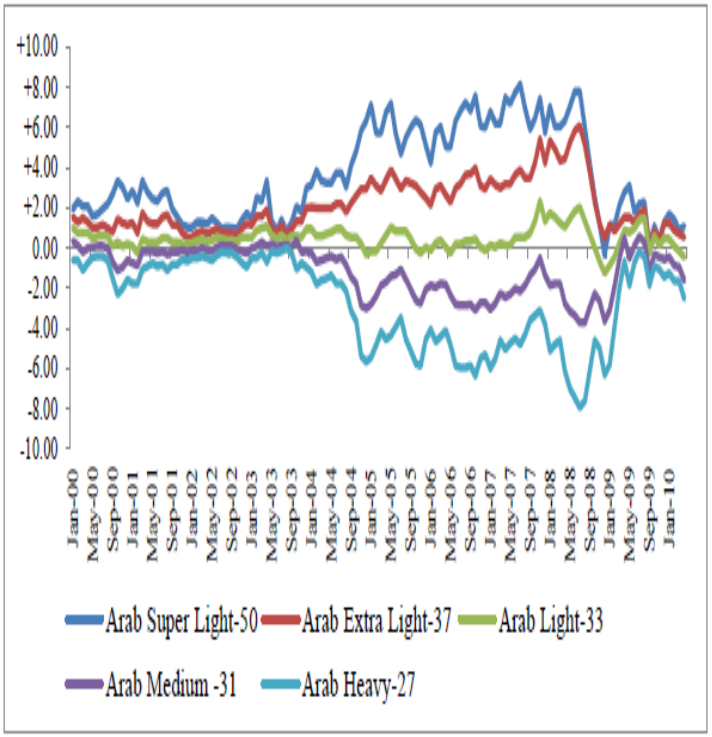
- Value of price differential could be set by oil exporting countries or assessed by PRAs

- Countries use different benchmarks depending on export destination

- Pricing may be based on assessed prices such as Dated Brent or on financial layers surrounding physical benchmarks such as Brent Weighted Average (BWAVE)
  - an index calculated on the basis of prices obtained in the Brent futures market

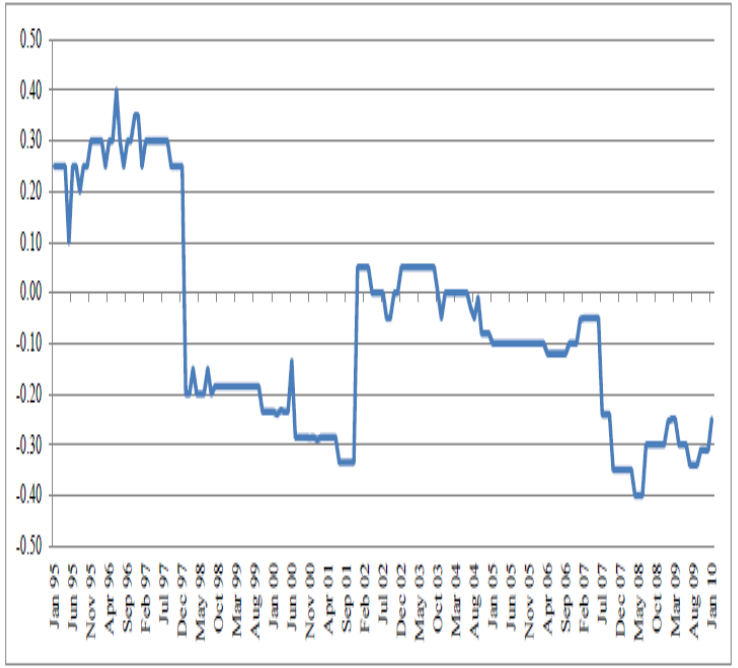
Setting the Price Differentials

Figure 1: Price Differentials of Various Types of Saudi Arabia's Crude Oil to Asia in $/Barrel



Source: Petroleum Intelligence Weekly Database

Figure 2: Differentials of Term Prices between Saudi Arabia Light and Iran Light Destined to Asia (FOB) (In US cents)



Source: Oil Market Intelligence Database

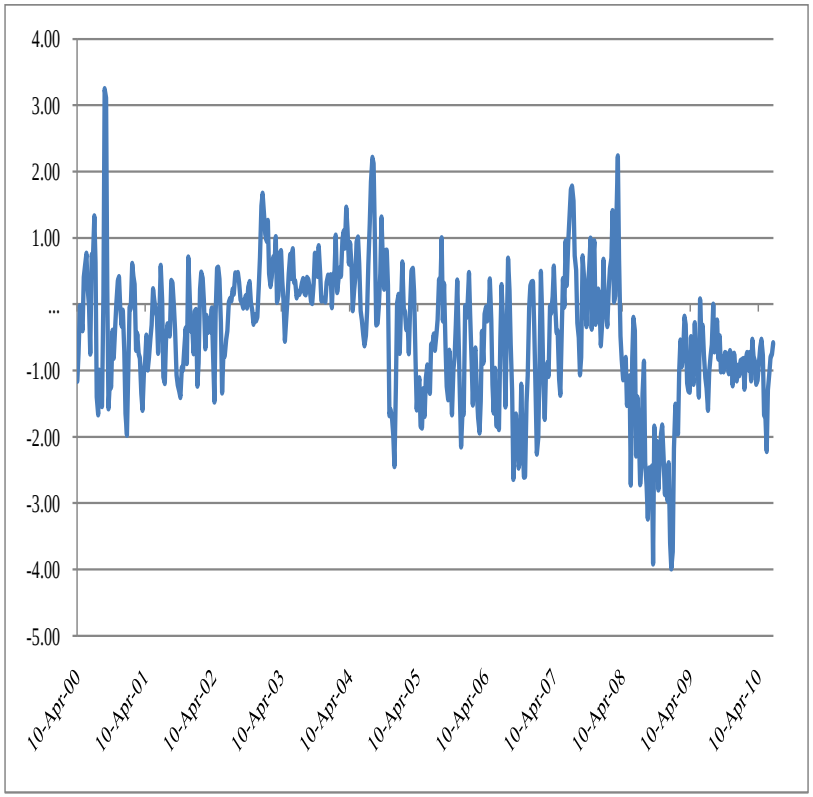
Benchmarks

Table 1: Main Benchmarks Used in Formula Pricing

	Asia	Europe	US
Saudi Arabia	Oman and Dubai	BWAVE from Jul.'00, Dated Brent Until Jun.'00	ASCI from Jan.2010, WTI until Dec.'09
Iran	Oman and Dubai	BWAVE from Jan.'01, Dated Brent Until Dec.'00	
Kuwait	Oman and Dubai	BWAVE from Jul.'00, Dated Brent Until Jun.'00	WTI
Iraq (Basrah Blend)	Oman and Dubai	Dated Brent	WTI Second Month
Nigeria		Dated Brent	Brent
Mexico (Maya Blend)		Dated Brent x0.527 + 3.5%HSFO x0.467 - 1%FO x.25 + 3.5%FO x0.25"	WTS x0.4 + 3%HSFO x0.4 + LLS x0.1 + Dtd.Brent x0.1

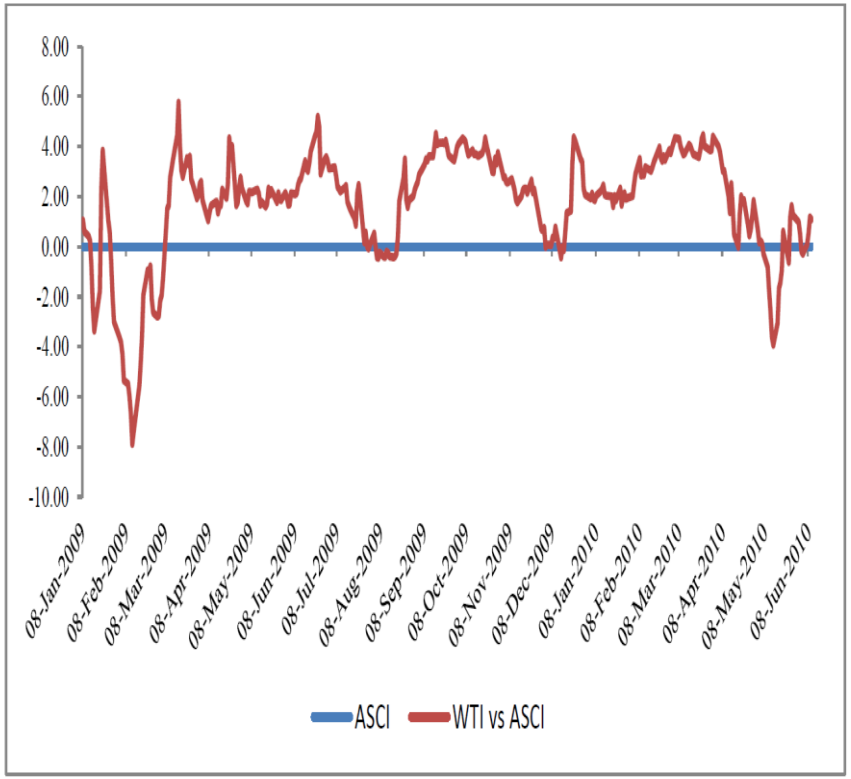
Linking to Benchmarks

Figure 4: Price Differential Between Dated Brent and BWAVE ($/Barrel)



Source: Petroleum Intelligence Weekly

Figure 5: Price Differential between WTI and ASCI ($/Barrel) (ASCI Price=0)



Source: Argus

Features of Benchmarks: Physical Liquidity of Benchmarks

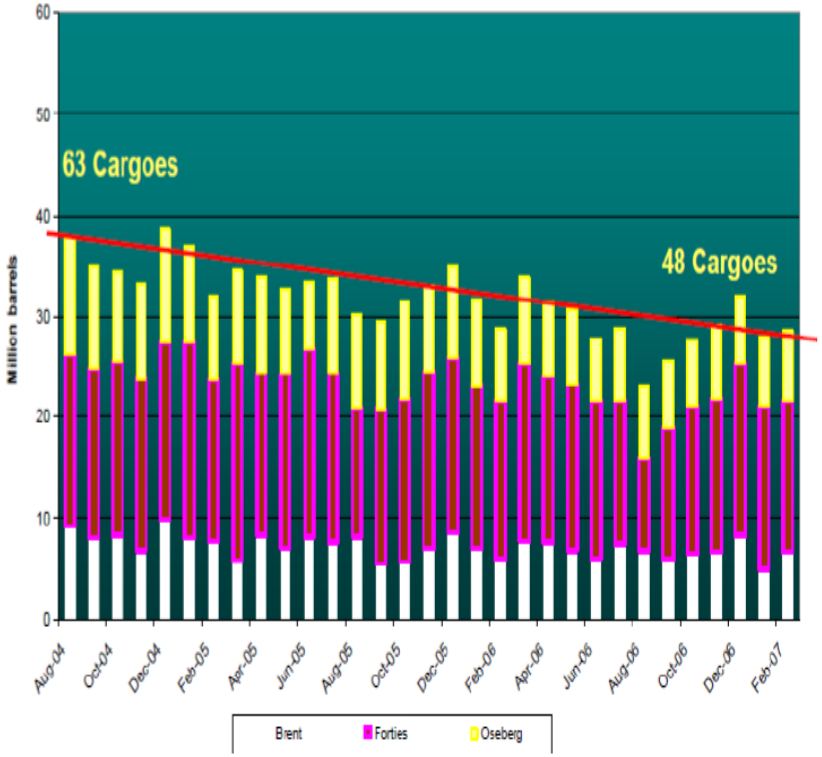
- Markets with relatively low physical liquidity set the price for markets with much higher volume of production

- Low physical liquidity and squeezes
  - As markets become thinner and thinner, squeezes and distortions become more widespread
  - Prices and spreads become less informative and more volatile

- Nature of these benchmarks tends to evolve over time but not without problems
  - Widen the benchmark for assessment purposes
  - Assessment of traditional Brent benchmark now includes North Sea streams Forties, Oseberg and Ekofisk (BFOE)
  - Dubai price includes Oman and Upper Zakum

- Short-term solutions of adding additional streams successful in alleviating problem of squeezes but should not distract observers from raising key questions
  - What are necessary conditions for the emergence of successful benchmarks in the most liquid market in terms of production?
  - Would a shift to price assessment in markets with high physical liquidity improve the price discovery process?

Comingling Benchmarks



Source: Joel Hanley, Assessing the Benchmarks, Platts Presentation, January 31, 2008.

Table 5: API and Sulfur Content of BFOE Crudes

	Forties Before Buzzard	Buzzard	Brent	Oseberg	Ekofisk
API	44.1	32.6	38.1	37.7	37.5
Sulfur Content wt.	0.19	1.44	0.42	0.23	0.23

Source: Bossley, L. (2007), Brent: A User's guide to the Future of the World Price Marker, London: CEAG, Table 5.

Figure 17: Dubai and Oman Crude Production Estimates (thousand barrels per day)

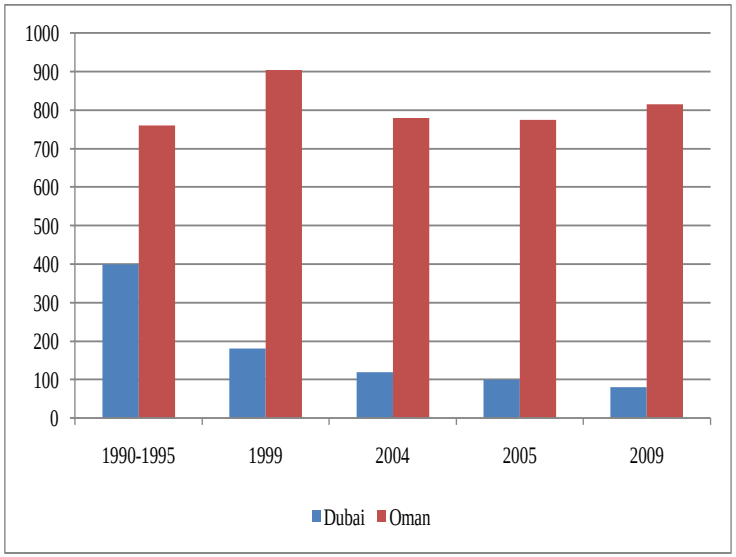
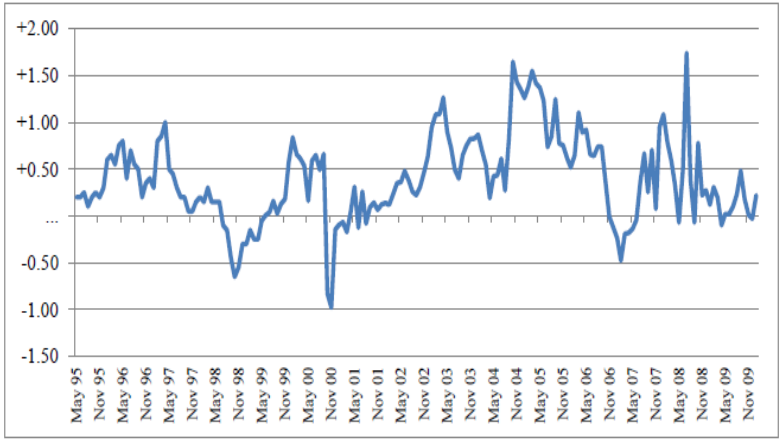


Figure 20: Oman-Dubai Spread ($/Barrel)



Source: Oil Market Intelligence

Feature of Benchmarks: Assessed Prices

- Prices of physical benchmarks ‘identified’ or ‘assessed’ by PRAs
  - Platts, Argus
- Assessments needed in opaque markets where physical transactions concluded between parties cannot be directly observed by market participants outside the deal
- Assessments needed in some illiquid markets where not enough representative deals can be observed or where no transactions take place
- PRAs assess prices based on information on
  - Concluded deals
  - Bids and offers
  - On market talk, other private and public information gathered by reporters (intelligent assessment)
  - Information from financial layers

Oil Price Reporting Agencies

- Only act a ‘a mirror to the trade’ and provide ‘transparency’?
- In attempt to identify oil price PRAs enter into decision-making territory that can influence market structure
  - Platts decides on when to stamp the oil price, width of Platt’s window used to make price assessment, size of parcel to be traded, process of delivery, time of delivery of contract, method that information should be delivered
- New markets and contracts emerge to hedge risks arising from some of decisions that PRAs make
- Even when price assessments based on observed deals and simple mathematical formula still an important element of decision-making involved
- PRAs assessment process is not neutral to the market

PRAs: Three inter-related dimensions

- Accuracy of price assessments
  - Market participants under no legal or regulatory obligation to report deals
  - Whether participants decide to provide information to RPAs depend on willingness, reporting policies, & interest in doing so
    - Companies may have reporting policies that bind them to report deals that take place at a certain time of day, or in certain regional markets
    - In some market such as US, confidentiality agreements dictate that some PRAs do not publish name of counterparties to a deal
  - In a liquid market
    - Reporters could observe concluded deals and confirm obtained information from both parties & look at regular flow of information coming from futures and OTC markets
  - In illiquid markets where few deals concluded small number of reported deals heavily influence assessed prices
    - Rely on variety of sources including information on bids & offers and on market talk to make “intelligent assessments”
    - Accuracy of assessed price will depend among other things on skill of reporter
- Internal procedures
  - To safeguard price assessment process and improve transparency PRAs self-impose and self-enforce their own rules and compliance procedures
    - Not subject to any external regulation but in theory strong incentive to self-regulate

Methodologies

- Methodology used in identifying oil price
  - Fundamental difference in methodology and in philosophy underlying price assessment
    - Example: Weighted average vs Window or MOC
    - MOC: Structured system for gathering information on the basis of which Platts assesses the daily price of key physical benchmarks
    - Similar to a futures exchange where traders make bids and offers, but with two major differences
      - Parties behind bids and offers known
      - Platts decides on information to be considered in the assessment
  - Different methodologies produce different prices for same benchmark

Different Methodologies, Different Prices

- Criticisms of weighted average approach
  - "an averaging system for price determination could result in assessments that lag actual market levels as deals done early in an assessment period at a level that is not repeatable, could mathematically drag prices down or up" (Platts, 2010, p.7)
- Criticism of window (Argus)
  - Often lacks sufficient liquidity and dominated by few players which may hamper price discovery process

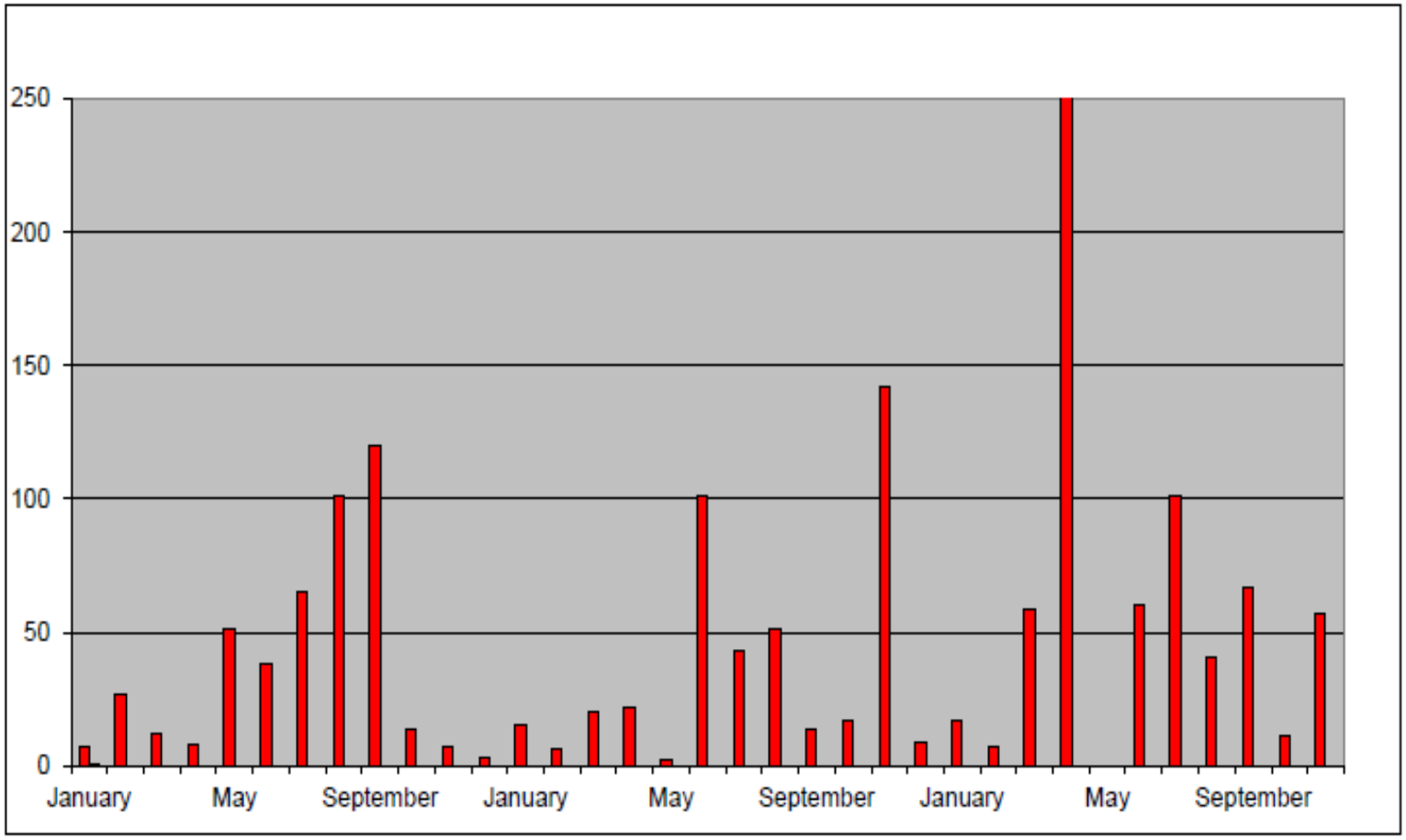
Table 2: Spot Market Traded Volumes in May 2007 (*May traded during May Trade Month*)

	Window	Entire Day (Argus)	Window % of Total
LLS	0	446,920	0%
WTI Diff to CMA	26,425	378,445	7%
Mars	5,418	185,252	3%
WTS	1,000	154,706	1%
WTI Midland	3,000	138,470	2%
HLS	1,000	100,032	1%
WTI P-Plus	1,000	88,802	1%
Eugene Island	0	40,044	0%
Poseidon	0	73,857	0%
SGC	0	22,100	0%
Bonito	0	9,140	0%
	37,843	1,637,768	2.31%

Source: Argus Media Ltd

Dubai Partials

Figure 21: Dubai Partials Jan 2008 - Nov 2010



Source: Platts

Feature of Physical Benchmarks: Financial Layers and the Spot Price

- Many financial layers (paper markets) emerged around physical benchmarks
- Financial layers highly interlinked with benchmarks through process of arbitrage and development of products that link layers together
- Idea that one can isolate physical from financial layers in current oil pricing system is simplistic
- Information derived from financial layers plays an important role in identifying the price level of the benchmark
- Brent market: Price of Dated Brent assessed using information from many layers including CFDs, forward markets, EFPs and futures markets
- WTI complex: prices of the various physical benchmarks strongly interlinked with the futures markets
- Price of Dubai often derived using information from the very active OTC Dubai/Brent swaps market and the inter-Dubai swap market

Spot Price Identification Process

- Process starts by identifying the price of *Forward Brent*
  - Movements on ICE futures Brent market, spread values, and EFPS factored into the assessment.

- Contract that links the futures Brent and the forward Brent is the Exchange for Physicals (EFPs)
  - Priced as differential to the futures price
  - Forward Brent (July) = Futures Price (July) + EFP (July)

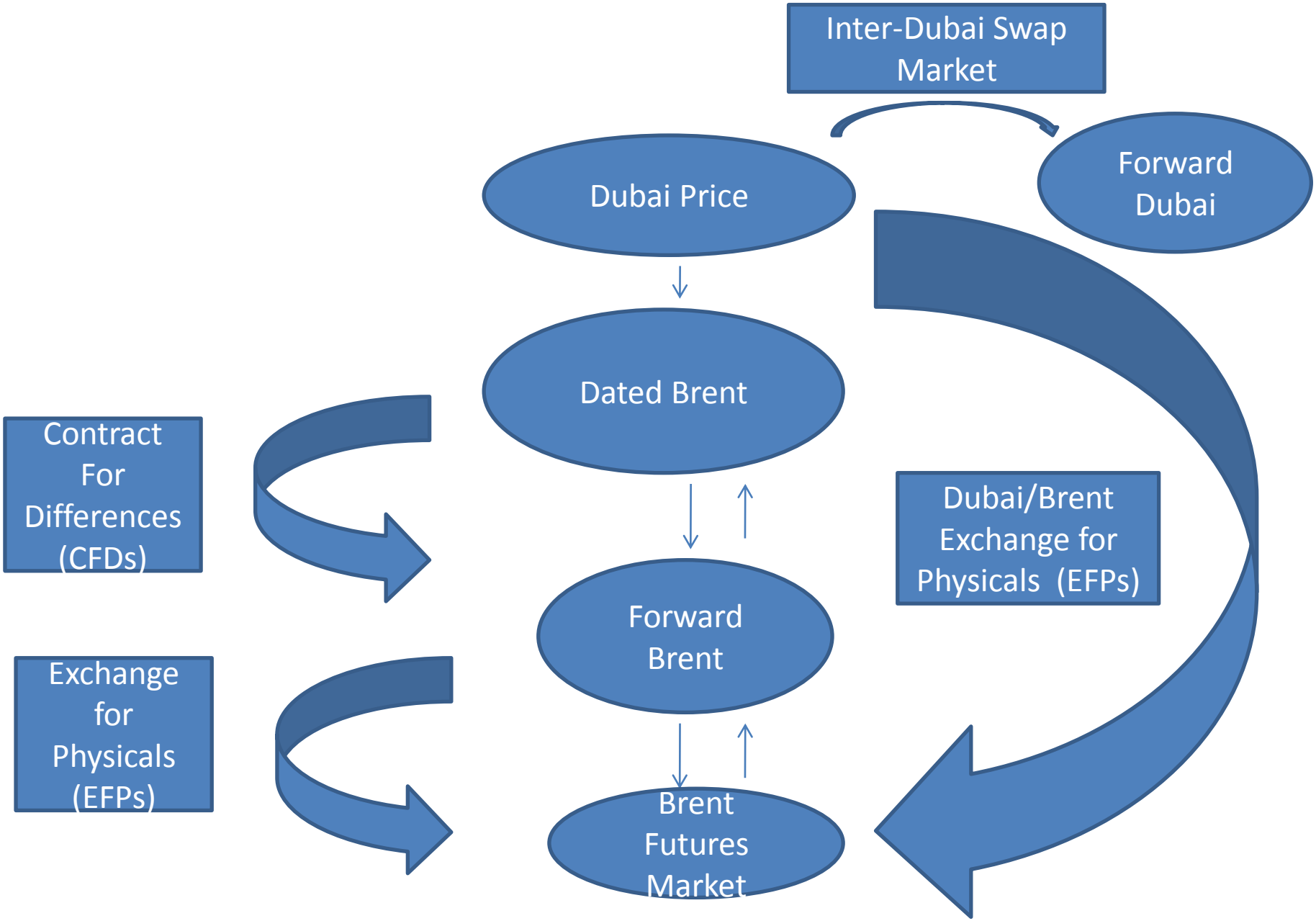
- Price of Dated Brent needs to be identified with the help of another layer: the OTC market of Contract for Differences (CFDs)
  - Forward Dated Brent = CFD plus Second Month Forward

- Given that CFDs traded and reported for eight weeks ahead Forward Dated Brent can be derived for 8 weeks into future which give us the 'Forward Date Brent Curve'

- Based on derived Forward Dated Brent Curve, possible to calculate average of the Forward Dated Brent from day 10 to day 21
  - Platts uses the term 'North Sea Dated Strip' or the 'Forward Dated Brent'

- Since BFOE is comprised of four different crudes, these blends individual crudes often trade as differentials to the 10-21 average of the Forward Dated Brent or North Sea Dated Strip
- Based on an assessment of these differentials, it is possible to calculate the price of Dated Brent/BFOE or Dated North Sea Light (Platts)
- Price of Dated Brent will settle on the most competitive crude among the BFOE combination (Forties)

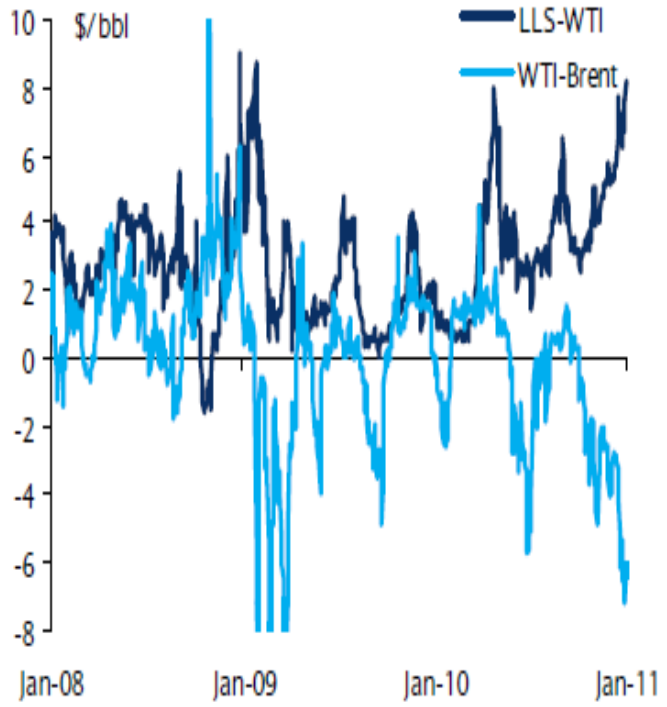
The Inter-linkages Between Financial and Physical Layers



How Reflective are Existing Benchmarks of Global Oil Market Conditions?

- Dislocations of benchmarks: What are some implications of such dislocations on oil market dynamics? Which benchmark is more representative of global market conditions? None?
- Dubai: Appropriate benchmark for crude oil destined to Asia despite decline in physical production? Does the rise in Asian consumer as the marginal buyer require the search for alternative benchmarks that reflect better market conditions in Asia?

Figure 4: WTI differentials to other benchmarks has widened



Source: EcoWin, Barclays Capital

Nature of Players

- Futures markets attracted wide range of financial players (pension funds, hedge funds, index investors, technical traders, & retail investors)

- Concerns that these financial players & their trading strategies could move the oil price away from the 'true' underlying fundamentals

- Participants in many of the OTC markets such as Brent forward market, Dated Brent and CFDs mainly 'physical'
  - Refineries, oil companies, downstream consumers, physical traders, and market makers
  - Financial players limited presence in some of these markets

- Any analysis limited to non-commercial participants in futures market and their role in oil price behaviour both incomplete and inaccurate

Participants in 21 Day BFOE

Table 5: Participants in the 21-Day BFOE Market and their Shares in Trading Volume

	Sales (b/d)				Purchases (b/d)			
	2007	**2008**	**2009**	**2010**	**2007**	**2008**	**2009**	**2010**
Arcadia	0	0	0	0	485	0	0	0
BP	23,786	3,005	13,699	29,545	25,243	273	10,959	12,662
Chevron	0	273	274	0	0	273	0	0
ConocoPhillips	18,447	11,749	12,329	32,143	6,311	5,464	12,329	29,545
Glencore	0	0	274	0	0	546	548	0
Hess	0	0	9,315	37,338	0	0	10,137	20,779
Hetco	0	0	822	7,143	0	0	1,096	974
Mercuria	12,136	12,842	64,658	79,545	13,107	24,863	54,247	89,286
Morgan Stanley	0	0	274	28,896	0	0	3,014	19,805
Noble	0	0	548	6,494	0	0	822	5,844
Phibro	46,602	19,126	25,479	23,377	36,408	23,770	36,164	14,935
Sempra	15,534	18,306	13,151	8,766	18,447	19,672	13,699	7,792
Shell	34,951	62,022	125,205	91,883	46,117	32,787	73,151	75,000
StatoilHydro	0	273	0	0	0	0	0	0
Total	0	0	0	649	0	0	0	2,273
Totsa	31,068	16,667	53,425	62,987	61,650	28,962	108,767	83,442
Trafigura	0	0	0	16,234	0	0	0	10,714
unknown	0	273	0	0	0	273	0	0
Vitol	68,447	12,842	48,219	56,818	43,204	20,492	42,740	108,766
	252,978	**159,386**	**369,681**	**483,828**	**252,979**	**159,383**	**369,682**	**483,827**

Source: Argus

Transparency in Oil Markets: Different Dimensions

- One dimension relates to transparency of physical fundamentals of oil market (demand, supply, inventories, investment plans)

- Transparency in financial layers surrounding physical benchmarks as important
  - Degree of transparency varies considerably within different layers in Brent, WTI and Dubai-Oman complexes as well as across benchmarks

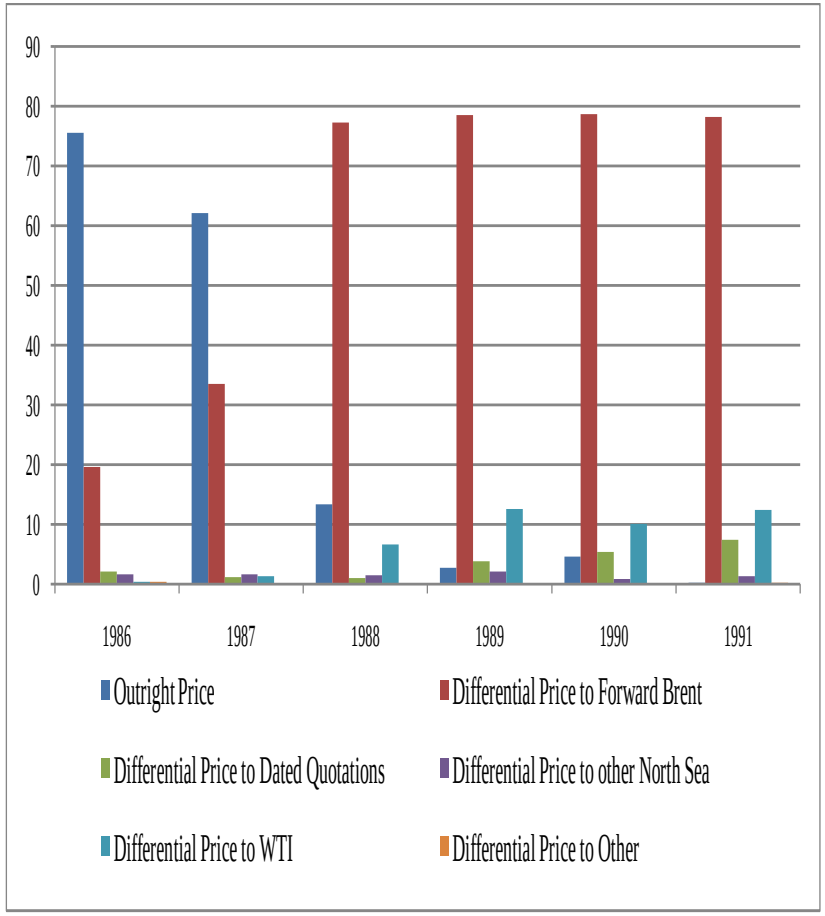
- An important dimension of transparency linked to PRA policies
  - PRAs under no obligation to release or share information with regulatory authorities
  - Ability of RPAs to collect reliable information in imperfect and illiquid markets
  - Internal features: skills of reporters, choice of methodology, and internal regulations and compliance procedures

Trade in Levels versus Differentials

- Trades in levels of oil price rarely take place in the layers surrounding physical benchmarks
- So-called physical markets trade price differentials based on timing, location and quality
- Level of the oil price set in futures markets?
- Differentials (crude-crude, crude products) adjust to changing market conditions
- Used by RPAs to identify price level of a physical benchmark
- Most evident in US but also Brent
  - Crude futures contract traded on NYMEX provides a visible real-time reference price for the market
  - In the spot market negotiations for physical oils will typically use NYMEX as a reference point, with bids/offers and deals expressed as a differential to futures price

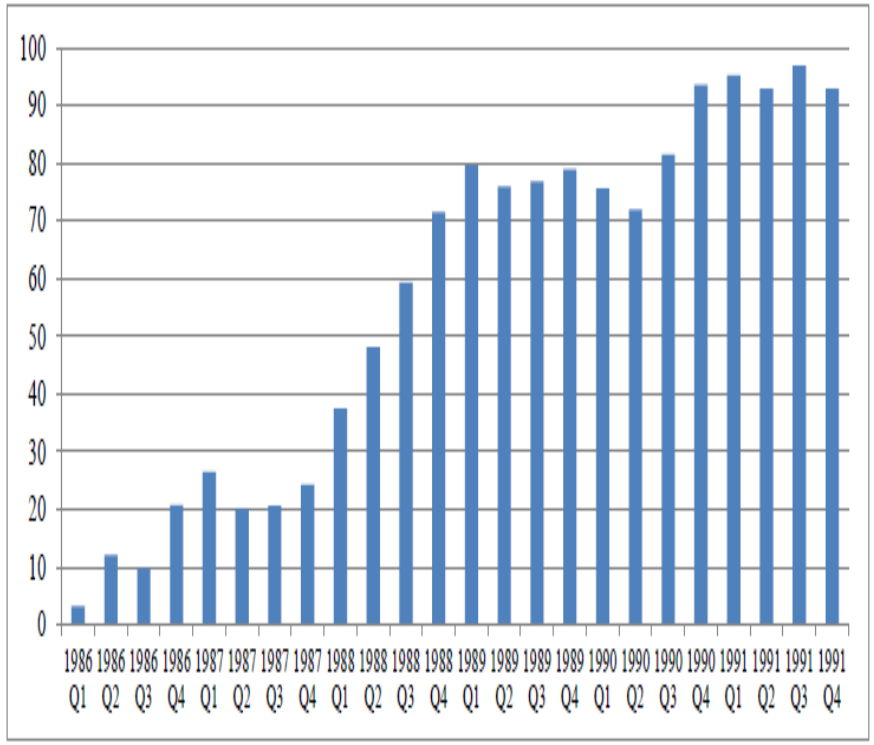
Trade in Spreads

Figure 8: Pricing basis of Dated Brent Deals (1986-1991); Percentage of Total Deals



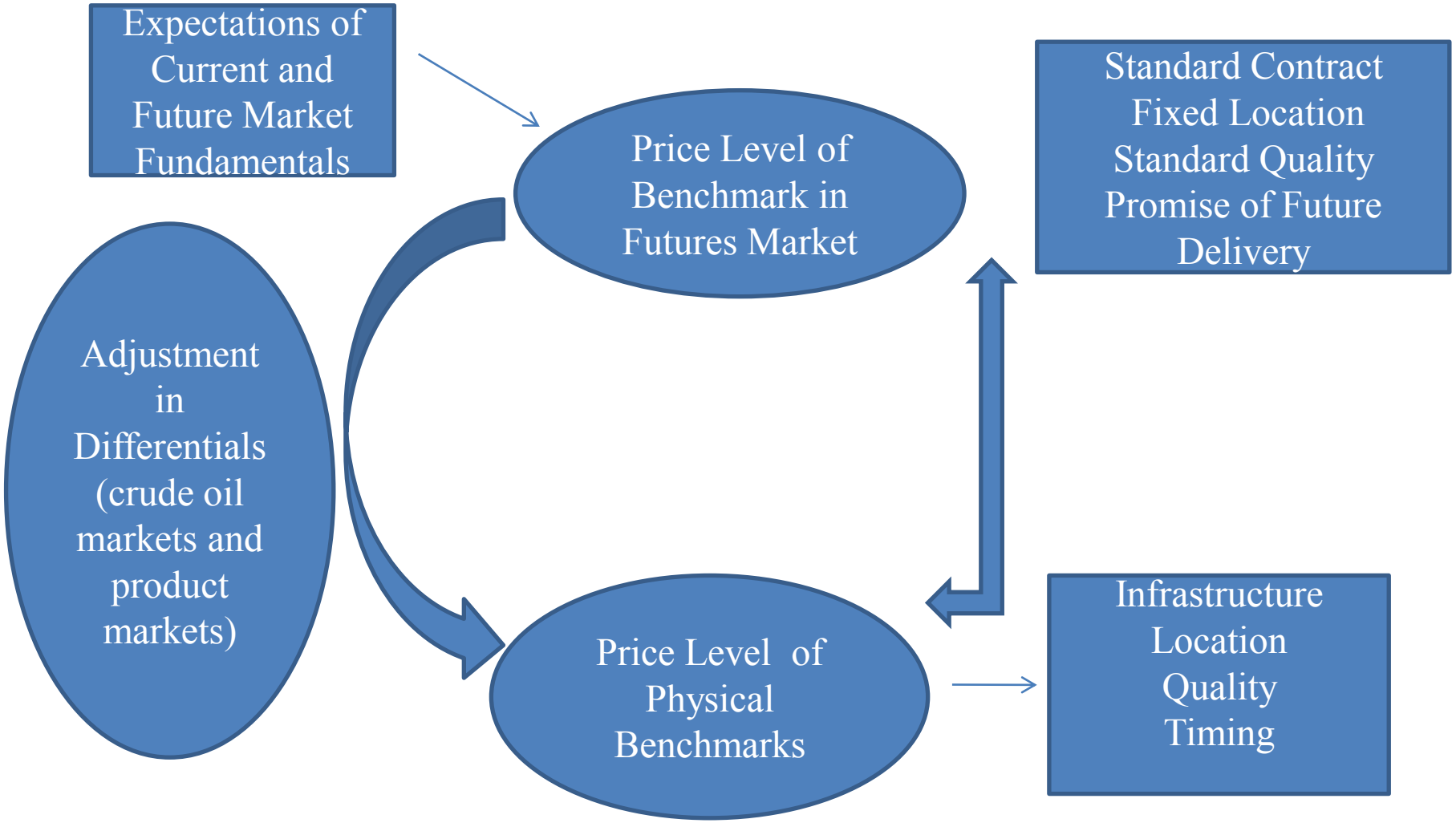
Source: Horsnell and Mabro (1993)

Figure 19: Spread Deals as a Percentage of Total Number of Dubai Deals



Notes: Spread deals include Dubai one-month spread, Dubai two-month spreads, and Dubai-Brent and Dubai-WTI Spreads.

Adjustment in Differentials and Price Levels

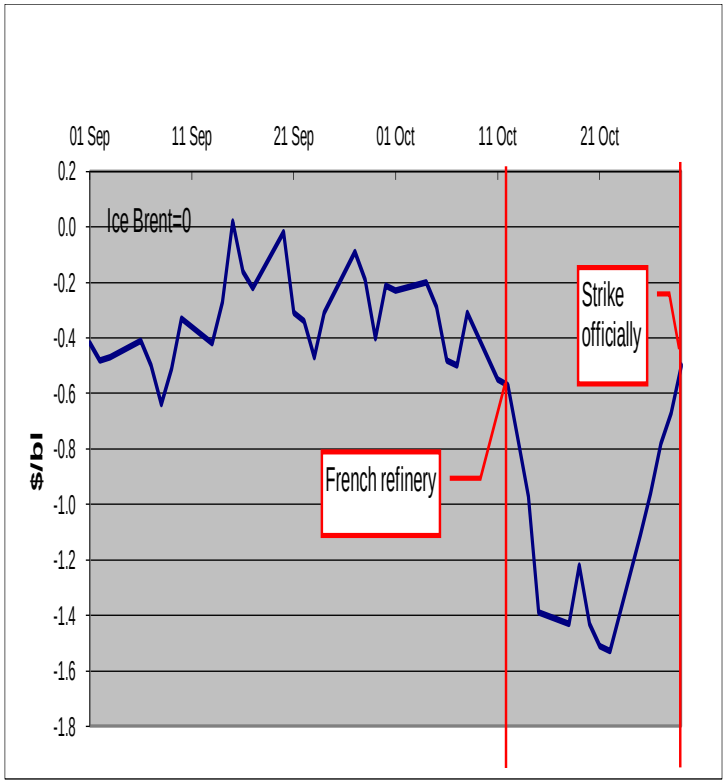


Question: Are Adjustment in Differentials Strong Enough to Influence Changes in Price Levels in Futures markets?

But What Determines the Oil Price Level?

- The oil price can clear within a wide range
  - Very low cost floor for crude oil production in OPEC and a very high price ceiling set by production in non-OPEC and substitutes & futures market participants' expectations
  - Within this range feedbacks from both supply and demand side in response to oil price changes are uncertain but perceived to be limited
- Pricing system reflects structure of oil market and how it functions
- Thought current oil pricing system can generate a spot price and that reflects 'true' current fundamentals flawed
- Possible to have situations in which there is a fundamental change in underlying physical fundamentals but the oil price level does not change
  - Most of the adjustment will take place through differentials if market expects these changes to be temporary
- Possible to have change in expectations which will be reflected in physical benchmark without change in underlying fundamentals
- Changes in benchmark price reflect hedging pressures, expectations, and arbitrage between very efficient markets
- In turn influenced by how flow of information and public signals affect these expectations, and coordination games among market participants

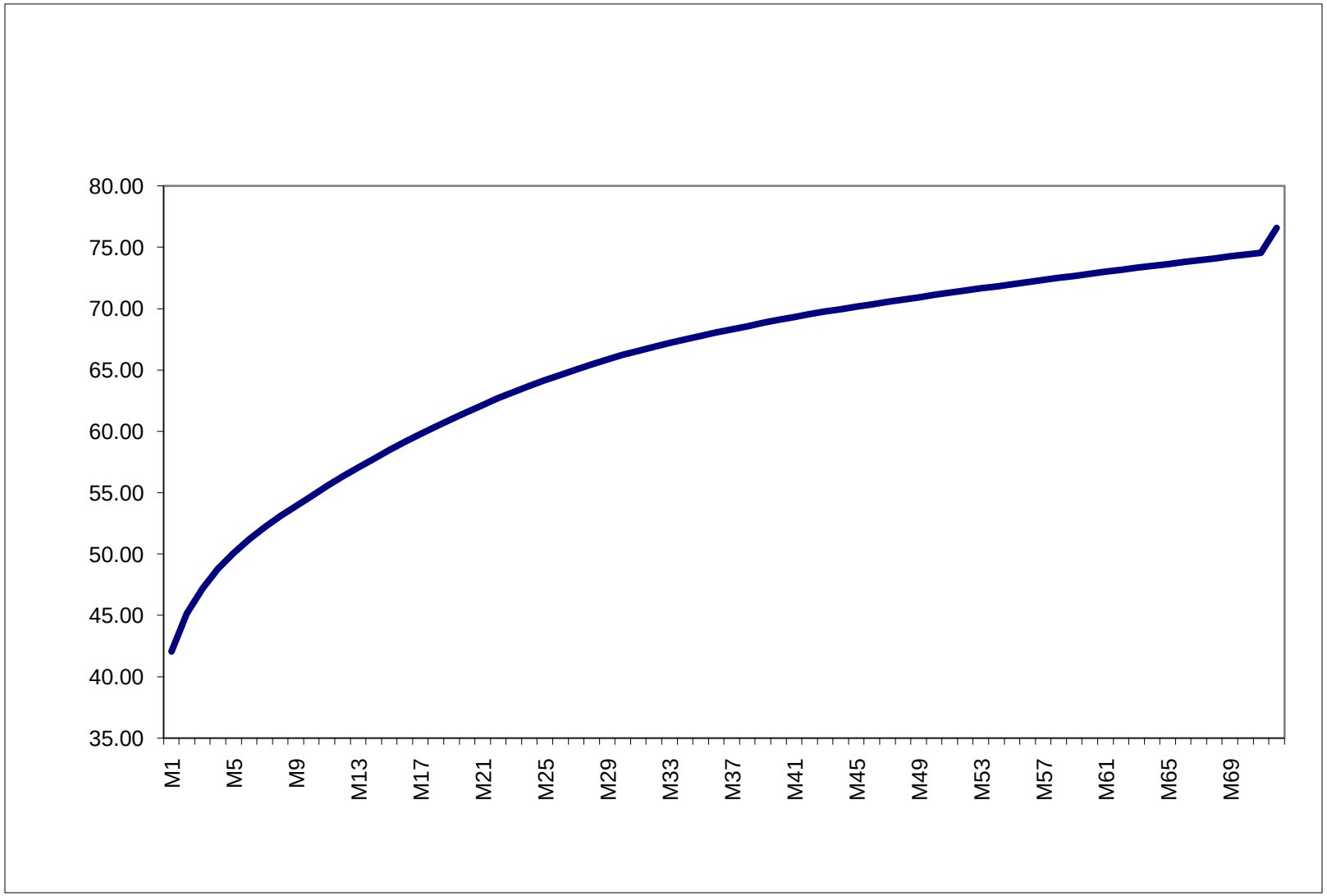
Figure: The North Sea Dated differential to Ice Brent during the French Strike



Source: Argus Medial Ltd.

Dislocation of Forward Curve in 2008

WTI Term Price Structure (December 2008, Monthly Average)



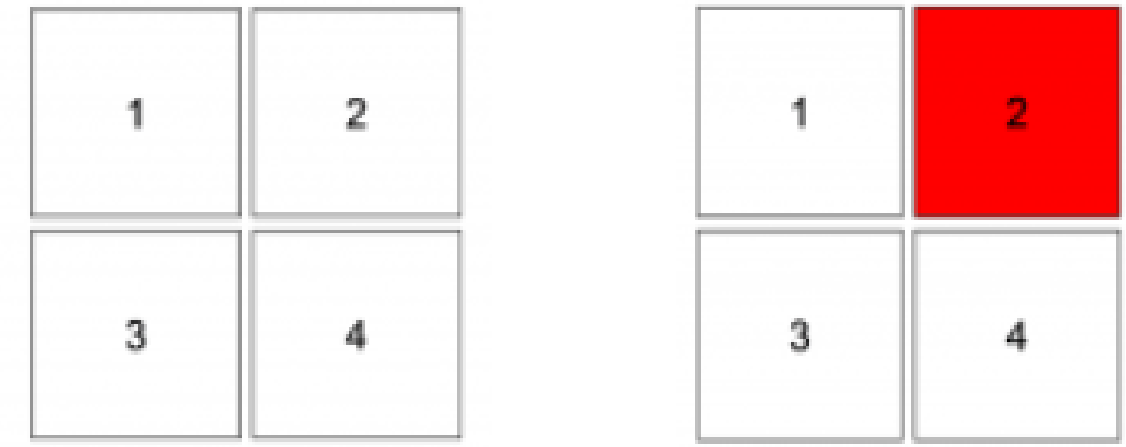
Price Movements in 2009

- 2009 represents a remarkable year in at least two respects
  - Witnessed sharpest increase in spot oil prices in decades
    - Recovery phase : WTI spot price rise from a very low base of $30.28 on 23 December 2008 to $79.39 on 31 December 2009, an increase of more than 160%
  - In second half of 2009 it exhibited a high degree of relative stability despite a very uncertain and volatile global economic environment
    - Stabilisation phase : Oil price oscillated within a relatively narrow price band between $60 and $70 between the months of July and September and then between $70 and $80 between the months of October and December

Current Fundamentals, Expectations and The Oil Price

- Underplay the weight of current oil market fundamentals, inventories, size of spare capacity and increase importance of future fundamentals
- Problem: Future fundamentals highly uncertain
  - many unknown variables that can play an important role in shaping anticipations of these future fundamentals, many of which originate from outside the oil market
- But at what level should the price be set?
  - There is a wide range of prices at which the market can clear
- The issue then is how does the market converge to one price and not another

Some signals more visible than others



Market players can coordinate on choosing a box without communicating with each other

There is nothing special about the red box other than the fact that it helps players coordinate their decisions

Such an equilibrium is known as the *focal point*

Convergence of Expectations

- Convergence of expectations provided a focal point
  - Consumers/producers/ industry/analysts: Too high or too low oil prices can be damaging for industry
  - “Everyone is happy with the price”

- Provided a focal point in the market
  - Classic case of coordination

- Can market participants can converge on another price range
  - Higher or lower?
  - Depends on the underlying story

The Battle of the Stories

- "But what if stories themselves move markets? What if these stories of over-explanation have real effects? What if themselves are a real part of how the economy functions?...The stories no longer merely explain the facts; they are the facts"

  Akerlof and Shiller; Animal Spirit, p.54

- Discourses of oil debate dominated by one view
  - Tight future market fundamentals, "likely return to oil shortages", energy crisis, etc...
  - Elements of the story
    - Limited non-OPEC supply growth (peak oil, over-ground constraints)
    - Limited investment and weak supply growth in OPEC countries (willingness, capability, geopolitical)
    - Rapid growth in global oil demand fuelled by non-OECD countries
- Is there a strong alternative story?

How Spare Capacity Will Erode?