Features of Recent Oil Developments

Paul Horsnell and Costanza Jacazio focus on the critical role of US oil demand

The latest sharp crash in the oil price cycle might seem to bear some strong parallels with 1986. In our view the key feature that makes the 2008/9 cycle different is that its cause lay primarily in demand conditions. In particular, as we detail below, the sharp swings in US demand played a particularly central role in the evolution of market perceptions as to the health of the market. However, in terms of straightforward price behaviour and market sentiment, the comparison with 1986 works better. In oil market mythology, 1986 swiftly gained a totemic status. Say, for example, '1992' to an oilman and you will probably get a blank look, as that year carries no clear association with any particular market environment. But say '1986' and you are using an oil shorthand that is fraught with meaning. To invoke 1986 is to call on the representation of those circumstances that are thought of as the worst of all possible times for producers, a yardstick against which all other periods of upheaval and misery in the industry can be measured. As in any mythology, the reality of the 1986 price crash may not always match up perfectly with the elements in the myth, but that probably matters little. Over time 1986 has become a form of code for an extremely challenging market environment, complete with a price crash and a severe and lasting bust in the investment cycle.

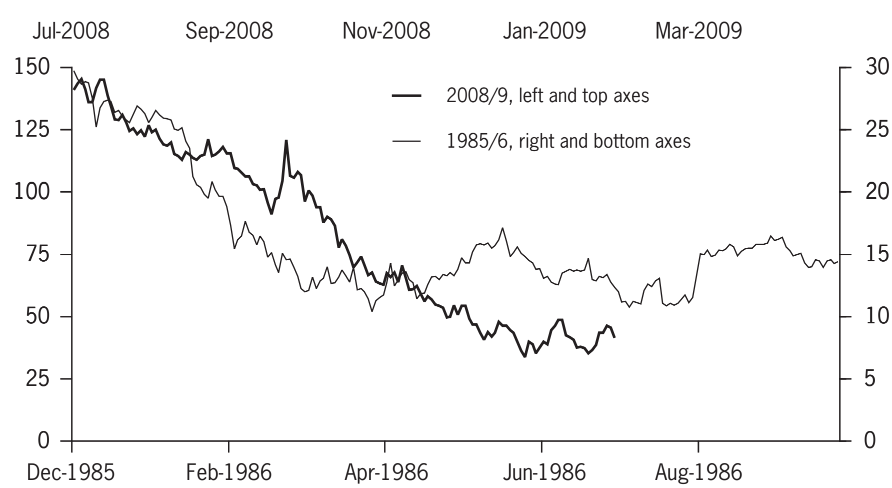
Given the usefulness of the concept of 1986 as a general state of mind, it may be difficult for 2008 to take over seamlessly as the oil market code for the foreboding associated with nasty things coming out of the dark forest. However, in terms of both the extent and duration of the price fall, recent market moves have now gone beyond 1986.

The depth of the current reversal is illustrated in Figure 1, which overlays the course of the market during the respective periods of the most rapid fall, i.e. from December 1985 onwards and from July 2008 onwards. The associated price axes are shown in the ratio of five 2008/9 dollars to each 1985/6 dollar. In terms of the period of pure downwards trend, the 2008/9 fall was sustained for some three months longer and, in current money, that fall continued for about $20 per barrel further.

Beyond the mere direction of prices, there is little else that links the two negative price shocks. In the simplest description, the dynamics in 1985/6 were primarily determined by changes in producer policy and the consequent rise of OPEC supply. While that policy was determined by the cumulative impact of the five previous years of sharp falls in demand accompanied by rising non-OPEC supply, by the time the price falls began global oil demand had begun to rise again, and demand developments were not the key factor in tracking the path of the crisis. By contrast, in the 2008/9 cycle the primary dynamic has been falling demand, and it is the path of demand that is likely to be key in bringing the cycle to an end. The earlier crash was supply-led and sparked by producer policy, the latest has been demand-led and was sparked by a rapid deterioration in the prospects for global economic growth.

While the price fall has brought a supply-side reaction, traders seem likely to maintain their bias towards looking to the demand side for signs of either further erosion or the green shoots of any underlying recovery. In trying to work out when the climate for demand will look better to the market, one factor will be the point at which the attrition in demand forecasts begins to ease off. The element of surprise to demand revisions in 2008 is quite how narrowly focused demand side forecasting errors have been. In particular, it has been variations in US demand that have dominated the divergence between forecast and actual demand. For example, compare the current (at time of writing, January 2009) tabulations of 2008 demand as made by the main forecasting agencies, with their projections of the same as they stood in December 2007. Between those dates, the OPEC Secretariat revised down its projection for the level of global oil demand by 1.23 mb/d. Of that, the downwards revision for OECD demand was 1.8 mb/d, and of

Figure 1: Price behaviour in 1985/6 and 2008/9 compared. WTI prices, $ per barrel



Source: Barclays Capital

that the revision for North America was 1.45 mb/d. In the case of the US Energy Information Administration (EIA), global demand was revised down by 1.25 mb/d, OECD demand was revised down by 1.67 mb/d, and US demand was revised down by 1.49 mb/d. Put another way, in the case of both the OPEC and EIA forecasts, the USA was the main source of negative forecast error. Indeed, oil demand outside of the USA was revised upwards over the course of 2008.

> "the key feature that makes the 2008/9 cycle different is that its cause lay primarily in demand conditions"

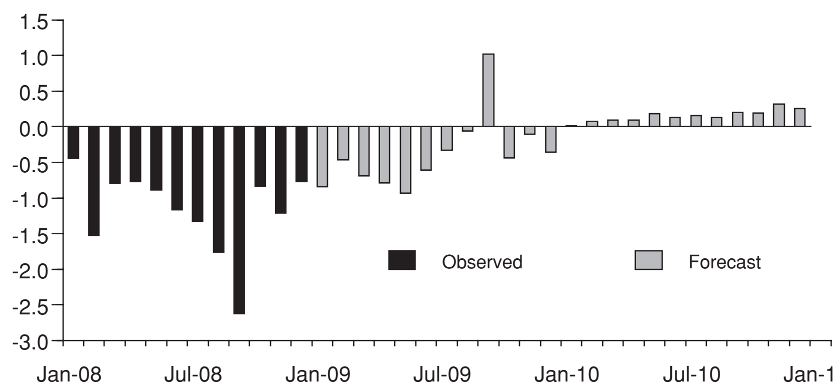
The downwards demand surprise for the International Energy Agency (IEA) was also heavily weighted towards the USA, although with the IEA having begun the year with by far the most optimistic view of likely overall growth, the downgrades have been slightly more evenly spread. The IEA revised its 2008 forecast down by 2.03 mb/d between December 2007 and January 2009, while OECD demand was revised down by 2.3 mb/d and US demand was revised down by 1.43 mb/d.

In summary, across the main sets of forecasts the revisions of US demand in 2008 have been an order of magnitude higher than for the rest of the world combined. The pattern of revisions has been such that US demand was revised down by between 6% and 7.5%, while the revision for the rest of the world combined ranged from an upwards revision of 0.3% to a downwards revision of 0.7%. The above suggests that the recent tendency among analysts in particular to concentrate on demand growth out of China and the Middle East as the key driver of oil market balances may well be misplaced. In the long term, the cumulative demand pressure from those areas is indeed central. However, if you want to get the immediate dynamics of the global oil demand outlook correct, then it is the US number that seems the most urgent to pin down.

The USA appears to be the key element of any forecast and the source of most potential error, because it is US demand that swings the most in response to changes in economic conditions and in other stimuli. Further, the track record over the course of the current decade suggests that it is US demand that is the hardest to forecast accurately. In terms of the distribution of the error within the US forecast, tracking the EIA forecasts for the individual products for each month across 2008 puts the average downwards revision at less than 5% for gasoline, between 7% and 8% for jet fuel, diesel and heating oil, and above 10% for residual fuel oil and petrochemical feedstocks. Errors appear to grow larger the further one moves down the demand barrel, perhaps simply because it tends to be those heavier elements of industrial demand that are most sensitive to both the economic cycle and to relative prices.

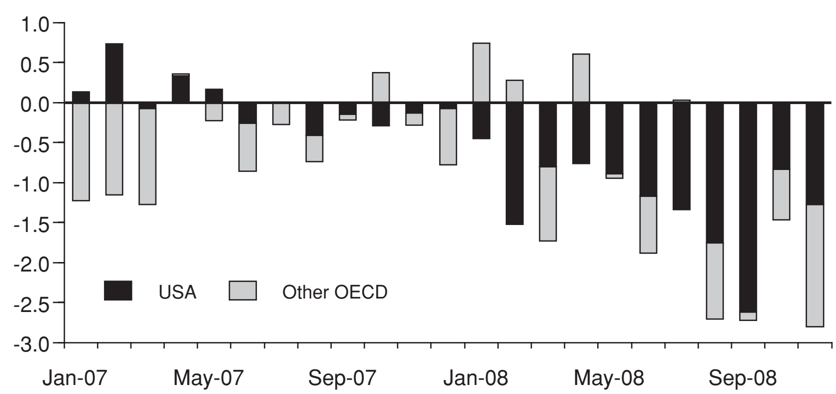
For the demand side to start to look more positive, or at least to appear as if it is on the mend, we believe that three conditions need to be met. First, the US data would need to stabilise, showing declines no worse than about 5% in the first half of 2009, thus stabilising expectations before some favourable year-on-year dynamics kick in over the course of Q3. Our own monthly projections are broadly in line with the shape of those of the EIA, as shown in Figure 2. The sharp

Figure 2: US oil demand, observed and forecast y/y changes. Million b/d, y/y change



Source: Energy Information Administration

Figure 3: OECD oil demand, split by US and non-US. Thousand b/d, y/y change



Source: Joint Oil Data Initiative

but temporary y/y improvement forecast for September 2009 is a key part of those projections. September 2008 was so severely distorted by hurricane and some other effects that a y/y demand increase of less than 1 mb/d for September 2009 would be considered as very weak. Overall, the pattern appears far stronger in the second half of the year, helped on by a series of favourable base effects and by the potential return to at least modest q/q GDP growth following the declines expected in the first half of the year.

> "it is US demand that swings the most in response to changes in economic conditions"

The second condition for relatively swift recovery would be that the extreme sensitivity of US demand to the economic cycle is not echoed in future data for other OECD areas, and most particularly in Europe. Outside the USA, the OECD demand profile showed little evidence of being on any severely weakening trend, or indeed on any trend at all, until the particularly weak data point seen in November 2008 raised some doubts (see Figure 3). There are some base effects at work that might lead one to discount that data point somewhat and not treat it as conclusive, but any spread of systematically weakening demand to Europe would be likely to prolong the trough in prices. That last data point in Figure 3 does however seem to at least sound a warning bell, and the apparent sharp tail off in macroeconomic performance across the OECD in the final quarter of 2008 suggests that there could be an element of further weakness yet to come.

The third condition would be that non-OECD demand growth merely slows, rather than disappearing altogether or becoming negative. Up to this point non-OECD demand has tended to be subject to upwards revisions. Further, the sharp falls in net non-OECD oil demand growth for 2009 projected in the main forecasts of between 50% and 65% already appear to assume a fairly downbeat macroeconomic environment. At this point a sharper deterioration remains possible, but is perhaps not yet in the base case. Overall what we appear to be in the middle of is a sharp macroeconomic-related downshift in global oil demand, with a swing in demand that is heavily weighted towards the USA. While that dynamic remains in place, we suspect that the current fear factor associated with accelerating rates of demand loss shows a reasonable chance of abating by mid-year. The sensitivity of US oil demand remains one of the dominant drivers of market balances and sentiment, and hence a US-centric approach to the small print and mechanics of the demand data appears relatively justified for the moment.

Ivan Sandrea asks what is next for the oil and gas industry?

The year 2008 marks the end of another period in the history of the oil and gas (O&G) industry. It started in 1999 with the Mergers and Acquisitions (M&A) wave and recovery in oil prices from record lows, and represents one of the strongest expansionary periods in the last 30 years. Between 1999 and mid 2008 oil and gas prices rose each year to record highs; cumulative industry M&A activity reached a historical record; total industry investment in E&P also grew 400% (real terms) to reach record highs; world liquids and gas production capacity rose 11 mb/d (14%) and 70 bcf/d (28%) respectively; global oil and gas reserves expanded; and profits reached record levels despite a large increase in costs. But from summer 2008 onwards oil prices began to fall, a credit induced severe global recessionary environment became obvious, global oil demand growth weakened versus trend, and signs of cuts in investment began to appear. Looking back, industry consensus suggests that most of the same signs featured in three other periods (1973–1981, 1982–1987, and 1988–1998). This is shown in Table 1.

Each period can be associated with discontinuities leading to different responses by major industry players (i.e. IOCs and NOCs), consumers, and governments. Nationalisations, new types of cars, the timing of the North Sea oil development, efficiencies, the rise of unconventional energy, market openings, and changes in demand growth from the trend are all examples of discontinuities. History also shows that at the end of each period most people, including the experts, failed to predict the events that followed and failed also to visualise the next period. We still remember when in 1999 *The Economist* predicted

Table 1: Recent Industry Periods: Key Statistics at End-periods

Periods	*1973–81*	*1982–87*	*1988–98*	*1999–08*
Prices WTI ($/b)	75	31.8	17.1	105
Liquids capacity (mb/d)	72	73	78.6	89
Gas capacity (bcf/d)	142	174	221	295
Real Capex ($bn/y)	191	80	140	400
Oil reserves (bnboe)	687	910	1068	1250
Gas reserves (Tcm)	86	111	149	180

Note: Oil prices crashed in 1986, 1998 and 2008

Source: StatoilHydro internal analysis, Sandrea 2005, *BP Statistical Review*, some figures for 2008 are projected.

$5 oil into eternity and how it saw the future of the industry!

In 2009 we are likely to see the start of new discontinuities and new events, and the only surprise should be the timing. It would be naive to ignore the potential effects of the recent volatility in oil prices, the current recession, and the adjustments taking place fairly rapidly in several important countries in the areas of finance, economics, energy, security, and politics at the same time that society and industry are finding new ways to interact with the natural environment.

Just as one of the most eventful years in modern history ends, some are already asking three questions that are familiar to the industry. First, what is going to happen to oil prices in the future? Second what will be the demand for oil, how fast will it recover, and how will it be met? And third, how will the major players respond strategically? Given that we cannot predict and that the past was unstable, at least partial answers can be provided by making sense of recent facts (see Table 2); the future tends to be largely a function of today's facts plus anything that we don't know but that is certain to come.

Table 2: 2009 Starting Point and Recent Significant Events

Macro	*O&G Industry Specific*
100% of global oil demand growth depended on Asia, developing countries, three-year contraction in the OECD	Limited capacity to increase global oil production above 1.5% pa, and gas production above 3% pa
Ability of consumer to pay higher energy prices than previously thought	A rapid strategic shift towards complex projects (unconventional in OECD, everything East of Suez, and technology plays)
Rapid demographic and technological changes that suggest future oil demand growth may be slower	Higher costs, some structural others cyclical; introduction of CO_2 taxes
New set of leaders who appear to focus on economic and social stability, rather than cold war-based policies	Increasing competition from all kinds of players
Start of a severe economic and financial recession in OECD countries; questioning of the architecture of all significant financial institutions	Oil prices below the level that starts to affect the investment framework of the industry

The Price Question

No one can predict the future level of oil and gas prices, but when thinking about the matter two facts are clearly significant. The upper limit which reflects the price all consumers (i.e. people, industry, and governments) can afford to pay. And the lower limit which reflects the price industry players need in order to cover the costs of producing and processing oil and gas. Like all variables, the ability to pay for energy and industry costs are dynamic variables; how we think about and model oil and gas prices in the future must also be dynamic.

Naturally, prices should fluctuate between the two, and if they extend much beyond these limits for whatever reason(s) something is bound to happen. In recent years, new players (i.e. mainly financial investors) began to increase their participation in the oil market, and soon predicted prices of up to $200/b (even as the economy, demand and refining margins took a nose dive!). Today, there is evidence that financial players are linked to the sharp rise and collapse in prices (due to bad models and false interpretations of how the oil markets worked) that took place in a matter of months.

In the period that just ended, for the first time in decades many consumers could afford to pay higher energy prices than previously thought – as a result the value of energy resources increased. Nevertheless after a certain level ($90/bbl +) prices started to badly hurt some important consumers. From 1999 to 2006, prices increased gradually and this kept demand in check, spurred new thinking, allowed profits to be generated and investment to rise – all of which are good for the world; but the commodity bubble, which caused prices to rise too rapidly in 2007 and 2008 abruptly interrupted an important process. On the cost side, due to structural and cyclical factors linked to prices, industry costs increased putting pressure on margins and the cost of new projects. This topic is fairly complex, but it is a fact that the cost structure of the industry is in transition from a lower to a higher structure. OPEC was aware of everything, which explains why it tried to maintain a flexible approach to prices whilst referring on numerous occasions to the damage caused by extreme speculative behaviour in the oil markets.

Today oil prices are well below the level that producers and consumers would consider 'fair' – that is a price that will sustain producers' economies while not slowing down economic growth in consumer countries. At the recent London Energy meeting (December 2008) the 'fair' price was identified as $75/bbl.

Without making any predictions, it is highly likely that when global economic conditions improve, oil prices will rapidly return close to the upper band, whatever this might be, and continue the trend to what consumers can afford to pay.

The Demand Question

Major consumers and industry players care about future demand. It is a fact that global oil and gas demand continues to grow, more recently driven by emerging powers such as China, but it is also a fact that today the world consumes 12 mb/d less oil than what the top planners told us ten years ago. In the last decade major downward revisions have also been made to long-term demand prospects. Last year, the EIA revised down global oil demand in 2020 sharply from the previous year's forecast and since 2001 cumulative downward revisions for 2020 now exceed 20 mb/d! The story for gas demand is similar, particularly in the USA, where major downward revisions have been made over the years. In these revisions, price has been a factor but others such as lower GDP and taxes have also played a role. The types of car we use and energy efficiency have evolved fairly rapidly, and continue to surprise the experts.

At the same time, it has also become apparent that for some of the natural resources, the level of consumption is more dependent on what can be delivered from the different types of resources at a given point in time than on anything else. The behaviour of non-renewable petroleum resources is not reversible once certain thresholds are crossed; this may be Malthusian and a subject of much debate, but it is the evidence of years of O&G production history. Production growth rates fluctuate with the type of reserves coming on stream and technology used (i.e. conventional onshore, offshore, deepwater, unconventional, arctic, and technology plays). Table 3 shows that historically, the offshore has sustained higher rates of growth than the onshore. It is therefore possible that the global O&G endowment (17+ tn boe in-place of which 1.5 tn boe have been produced) can only sustain a maximum rate of consumption/production growth whatever this might be.

"there is evidence that financial players are linked to the sharp rise and collapse in prices"

Many doubts continue to arise about the ability of O&G production capacity to meet future demand.

Table 3: Historical Growth Rates, annual percentage growth

	Global Oil Demand	*Oil Production: Global Onshore Crude*	*Oil Production: Global Offshore Crude*	*Oil Production: Global NGIs + Unconventionals*
1973–81	0.7	-1.3	9.2	4.5
1982–87	1.1	-0.3	5.4	5.1
1988–98	1.2	-0.3	4.9	4.7
1999–08	1.3	0.5	1.5	4.4
	Global Gas Demand	*Gas Production: Global Onshore Crude*	*Gas Production: Global Offshore Crude*	*Gas Production: Global NGIs + Unconventionals*
1973–81	2.8	0.6	7.5	n.a.
1982–87	3.3	3.1	3.2	-0.1
1988–98	2.1	1.2	5.8	15.5
1999–08	2.9	2.2	2.8	5.9

Source: StatoilHydro internal analysis, Sandrea 2005, *BP Statistical Review*, some figures for 2008 are projected.

Probably the number one question is what the oil production decline rates are or how much the industry needs to replace each year. Gas is rarely questioned as it is assumed that there are bountiful reserves, many yet to go on stream. A recent IEA report estimated that the global oil production decline rate is 5.2% per year, which appears fairly high. A back of the envelope calculation which relates global oil production, global capacity expansion by year, and gross oil production increments by year, indicates that global decline rates do not exceed 3% per year. For the USA, the rate is about 1% per year.

It is impossible to predict what future world capacity will be, but nature is telling us that the growth rate of world O&G productive capacity will be slower, that it will be sustained by significant EOR possibilities, advancing technology, and the improving ability of consumers to pay for energy resources. The new projects (600+ in total) being executed represent at least 25% of current global O&G production capacity, and are certainly different and more complex than past ones. The decline rate of oil and gas resources is the main challenge of the industry but this has been true since oil was first produced.

The resources that have been discovered are vast and the industry is working to produce these and increase the recovery rate; but perhaps the world won't need as much as we think today. On the demand side, we have to ask whether the growth of oil demand in China can continue at high rates forever, and if the current levels of petrol taxes in major consuming countries can co-exist for long with a strong desire to protect the environment, energy diversification, and more efficiency. Regarding gas, can the experience of the USA with the rise of unconventional gas and lower demand be repeated in Europe, Russia, and China?

Where Does the Industry Go from here?

In contrast to the inherent uncertainties of the previous questions, the answer to this is more predictable. After more than a century, the major industry players are already producing something from nearly every type of petroleum reserve from most regions in the planet. The industry has had time to work in more places than any other industry, and along the way it has considered where it wants to stay and where it would like to establish itself for the long term. Seventeen plus trillion barrels of oil and gas resources in place discovered (excluding gas hydrates, shale oil) is no small amount.

How the most important industry players (IOCs and NOCs) and others will respond strategically is more uncertain for the short term than for the long term. In the short term, the industry will need to adjust and respond to changing conditions in the macro environment. That is, players may engage in M&A, restructure, divest non core assets, reduce capex of short-term pay back marginal projects, and delay some projects to save costs.

But for the long term, the players that see future in O&G, it is hardly an open question. This is because from the early 2000s onwards, many companies made drastic changes to the strategy in order to tackle the full suite of reserves in sight, which now covers pretty much everything we know.

Looking at the E&P activity since 2003 of the top ten international O&G companies (Exxon, Shell, BP, Total, Chevron, Conoco, Eni, Petrobras, Petronas, and StatoilHydro) it is clear that these companies set out with a new focus to access additional reserves and production via M&A, organic, and exploration. In the last five years alone, they accessed 9.8 mboe/d of future production of which a large portion includes unconventional energy and large complex projects. Production from the pre salt, a new source and perhaps even a large discontinuity, also forms part of the new access.

> "The vast majority of the discovered and yet to be found resources in the world are in just 30 countries"

All new efforts focused on 20 countries, the very same ones that provided the bulk of production in 2003. These countries account for 85% of the total production of the top 10 companies, and represent 2.2 tn boe of discovered reserves (~10 tn boe in place) in the world. In a portfolio context, these companies currently produce 25 mboe/d (entitlement basis) from 57 countries, and the newly accessed production represents about one-third of the total the industry (ex NOCs) is set to develop over the next 20 years.

Some new discoveries have been made in countries with a limited history of hydrocarbons (i.e. Ghana, Mauritania, and Uganda). This is good news, but most geoscientists would concede that these new discoveries are outside the places where hydrocarbons have accumulated. The vast majority of the discovered and yet to be found resources in the world are in just 30 countries, and there are nearly 200 countries in total. The impact of these new discoveries to the global industry and the world continues to be very small.

> "is our industry destined to continue to go through extreme boom and bust cycles or might it at some point see a more steady development?"

The most important producing NOCs in the world – those that are generally very long on resources and account for the bulk of productive capacity – also made changes to their strategy in recent years. Of course they could have gone abroad too, but in fact they took a look around and decided that something new could be done at home. Companies like Aramco, Pemex, Qatar Petroleum, and ADNOC have embarked on significant long-term expansion projects either alone or with partners, many of which are complex and represent the next generation of projects. Other NOCs, such as the Asian ones, expanded at home but also began to adventure outside and participate in new types of projects such as deepwater.

Final Observations, the Long View

In general, the future is unpredictable and will be unstable. The O&G industry is no exception. While the exact level of future energy prices, demand, and capacity, can not be predicted, nevertheless a future path for each may be visualised. Prices will move along two dynamic bands, oil and gas demand may not grow as much as we think, whilst production capacity will be there to meet energy demand. In contrast to conventional wisdom, a potential maximum rate for consumption/capacity growth does not need to be a problem nor translate into rising oil and gas prices for eternity.

The industry will continue to work the large resources already discovered and look for new finds; its focus will remain on the areas where hydrocarbons have or might have accumulated. The major IOCs and NOCs are already running on nearly every fossil energy track. There are certain limits in the O&G industry and many challenges, but it will adapt; there are plenty of fossil fuels and possibilities in new energy too. However, is our industry destined to continue to go through extreme boom and bust cycles or might it at some point see a more steady development?

Bassam Fattouh studies the behaviour of spreads between the prices of oil futures contracts of different maturities

Introduction

One of the very interesting features in the recent behaviour of crude oil prices has been the increase in the variability of the spread between the oil futures prices at different maturities. Figure 1 shows the daily spread between the first-month and the second-month NYMEX Light Sweet Crude Oil futures contract (WTI contract) over the period 1997 to 2008. The figure reveals the following three interesting features. The first one concerns the high volatility of the spread especially towards the end of our sample. During the period 1997–2008, the mean of the spread stood close to zero but with a relatively high standard deviation of $0.87. The maximum and minimum values that the spread has taken (excluding the two spikes which were driven by last-minute positioning due to contract expiry) range from -$6.99 to +$2.4 during this period.

The second interesting feature is the frequent switches between backwardation and contango. While the crude oil market is expected to spend most of its time in backwardation, examining more recent data and focusing on the front part of the futures curve suggest the opposite. As can be seen from this figure, since 1997, the oil market has witnessed many switches from backwardation to contango. In fact, in our sample the first-month futures crude oil prices were below the second-month prices more than 55% of the time. In other words, the crude oil market has been in partial contango for longer than it has been in backwardation.

The third observation concerns the persistence of backwardation or contango regimes. In April 1997, the oil market entered into a contango which lasted until August, 1999. In May 2002, the market entered in a long backwardation which lasted until mid 2003. In November 2004, the market entered in prolonged contango which lasted until mid 2007. In October 2008, the market switched to a contango which many observers expect to last for a long time.

The large variability of the spread, the occasional switches from backwardation to contango, and the persistence of the regimes raise a series of questions: what can explain the dynamic behaviour of the spread in recent years? Is the behaviour of the spread really unusual? This article tries to provide answers to the above questions by drawing some lessons from the period 1997–2008. But before discussing these episodes in detail, it is worth considering very briefly how economists explain the variability of the spread and highlight some of the limitations when applied to the oil market.

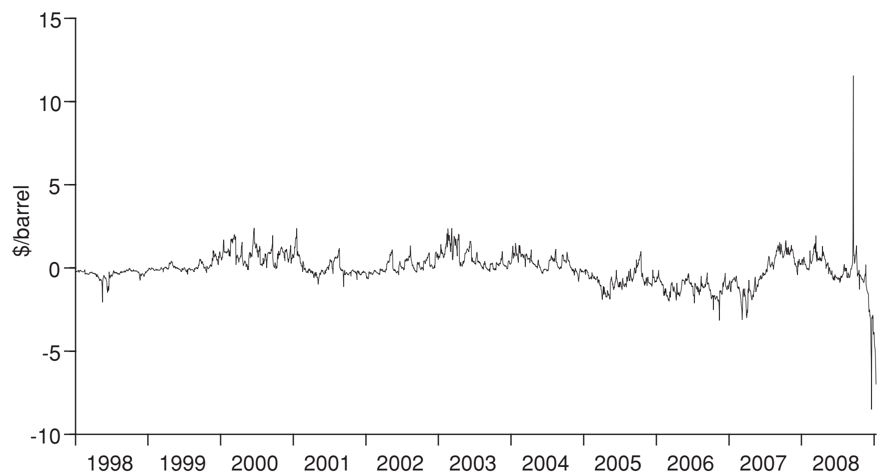
What Does Theory Tell Us?

One way to explain the variation in the basis is in terms of a risk premium which arises in the process of transferring risk from hedgers to speculators. Specifically, the basis can be written as the sum of the following two main components: the expected change in the spot price and the ex-ante risk premium. The risk premium can be positive or negative (and hence the basis can take negative or positive values) depending on investors' beliefs, endowments, and preferences.

An alternative theory, the theory of storage, explains the difference between the futures price and the spot price of a commodity in terms of interest foregone in purchasing and storing the commodity, storage costs, and the convenience yield. The latter was defined by Brennan and Schwartz in 1985 as a yield or benefit that 'accrues to an owner of physical asset but not to an owner of a contract for future delivery of the commodity'. The convenience yield affects the basis through arbitrage. When the convenience yield goes up, the attractiveness of holding futures contract relative to physical stocks goes down. This will lower the futures price and increase the spot price until an equilibrium relationship between the two is attained.

Studies based on the storage model relate the convenience yield directly to the level of inventories. Generally, the theory of storage suggests that marginal convenience yield falls with inventory but at a decreasing rate. At low levels of inventory, the marginal convenience yield is larger than carrying costs and the spot-futures price spread is positive. As the level of inventories goes up, the marginal convenience yield falls towards zero and the spot-futures price spread becomes negative and converges towards the cost-of-carrying the commodity. More recent models describe the convenience yield as a financial call option held by storage agents. The call option can have value when, for example, demand shocks create a positive probability that agents can sell their stocks at higher price during the storage period.

Figure 1: First-Month WTI Contract minus Second-Month WTI Contract



Source: Energy Information Administration (EIA) website

What is Missing in These Models?

While these models are very useful in explaining the behaviour of the spread, there are three features that one should consider in the context of the crude oil market. The first is related to the feedback mechanism and the possibility that the market can enter into a reinforcing feedback. The second feature is related to the oil market structure where OPEC can play the role of an active or a passive quantity adjuster which can affect the process of inventory accumulation and the behaviour of the spread. The third feature is related to the fact that reinforcing mechanisms can lead to the dislocation of key benchmarks used for oil pricing with wide implications on the behaviour of key spreads such as the WTI-Brent spread or time spreads.

Reinforcing Dynamics

While most empirical studies focus on how changes in inventories affect the variability of the spread, the feedback mechanism from the spread to inventories is rarely explored. These feedbacks are important as they often result in reinforcing dynamics which may take a long time to break. Specifically, increases in the level of inventories would push prices for immediate delivery down as a higher level of inventories is often interpreted as a sign of a well-supplied market. At the same time, the convenience yield of holding inventories goes down pushing the futures price upward. The end effect is a widening spread between prices for immediate delivery and prices for future delivery. This in turn will induce further accumulation of inventories as traders take advantage of the spread. This process can continue for a long time and can be broken in either of two ways. At a sufficiently high level of inventories, the marginal storage becomes increasingly expensive. Alternatively, oil producers can decide to cut supplies and prevent physical traders from accumulating inventories.

In 1998, the oil market was trapped in such a reinforcing mechanism. A decline in oil demand due to the Asian financial crisis and a market perception that OPEC supplies have increased resulted in a sharp fall in prompt prices relative to oil prices for future delivery. This triggered the accumulation of crude oil which led to the decline in spot prices and widened the contango. This reinforcing contango was broken after a series of output cuts which saw OPEC draw more than 1 billion barrels from 1999 to early 2000.

While reinforcing contango is usually associated with sharp declines in oil prices, this does not necessarily have to be the case. In 2006, the reinforcing contango and the associated rise in inventories went hand in hand with rising oil prices. This is because the spread and not the price level drives these dynamics. As long as futures prices are rising faster than prompt prices, these reinforcing mechanisms are likely to prevail. Thus, in 2006 while the inverse relationship between inventories and prices collapsed, the relationship between inventories and the spread remained intact.

"the feedback mechanism from the spread to inventories is rarely explored"

These dynamics can also work in the opposite direction as occurred in the first half of 2008. Despite evidence of a weaker oil demand growth, declining inventories continued to push up spot prices (falling inventories are seen as indicating a supply shortage). Now let's suppose that refineries thought at that time that the rise in oil price is only temporary and that weaker oil demand will eventually bring prices down. This would induce them to use their own stocks. Thus, although oil demand growth was slowing down, spot prices kept rising as traders were coordinating on public signals about declining inventories. This deepened and prolonged the backwardation and decreased the incentive to hold stocks as it was not profitable to do so. This process can continue until stocks reach minimum operating levels or until there is a change in market sentiment as happened in the second half of 2008.

This leads us to the current behaviour of the spread which as can be seen from Figure 1 has entered into a contango which many market participants expect to last for a long time. The current dynamics are very similar to what happened in 2008. Fears about the impact of deteriorating prospects of the global economy on oil demand have been placing a downward pressure on oil prices. While both the front end and the back end of the oil price curve have seen sharp declines in the past few months, long-term oil prices have fallen more slowly. This may be due to concerns about long-term supplies as the market expects that the current crisis will induce a slowdown in investment and tighter oil market conditions in the future. Alternatively, this behaviour may be due to the current weakness of the market in the short term, where the bulk of the trading activity is concentrated. Either way, the term-structure has shifted to contango, with the price of the first month futures contract falling below the prices of subsequent contracts for each maturity. This term structure is providing incentives for traders to accumulate inventories. Higher levels of inventories are in turn leading to further falls in oil prices which is widening the contango. The problem is that the contango is so steep that the incentive to stock may last a long time.

The Role of OPEC

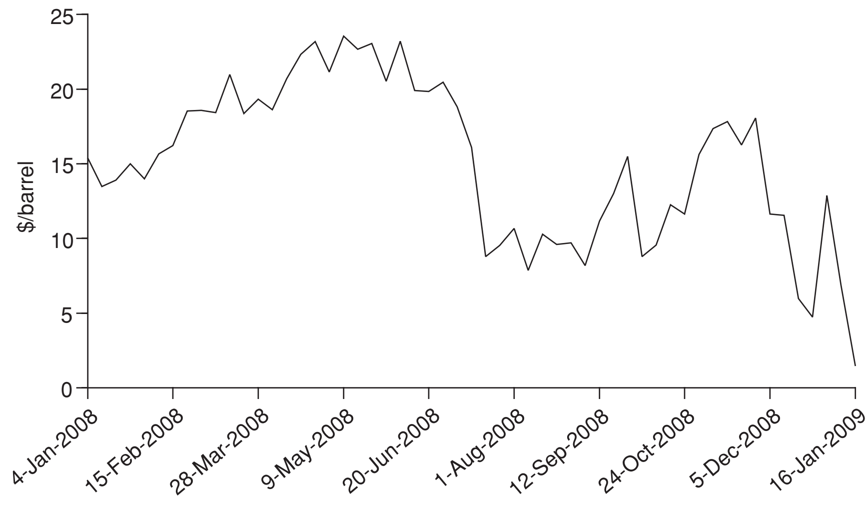
Unlike other markets, OPEC can affect the rate of accumulation of inventories either through an active or passive policy. In terms of active policy, OPEC can decide to target the level of inventories. Specifically, high levels of stocks may increase the incentive for OPEC to engage in output cuts if the Organization feels that high stock levels can induce a sharp downturn in oil prices. OPEC cuts would have the effect of lowering inventories and raising the price at the front end of the futures curve increasing the probability of the basis moving back into backwardation. The speed at which OPEC can achieve this depends on the tightness of market conditions and how effective OPEC is in implementing these cuts. This can explain the switches in 1997 and 2006 from contango to backwardation.

In terms of passive policy, OPEC can continue to supply upon demand based at prevailing market prices. This will help balance the market without an increase in inventories. These dynamics were present in the first half of 2008. Despite the fall in demand, excess supply did not appear in the market and we did not witness any significant rise in inventories as OPEC passively adjusted its output to counteract the decline in oil demand.

The Breakdowns of the Benchmark

The third distinguishing feature of the oil market is that these reinforcing mechanisms affect the behaviour of a key benchmark with very wide implications on oil prices. Since the adoption of formula pricing in 1986, WTI has served as one of the main international benchmarks, along with Brent and Dubai, against which other types of crude oil are priced. Thus, reinforcing dynamics affect the entire pricing mechanism and arbitrage between markets. Furthermore, the time spread affects the attractiveness of oil as a financial asset by affecting the roll return on passive futures-based commodity investment i.e. the return from selling the expiring contract and buying the new front month contract (in a contango the roll return is negative).

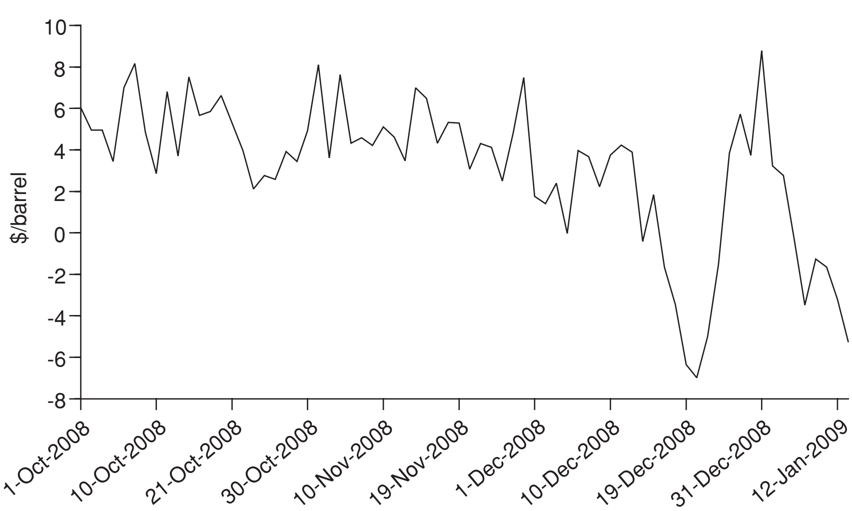
Figure 3: Cushing WTI Spot Price minus Mexico Maya Spot Price ($/barrel)



Source: EIA

It has long been recognised that the link of the WTI price to oil prices in international markets can be dictated by infrastructure logistics. In 2007, due to logistical bottlenecks which resulted in a large build-up of inventories at Cushing, Oklahoma the WTI disconnected not only from the rest of the world, but also from other US regions. In the current market conditions, something similar is taking place though the cause for the build-up is different. Due to a reinforcing contango, Cushing is being flooded with inventories. Crude inventories at Cushing have grown from 14.383 million barrels in October 2008 to almost 33 million barrels by 19 January 2009, an increase of more than 18.5 million barrels. This increase in crude oil inventories is concentrated in Cushing and not in the rest of the USA. This is because traders can implement the arbitrage most effectively at Cushing, which is the delivery point for benchmark West Texas Intermediate.

Figure 2: Cushing WTI Spot Price minus European Brent Spot Price ($/barrel)



Source: EIA

The effects of this rapid build-up of inventories in Cushing are widespread and affected the oil price structure in three major ways. First, the feedback is creating distorted sets of time spreads as reflected in the large differential between months with front month spreads reaching $7 and much higher for further away maturities .

Second, the WTI decoupled from Brent, as reflected in the large differential between the prices of the two international benchmarks (see Figure 2). Although WTI and Brent are of similar quality (light and sweet), WTI has been trading at large discounts to Brent. Since 6 January the differential has been widening, reaching more than $5 on 19 January.

Third, the build-up of stockpiles around the area of Cushing has also resulted in the sour-sweet crude oil price differential narrowing to very low levels. Figure 3 shows that while WTI was trading at a premium of more than $23 to Mexican Maya Blend in mid 2008, the differential has narrowed considerably and in 9 January 2009 Mexican Maya was trading at a discount of less than $7 per barrel. This can also be explained by the fact that most OPEC production cuts are usually concentrated on heavy crudes.

In short, WTI's dislocation has had serious implications across the various crude oil markets, resulting in unusual price differentials. These effects, however, do not imply that the local market is not functioning well. On the contrary, price movements are efficiently reflecting the local supply-demand conditions in Cushing. The main problem is that when localised conditions become dominant, WTI can no longer reflect the supply-demand balance in the USA, nor act as an international benchmark for pricing the millions of barrels of oil imported into the USA.

"the link of the WTI price to oil prices in international markets can be dictated by infrastructure logistics"

Conclusions

While the media often focuses on the sharp swings in oil price, there have been some interesting feedbacks unfolding in the term structure of oil prices with wide consequences on the international pricing system, financial investment, inventories and OPEC behaviour. These feedbacks are not new to the oil market, but the current environment seems to have amplified price distortions. While the market will eventually succeed in eliminating these distortions and market dislocation, the fact remains that these reinforcing feedbacks seem to have become more common in recent times. This suggests that we need to get prepared for some more sharp irregularities in months to come.

LNG Trading: Overview and Challenges

Axel Wietfeld and Niels Fenzl

The Need for LNG

In the 27 countries of the European Union, growing demand for gas over the next decade or so will create a need for new import projects covering 140 bn m^3 p.a. – needs which are not going to be covered by Russian and Norwegian imports alone. Diversification is required to avoid a singular dependency, which is not conducive either to supply reliability or to an acceptable price level. This is why international corporations are looking to North Africa, West Africa, the Middle East and Asia for new sources of supply. That being so, there are five countries – Iran, Qatar, United Arab Emirates, Nigeria and Algeria – which now number in the world's Top Ten in terms of natural gas reserves. However, it is from these countries that the delivery of gas is usually made by ship, in the form of LNG (liquefied natural gas), and not by pipeline.

Definition of LNG and Costs

The worldwide LNG market is basically divided into two regions: the Pacific Basin and the Atlantic Basin. The LNG chain involves a liquefaction plant with several 'trains' situated in the producer country; marine transport with LNG tankers; and regasification terminals in the receiving country where the LNG is temporarily stored in tanks before being regasified and fed into the pipeline network.

With investments well into the US$-billions, the liquefaction plant represents the biggest cost factor within the LNG chain. The LNG chain initially involves natural gas being refrigerated to approximately -162 °C, at which point it condenses to a liquid and takes up only 1/600 of its original volume. For a large-scale plant, then, as currently being built in Qatar with a planned capacity of 7.8 mn t LNG p.a. (≈10 bn. m^3 p.a.), investments of between US$900 and 1500 per t LNG p.a. are required or anything between US$7 and 12 bn in total. In comparison, a regasification terminal of the same scale and constructed for US$0.8–1.2 bn comes over as relatively affordable. For an LNG tanker with a load capacity of, say, 265,000 m^3, you have to reckon between US$250 and 290 mn. At the time of writing, the going charter rate is between US$45,000 and US$70,000 a day.

In the 1990s, the LNG industry was able to achieve considerable cost reductions based on improved efficiency, design innovations, greater professional project management and, in particular, economies of scale.The first LNG projects in the 1960s had a capacity of 0.5 mn t LNG p.a. whereas the liquefaction plants of today are being put up for 7.8 mn t LNG per annum. Plus, the possible load capacity of the LNG tankers has grown from approximately 30,000 m^3 to 265,000 m^3, another reason why specific costs have gone down substantially. All the same, the engineering, procurement & construction (EPC) costs for liquefaction plants have shot up over recent years. This was largely due to the rising cost of raw materials and other input materials, the low number of suitable contractors and the shortage of engineers in this specialist field.

Meanwhile, it has emerged that energy consumptions along the LNG chain are actually much lower than hitherto widely assumed –

- liquefaction approximately 7%,
- shipping approximately 0.15% per day and
- regasification approximately 1.5%.

All in all, energy consumptions can usually be kept to below 10%, correlated of course to the technology deployed and, in particular, to actual shipping distance.