Oil and gas: the facts of life

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Tokyo — 5th November 2008
The importance of the oil industry: a reminder

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/bbl</td>
<td>$ billion</td>
</tr>
<tr>
<td>Production (84.5 mbpd)</td>
<td>69.0</td>
<td>2,141</td>
</tr>
<tr>
<td>Transportation (50.0 mbpd)</td>
<td>2.5</td>
<td>48</td>
</tr>
<tr>
<td>Refining (margin)</td>
<td>7.5</td>
<td>235</td>
</tr>
<tr>
<td>Distribution &amp; Marketing</td>
<td>7.5</td>
<td>235</td>
</tr>
<tr>
<td>Downstream taxes</td>
<td>16.0</td>
<td>500</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>102.6</strong></td>
<td><strong>3,158</strong></td>
</tr>
</tbody>
</table>

* based on long-haul costs

6.6% of global GDP

Oil: what are its “facts of life”?

- **Oil exploration** remains a gamble despite technological progress.
- From the very beginning there have been those who fear the world is running out of oil; the idea that oil is peaking is not new.
- **Oil demand** is relatively insensitive to oil prices and reacts to changes in these prices with long lags.
- **Oil supply** responds to oil prices too, but in a complicated fashion.
- As a result, the oil market is subject to large price swings, unless …
- … oil supplies are controlled and managed in the interests of price stability.
- Pre-1973 the **oil majors managed supplies**: since then OPEC has arrogated to itself this role.
- **OPEC has tried to stabilise prices** by fixing prices (OGSPs from 1973 to 1983), by S. Arabia acting as the residual supplier (1983-85), by quotas (1986-98) and since 1998 by trying to control stocks.

OPEC would have to realise that there is no natural law which provides for the sale of a commodity in abundant supply at prices which are many times its cost.

— Paul Frankel, “Oil: the facts of life” (1962 essay)

The price of oil adjusted for inflation (1860-2008)

Between 1860 and 1880 rampant competition caused oil prices to be highly volatile. Thereafter the Rockefeller model took hold and the integrated oil companies proceeded to stabilise the oil price for decades. After World War II the world experienced the golden age of oil price stability, which lasted until the year 1973 and the first oil price spike. Since then the oil price has become volatile once again.
**Historical evolution of the oil industry**

- **Rampant competition in the early days**
  1860 - 1880

- **Vertical integration**
  1880 - 1930

- **State-owned oil producing entities**
  1930 - 1970

- **Oil nationalisations of the mid-1970s**
  1970 - 1980

- **End of the concessionary era**

**Current hybrid model**

- **Semi-integrated majors**
- **The OPEC cartel**

**Evolution of futures and OTC markets to handle price risk**

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**OPEC has failed to stabilise the price of oil**

OPEC has not been able to stabilise the price of oil since the abandonment of the official-government-selling-price (OGSP) regime in the summer of 1985. Between 1985 and 2002, the oil price oscillated between $10/bbl and $36/bbl, which was bad enough; however, since 2002 the price of oil has surged to unprecedented heights and then fallen heavily, causing volatility to increase dramatically.

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**OPEC’s share of global oil reserves (end 2007)**

(Source: Oil and Gas Journal, and CGES)

- Western Europe (11%)
- North America (3%)
- Latin America (2%)
- Eastern Europe (9%)
- Asia (3%)
- Africa (1%)
- Middle East (1%)
- OPEC (80%)

At the end of 2007 the world’s oil reserves stood at 1,156 billion barrels (lasting 43 years at current rates of production), the vast majority (80%) of them in the OPEC countries. Eastern Europe’s oil reserves are mostly (99%) those of the former Soviet Union. If the FSU were to be placed in the OPEC camp, then the two would control 90% of global oil reserves.

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**Gas: the oil connection**

- Oil has not done natural gas many favours over the last few years. Prices of natural gas have followed oil prices to record highs and have caused gas’ share of primary energy to stagnate.

- Gas prices are linked to oil prices via long-term contracts; the path natural gas prices will follow in the future therefore depends on what will happen to oil prices, unless …

- … the natural gas market is decoupled from oil. Is this a matter of “if” or “when”?

- How can the gas market stand alone? The obvious answer is when (or if) it becomes like the oil market.

- When will natural gas’ share of primary begin to rise again globally?
Crude oil and natural gas prices — follow the leader

Crude oil prices are the leader of the natural gas price pack, as can readily be seen from the graph. Representative gas prices from three continents all follow, with varying lags, the price of oil. The linkage is obvious in the case of long-term gas contracts (Japanese LNG and EU pipelined gas from Russia). It exists in the US too. “A permanent shock of 20% in WTI leads to a 14% increase in the Henry Hub price 1 year out; all else being equal,” from a report entitled The Relationship between Crude Oil and Natural Gas Prices, by Jose Villar, EIA, and Frederik Jouze, George Washington University (2006), www.eia.doc.gov

Gas and coal shares in Japan’s primary energy demand

Coal’s share in Japanese primary energy has been rising since 1999 after a long period of stagnation. Coal competes with natural gas in power generation and — as we can see — natural gas prices in Japan have followed oil prices, whereas coal prices declined until 2003 and then increased at a much slower pace than both oil and gas. The relative price of LNG to coal (right-hand diagram) goes a long way towards explaining the rise in coal’s share in Japan from 1999 onwards.

Ten reasons why oil prices reached such heights

1. Dollar weakness, inflation
2. Strong oil demand growth
3. Slow growth in non-OPEC oil supplies
4. Speculation in oil futures markets (geopolitics)
5. OPEC’s oil price ambitions
6. Fear that we have reached ‘peak’ oil
7. High marginal costs
8. Structure of the oil industry
9. Low oil inventory cover
10. OPEC’s low spare output capacity

The oil price spike of 2008 was not due to the Dollar

<table>
<thead>
<tr>
<th>US Dollar exchange rates (currency per $) on the 1st January 2007</th>
<th>US Dollar exchange rates (currency per $) on the 30th June 2008</th>
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</thead>
<tbody>
<tr>
<td>Euro</td>
<td>0.758</td>
</tr>
<tr>
<td>Yen</td>
<td>119.1</td>
</tr>
<tr>
<td>Yuan</td>
<td>7.818</td>
</tr>
<tr>
<td>£ Sterling</td>
<td>0.511</td>
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Note: A dated Brent on the 30th of June 2008 was $115.64/bbl.
**Oil demand — one of the facts**

- Oil demand is relatively insensitive to changes in the real price of oil, but the price elasticity of demand is not zero and increases in the oil price have been considerable (9.4% a year in real terms between 2000 and 2007).

**Implied price elasticities of oil demand over the period 2000-2007**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>World</td>
<td>-0.3</td>
</tr>
<tr>
<td>USA</td>
<td>-0.2</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.4</td>
</tr>
<tr>
<td>China</td>
<td>-0.3</td>
</tr>
<tr>
<td>India</td>
<td>-0.6</td>
</tr>
<tr>
<td>Germany</td>
<td>-1.0</td>
</tr>
<tr>
<td>France</td>
<td>-1.4</td>
</tr>
<tr>
<td>Iran</td>
<td>-0.1</td>
</tr>
<tr>
<td>S. Arabia</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Is strong oil demand growth to blame?**

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>670</td>
<td>340</td>
<td>-240</td>
<td>-430</td>
<td>-1090</td>
</tr>
<tr>
<td>of which USA</td>
<td>350</td>
<td>70</td>
<td>120</td>
<td>150</td>
<td>-700</td>
</tr>
<tr>
<td>Non-OECD</td>
<td>1210</td>
<td>750</td>
<td>690</td>
<td>930</td>
<td>930</td>
</tr>
<tr>
<td>Former CPEs</td>
<td>1010</td>
<td>340</td>
<td>690</td>
<td>390</td>
<td>350</td>
</tr>
<tr>
<td>of which China*</td>
<td>900</td>
<td>270</td>
<td>520</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

**GRAND TOTAL**

| 2890 | 1430 | 1140 | 890 | 190 |

* Includes large inventory build in 2004.

Note that the trend rate of oil demand growth since 1986 has been 1.6% per annum. Below trend oil demand growth of 1.4% and 1.0% in 2006 and 2007 respectively — despite continuing strong economic growth — suggests that high oil prices have dampened the rate of oil demand growth. In 2008, an expected economic slowdown, coupled with high prices, will take the global rate of growth of oil demand down to 0.2% p.a., and even lower if a recession materialises.

**Shares of the main fuels in global primary energy**

![Diagram showing shares of main fuels in global primary energy]

Oil first gained and then lost market share, heavily influenced by movements in the price of oil. Since 2000 oil’s share is on the slide (affected by the oil price) while natural gas share in primary energy has stagnated since 2002, whereas coal’s share has been rising. This counter-intuitive move in coal’s share is explained by the surging oil price dragging up behind it the price of natural gas and, since natural gas competes head on with coal in power generation, increases in the price of oil benefit coal.

**Incremental oil demand growth 1985-2007**

![Diagram showing incremental oil demand growth 1985-2007]

Note that during this period global oil demand growth was 1.6% per annum and economic growth averaged 3.7% a year.
Gasoline demand growth in the US and the price of gasoline

There can be little doubt now that high gasoline prices in the US have had a large adverse effect on gasoline demand growth. The slowing US economy is also kicking in at present to exacerbate the impact of high gasoline prices and send incremental gasoline demand heavily into negative territory.

Global oil reserves are not a problem

Cumulative oil production
1. 1,064
Remaining oil reserves
2. 1,156
Reserves growth
3. 378
Undiscovered conventional oil
3. 402
GRAND TOTAL
3,000

1. Until the 1st of January 2008. The figure refers to crude oil only. Sources are the Oil and Gas Journal, DeGolyer and MacNaughton, and the CGES.
2. On the 31st of December 2007, as reported by the Oil & Gas Journal, representing 43 years of reserves at current rates of oil production. Note that we have excluded tar sands from Canada’s total as given by the OGI.
3. We have arrived at these figures by subtracting cumulative output and remaining oil from 3,000 bn bbls and then provoking the result by the US Geological Survey’s split between reserves growth and undiscovered oil.

What determines the price of oil?
- In the short run: spot oil prices are driven by the imbalance between desired and actual inventory cover, while futures prices are heavily influenced by news about oil inventories, demand/supply, OPEC’s output and its spare capacity, and political developments. Oil is also a commodity and attracts attention as an alternative form of investment, competing with equities and fixed-income assets. Spot and futures prices constantly interact.
- In the medium term: oil prices are driven by oil demand, the world’s spare capacity, the non-OPEC countries’ oil reserves position and their production, and OPEC’s investment intentions and oil price targets. They say prices in the medium term revert to the mean.
- In the long run: costs of supply have a big influence on oil prices in the long term. These in turn are affected by discoveries, gross additions to reserves, depletion rates, access to reserves, technological advances, investment in productive capacity, OPEC’s policies, and trends in oil demand and non-OPEC supplies.
What about OECD company stock cover?

Between Q3Q6 and 2003 oil prices seemed to be the mirror image of OECD company inventory cover, rising when cover was low and falling when cover was high. From 2003 onwards forward cover rose from 51 days to 55 days, yet oil prices rose relentlessly, except for two episodes of price weakness (Q2Q5 and Q206-1Q07), both associated with rises in inventory cover. Since Q2Q7 OECD company stock cover has not changed much and yet oil prices have soared and then tumbled.

What should be done to improve matters?

- Oil should be de-politicised and, ideally, de-nationalised.
- Since this looks unlikely, the second best solution is for OPEC to set annual output targets and allow global inventories to take the strain.
- OPEC’s annual production targets should be based on estimates of world oil demand, non-OPEC supplies, desired stock-cover and oil price targets.

What about OPEC’s spare capacity?

<table>
<thead>
<tr>
<th>Incremental...</th>
<th>1998-2008 mbpd</th>
</tr>
</thead>
<tbody>
<tr>
<td>World oil consumption</td>
<td>12.25</td>
</tr>
<tr>
<td>Non-OPEC production</td>
<td>4.40</td>
</tr>
<tr>
<td>OPEC’s output of NGLs</td>
<td>2.01</td>
</tr>
<tr>
<td>Processing gains</td>
<td>0.62</td>
</tr>
<tr>
<td>Biofuel production</td>
<td>0.46</td>
</tr>
<tr>
<td>OPEC’s output of crude oil</td>
<td>4.63</td>
</tr>
<tr>
<td>Stock changes</td>
<td>-0.13</td>
</tr>
<tr>
<td>World oil supplies</td>
<td>12.25</td>
</tr>
<tr>
<td>OPEC capacity</td>
<td>1.73</td>
</tr>
</tbody>
</table>

OPEC panicked in the 3rd quarter of 2006 upon seeing the big OECD company inventory build of that quarter and instituted production cuts over the winter of 2006/7 that lightened the market considerably in 2007 (bringing about a 94-mmbl decline in OECD company stocks last year). We expect a very small OECD company inventory build in 2008, which will leave oil stock cover in the region on the low side. OPEC needs to allow inventory cover to rise to more comfortable levels.
The heart of the problem: OPEC’s capacity growth has been disappointing

<table>
<thead>
<tr>
<th>Capacity change</th>
<th>1998-2008</th>
<th>mbpd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia *</td>
<td>1.06</td>
<td></td>
</tr>
<tr>
<td>Iraq</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Kuwait *</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>U.A.E.</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Qatar</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>Libya</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Algeria</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>-0.33</td>
<td></td>
</tr>
<tr>
<td>Venezuela</td>
<td>-0.95</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>-0.55</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1.73</td>
<td></td>
</tr>
</tbody>
</table>

* plus half the Neutral Zone

Since the oil price collapse of 1998, OPEC has not added much new capacity. Aging oilfields in Nigeria, civil unrest in Nigeria, a lack of investment in Venezuela and economic sanctions imposed on Iran have all taken their toll. Note that Iran’s capacity remains below the level reached prior to the 2003 invasion.

Can OPEC’s low spare output capacity explain the oil price surge?

Low spare capacity (as a % of global demand) is generally associated with high prices and vice versa. However, the relationship is distorted by OPEC’s occasional drives to push up oil prices by constraining production and thus raising spare capacity (e.g., in 1998-99, 2002 and in 2006-07). Between 2003 and 4Q04 spare capacity genuinely became much tighter. Spare capacity then increased between 3Q05 and 3Q07, only to decline slightly from 3Q07 to date.

The elephant in the room: growth in crude oil open interest at NYMEX

Annual growth rates of open interest positions (average of long and short) 2001 to 2007

- Commercial: 13%
- Non-commercial: 23%
- Non-reporting: 8%
- TOTAL: 19%

Open interest in WTI grew exponentially at 19% per annum between 2001 and 2007. Much of this surge occurred between 2004 and 2007. A new investor class of commodity investors, hedge funds and financial players emerged. The funds tracking commodity indices (like the Goldman Sachs and Dow Jones-AIG indices) grew dramatically from $6bn in 2000 to around $130bn in 2006 before a sell-off at the end of 2006. They came back into the market in 2007. Note that the assets under pension fund management worldwide exceed $21 trillion; note also that so far in 2008 there has been a decline in open interest positions.

The WTI oil futures forward curve Nov. 2008 to Dec. 2016

Most of the open interest is concentrated in the first three months (50% of the total). The front end of the forward curve is backwardated till January 2009; thereafter it is contangoed all the way till December 2016.
Evidence by Michael Masters of Masters Capital Management before a US Senate Committee hearing in May 2008

- The severe bear market in equities over the period 2000-2002 drove institutional investors into commodities, which usually trade inversely to fixed-income and stock portfolios.
- As a result, assets allocated to commodity index trading jumped from $13 billion at end-2003 to $260 billion by March 2008. Over this period the prices of the 25 commodities making up these indices surged by 183%.
- "The huge growth in demand [for futures contracts] has gone virtually undetected by classically trained economists, who almost never analyze demand in futures markets."
- "Refiners have told me that the price of oil, excluding the impact of speculation, would be in the $65 to $70/bbl range."

Other commodity bull markets

- The 1906 — 1923 bull market (17 years)
- The 1933 — 1955 bull market (22 years)
- The 1968 — 1982 bull market (14 years)
- The 2000 — 2008 bull market (7 years)

Bursting bubbles

- The Baltic Dry Cargo Index is down 80% since May ’08.
- Oil has dropped around 40% from its peak.
- Copper has fallen by 38% from the peak.
- Wheat is down by 50% from its highest level.

Oil price prospects until the end of 2009

The key to the oil price lies in the call on OPEC (including desired stocks) versus OPEC’s output. Angola’s figures distorted the picture for 2007, but the key feature of the year was a significant tightening of the oil market, with the call on OPEC exceeding OPEC’s production for almost the whole of 2007. This continued into 2008, peaking in 2008, but since then the call on OPEC (with stocks) has been falling steeply, requiring output cuts from OPEC in the 1st and 2nd quarters of 2008 to slow down and eventually reverse the oil price decline. The CGES view is based on a global economic slowdown in 2008 and 2009.
Oil price scenarios

Source: IEA and CGES

If the world were to slide into recession, oil demand would actually decline in 2009 and the price of oil would drop under $60/bbl, despite OPEC cuts that reach 1.5 mbpd below current levels by the middle of next year. OPEC needs to cut its production early on in 2009, and keep cutting, to keep the oil price from gathering downward momentum and eventually guide it back up above $100/bbl by 4Q09.

The IEA’s forecasts — some comments

- It is clear that the IEA’s forecasts of oil demand are not very responsive to changes in the price of oil. This is a common point of view.
- The future trajectory of oil demand in this sort of scheme is largely driven by economic growth and the intensity of oil use.
- Once oil demand is determined, prices play the role of eliciting the appropriate supplies to satisfy demand, hence the talk of ‘oil crunches’ and ‘investment needs’.
- In fact, oil demand is responsive to oil prices, albeit with lags. To neglect this relationship means missing a key mechanism that brings oil demand into line with the available supply.
- It is not easy to disentangle the effect of oil prices and economic growth on oil demand. The CGES work on the long-run price elasticity of demand for oil suggests a value around -0.7, implying that a 10% increase in the real price of oil leads over time to an 7% fall in the consumption of oil, ceteris paribus.

A few words about the longer term

- In its 2007 World Energy Outlook the IEA painted a picture of oil supplies chasing robust oil demand, with oil prices above $65/bbl till 2010 and rising thereafter to $81/bbl by 2020. OPEC remains in the driving seat, its output reaching 48% of global consumption in 2020.
- The IEA sees oil demand growing by 19 mbpd (1.5% a year) between 2006 and 2020, despite oil prices well above $65/bbl and slower economic growth after 2015. Worries about the security of oil supplies and environmental issues lead to an alternative scenario in which governments use an array of powers at their disposal to curtail oil demand.
- After the oil crises of the 1970s, most observers predicted that oil prices would rise inexorably, because oil demand was considered highly inelastic and alternative supplies inadequate. These predictions proved to be entirely wrong. Could we be making the same mistakes once again?
- The key issue is whether the free market system can prevent what some people are calling ‘the impending oil crunch’ from taking hold?

Looking at the oil price both near and far

As OPEC’s spare capacity builds up after 2008 the oil price begins to weaken, reaching a trough around 2018 and rising thereafter with gathering speed as spare capacity drops to the 4% level. From 2020 onwards the oil industry will have entered the fourth and final phase of its life cycle.

The recent spate of high oil prices has come before its time, resulting in weaker oil demand growth than otherwise would have been the case. Non-OPEC supplies reach a plateau around 2015 and decline inexorably after then. World oil supplies peak at or near 2022, as does oil demand.
Concluding remarks

- The oil price peak of $147/bbl in July 2008 is highly unlikely to be seen again for the foreseeable future, unless the geopolitical scene deteriorates rapidly (because of Iran).

- OPEC will try to keep prices above $80-90/bbl; the outcome will depend on the struggle between the impending recession and the fiscal needs of the oil-producing states.

- In the longer term, oil demand growth is likely to slow up considerably due to high oil prices and worries about the environment.

- The world’s oil resources are ample; getting them out of the ground is the problem. Key questions: (1) is there the desire to do so, (2) will there be enough investment by OPEC and the oil companies, (3) will there be political stability?