Lehman Brothers oil outlook: Stronger signals of weaker prices

Adam Robinson

April 8, 2008
What’s driving oil markets today?

- Not the short run: Oil prices go up every time the US economy gets worse
- It’s tempting to argue that the rise in oil prices now is simply a continuation of past trends
  - The cost of F&D continues to march up
  - Demand in China growing faster with no signs of slowdown
  - Upstream and downstream supply bottlenecks are permanent
- We think current price may be rising despite improvements on these fronts
- Yes, in the short run, weak dollar and inflation fears can push prices higher, but these are likely to dissipate by the end of the year
- We may be on the verge of a turning point in prices
  - Possibly the peak oil price comes this summer at $110-$120
  - Prices afterward could decline for 3 years or more
  - Oil may drop to $70-$80 by end-year
Upstream costs: After a clear run-up, US costs are flattening

US drilling cost rise and fall even more stark

Even deepwater drilling costs are flattening

Deepwater Rig Day-Rates

Avg dayrates in '000 dollars

0 100 200 300 400 500 600
Jan-01 May-01 Sep-01 Jan-02 May-02 Sep-02 Jan-03 May-03 Sep-03 Jan-04 May-04 Sep-04 Jan-05 May-05 Sep-05 Jan-06 May-06 Sep-06 Jan-07 May-07 Sep-07 Jan-08

Semisubmersible Dayrates, U.S. GOM, 5,000- to 7,499-Foot
Semisubmersible Dayrates, U.S. GOM, 7,500-Foot or More
Semisubmersible Dayrates, North Sea, 3,000- to 4,999-Foot
Drillship Dayrates, GOM, Dynamically Positioned

Source: ODS-Petrodata and Lehman Brothers Estimates
That costs have flat-lined is a problem for NYMEX WTI

Higher US costs appear to explain much of the rise in long-dated WTI prices until the divergence in October 2007.

US monthly PPI data regressed against average monthly 5-yr out WTI prices

- R² through Oct-07 is 96%
- Divergence worsens: Dec-13 WTI to average $98 in Mar-08

5-year out Dec avg monthly WTI price

Predicted 5-yr out WTI based on PPI cost indices
What may explain the breakdown?

- Costs of the global marginal producer can go up but not be reflected in the US PPI
  - Russian taxes or political risk
  - Specific machinery not used in the US

- Because US costs are flat, we can test whether the global supply-demand balance has indeed tightened the way the back of NYMEX WTI would suggest
The market for US oil assets provides another data point for long-dated crude oil prices, holding US costs and politics constant.

- US Oil Production Costs
- US Tax Regime and Political Uncertainty
- Global Supply-Demand Balance

These should trend together if fundamentals are behind WTI price changes.
Like costs, US reserve prices have flattened

Relative to the fundamentals, either US reserves are undervalued or WTI is overvalued for some flows-related reason

Index of WTI/HH prices vs US reserves valued through US M&A activity

Index = 100

Source: John S. Herold Upstream M&A Review
Is there an arbitrage that will push NYMEX WTI lower?

Price of US reserves valued through US M&A activity

Source: John S. Herold Upstream M&A Review
Adjusting US reserve values to compare to oil price levels

Rule of thumb for the US: Multiply reserve valuation by 3-4x to get expected minimum realized oil price

Assumptions

- Cost of proposed reserve acquisition: $15/boe
- Lifting cost: $8/boe
- R/P Ratio: 10 years
- Required minimum ROCE: 10%
- Government take = 40%

Math

- Total capex = $15/boe for 10 years = $150/boe of daily capacity
- That requires $15/boe of daily profit to make a 10% return on capex
- Assuming a 40% tax rate, profit before tax must equal $25/boe
- Then you must cover capex of $15/boe and lifting costs of $8/boe, meaning your overall realized price must equal $25+$15+$8 = $48, or 3.2x your capex cost
- 20% ROCE achieved if realized oil and gas prices are $73/boe, what they are today
How Wall Street may have broken the markets’ link

◆ What may be preventing the arb?
  – No access to credit to purchase assets
    • Many producer hedges already underwater
  – Counterparty risk and margin calls
    • Grain elevator operators in 2008
  – Inability especially of big players to hedge all production
    • A big hedge could cause a major drop (Mexico in Dec-06)

◆ Arb may work again if:
  – Confidence rebuilds in the US banking system
  – As financial instruments to mitigate these risks become more widespread
So is NYMEX overvalued or reserves undervalued?

- Cost of exploration and price of US oil assets are substitutes
  - Could provide an anchor to price of oil reserves as the arb closes, forcing NYMEX WTI down

- Stronger natural gas prices take pressure off of oil to rise to provide an incentive to invest all on its own

- But in the meantime, in the absence of producer selling or links to the market for physical oil reserves, WTI prices can trade purely on financial flows
Commodities and inflation: the vicious cycle

Strengthening rolling correlations between oil/dollar and oil/inflation expectations have created a self-fulfilling prophecy

WTI 1M vs. DXY Index

WTI 1M vs. Inflation*

*Inflation compensation as measured by the difference between 10-year treasuries and 10-year TIPS
Source: Bloomberg, Lehman Brothers Estimates
Tighter fundamentals may reinforce flows in 3Q08

Summer tightness to come from Iran, hurricane risks, North Sea maintenance, US fiscal stimulus, Mideast supply-demand shock

Lehman Brothers monthly oil supply-demand balance

Source: Lehman Brothers.

Inventory builds and periods of relative price weakness

Global Demand

Global Supply

Source: Lehman Brothers.
China could turn bearish versus expectations

* Via the trade and financial market channels, a period of extended US weakness could spread to emerging markets by 4Q08

- China is particularly vulnerable and crucial to commodity markets
  - China GDP growth depends on investment (60% self-funded) and exports
  - Rising RMB, higher taxes, less import demand, higher energy prices = lower profit margins and potential overcapacities in China’s heavy industries
  - Pollution concerns + Olympics could be the catalyst for permanent closures and starting back toward less energy-intensive GDP growth seen in 1990s
Show-me-market: Until the creation of market cushions is imminent, fear of long-term shortage to push prices up

We think 5m b/d of upstream and downstream spare capacity by end-2009 will be enough to stem the price rise for at least 3 years

Source: Lehman Brothers estimates
## Lehman Brothers Oil Price Outlook

<table>
<thead>
<tr>
<th></th>
<th>1Q07A</th>
<th>2Q07A</th>
<th>3Q07A</th>
<th>4Q07A</th>
<th>1Q08E</th>
<th>2Q08E</th>
<th>3Q08E</th>
<th>4Q08E</th>
<th>2006A</th>
<th>2007A</th>
<th>2008E</th>
<th>2009E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brent ($ per barrel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Q07</td>
<td>58.62</td>
<td>68.66</td>
<td>74.61</td>
<td>88.53</td>
<td>96.31</td>
<td>90.00</td>
<td>105.00</td>
<td>80.00</td>
<td>66.15</td>
<td>72.60</td>
<td>93.00</td>
<td>83.00</td>
</tr>
<tr>
<td>2Q07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3Q07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4Q07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Q08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2Q08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3Q08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4Q08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Source: Lehman estimates; (1) Other includes global processing gains, biofuels outside US, Brazil and Europe, GTL, CTL and unaccounted for new projects |

## Lehman Brothers Oil Supply-Demand Balance

<table>
<thead>
<tr>
<th></th>
<th>1Q07</th>
<th>2Q07</th>
<th>3Q07</th>
<th>4Q07</th>
<th>1Q08</th>
<th>2Q08</th>
<th>3Q08</th>
<th>4Q08</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Demand</td>
<td>85.9</td>
<td>84.8</td>
<td>85.3</td>
<td>86.4</td>
<td>86.9</td>
<td>85.8</td>
<td>86.3</td>
<td>87.6</td>
<td>84.4</td>
<td>85.6</td>
<td>86.7</td>
<td>87.6</td>
</tr>
<tr>
<td>OECD</td>
<td>49.4</td>
<td>47.9</td>
<td>48.4</td>
<td>49.4</td>
<td>49.4</td>
<td>47.6</td>
<td>48.2</td>
<td>49.4</td>
<td>49.0</td>
<td>48.7</td>
<td>48.6</td>
<td>48.5</td>
</tr>
<tr>
<td>USA</td>
<td>20.9</td>
<td>20.7</td>
<td>20.8</td>
<td>20.8</td>
<td>20.5</td>
<td>20.5</td>
<td>20.5</td>
<td>20.7</td>
<td>20.7</td>
<td>20.7</td>
<td>20.8</td>
<td>20.6</td>
</tr>
<tr>
<td>Europe</td>
<td>15.2</td>
<td>15.0</td>
<td>15.4</td>
<td>15.6</td>
<td>15.4</td>
<td>15.0</td>
<td>15.5</td>
<td>15.6</td>
<td>15.6</td>
<td>15.3</td>
<td>15.4</td>
<td>15.3</td>
</tr>
<tr>
<td>Non-OECD</td>
<td>36.5</td>
<td>37.0</td>
<td>36.9</td>
<td>37.0</td>
<td>37.6</td>
<td>38.2</td>
<td>38.1</td>
<td>38.2</td>
<td>35.5</td>
<td>36.8</td>
<td>38.0</td>
<td>38.9</td>
</tr>
<tr>
<td>China</td>
<td>7.4</td>
<td>7.6</td>
<td>7.4</td>
<td>7.6</td>
<td>7.7</td>
<td>8.1</td>
<td>7.7</td>
<td>8.0</td>
<td>7.0</td>
<td>7.5</td>
<td>7.9</td>
<td>8.2</td>
</tr>
<tr>
<td>Middle East</td>
<td>6.6</td>
<td>6.7</td>
<td>7.1</td>
<td>6.6</td>
<td>6.9</td>
<td>7.0</td>
<td>7.4</td>
<td>6.9</td>
<td>6.4</td>
<td>6.7</td>
<td>7.1</td>
<td>7.5</td>
</tr>
<tr>
<td>Global Supply</td>
<td>84.5</td>
<td>84.5</td>
<td>84.1</td>
<td>85.5</td>
<td>86.2</td>
<td>86.8</td>
<td>86.7</td>
<td>88.3</td>
<td>84.7</td>
<td>87.0</td>
<td>89.0</td>
<td>89.0</td>
</tr>
<tr>
<td>Total Non-OPEC</td>
<td>50.5</td>
<td>50.2</td>
<td>49.7</td>
<td>49.9</td>
<td>50.3</td>
<td>50.5</td>
<td>50.6</td>
<td>51.1</td>
<td>50.1</td>
<td>50.6</td>
<td>51.4</td>
<td>51.4</td>
</tr>
<tr>
<td>OECD</td>
<td>20.1</td>
<td>19.9</td>
<td>19.5</td>
<td>19.6</td>
<td>19.7</td>
<td>19.6</td>
<td>19.5</td>
<td>19.8</td>
<td>20.0</td>
<td>19.8</td>
<td>19.6</td>
<td>19.6</td>
</tr>
<tr>
<td>Europe</td>
<td>5.3</td>
<td>5.0</td>
<td>4.7</td>
<td>5.0</td>
<td>4.9</td>
<td>4.7</td>
<td>4.6</td>
<td>4.7</td>
<td>5.3</td>
<td>5.0</td>
<td>4.7</td>
<td>4.3</td>
</tr>
<tr>
<td>Non-OECD</td>
<td>28.1</td>
<td>28.0</td>
<td>27.9</td>
<td>28.0</td>
<td>28.2</td>
<td>28.5</td>
<td>28.7</td>
<td>28.9</td>
<td>27.5</td>
<td>28.0</td>
<td>28.6</td>
<td>29.1</td>
</tr>
<tr>
<td>FSU</td>
<td>12.8</td>
<td>12.7</td>
<td>12.8</td>
<td>12.8</td>
<td>12.9</td>
<td>13.1</td>
<td>13.3</td>
<td>13.6</td>
<td>12.2</td>
<td>12.8</td>
<td>13.2</td>
<td>14.0</td>
</tr>
<tr>
<td>Other (1)</td>
<td>2.3</td>
<td>2.3</td>
<td>2.3</td>
<td>2.3</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
<td>2.5</td>
<td>2.2</td>
<td>2.3</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>OPEC Crude</td>
<td>29.8</td>
<td>30.0</td>
<td>29.9</td>
<td>31.1</td>
<td>31.2</td>
<td>31.7</td>
<td>31.2</td>
<td>31.9</td>
<td>31.0</td>
<td>30.2</td>
<td>31.5</td>
<td>31.8</td>
</tr>
<tr>
<td>OPEC NGLs</td>
<td>4.2</td>
<td>4.4</td>
<td>4.4</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.9</td>
<td>5.3</td>
<td>4.1</td>
<td>4.4</td>
<td>4.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Inventory Change</td>
<td>-1.3</td>
<td>-0.3</td>
<td>-1.2</td>
<td>-0.9</td>
<td>-0.8</td>
<td>1.0</td>
<td>0.5</td>
<td>0.7</td>
<td>0.4</td>
<td>-0.9</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Call on OPEC</td>
<td>31.1</td>
<td>30.3</td>
<td>31.2</td>
<td>31.9</td>
<td>32.0</td>
<td>30.7</td>
<td>30.8</td>
<td>31.2</td>
<td>30.7</td>
<td>31.1</td>
<td>31.2</td>
<td>30.4</td>
</tr>
</tbody>
</table>
Analyst Certification and Disclosures

Analyst Certification

I, Adam Robinson, hereby certify (1) that the views expressed in this research report accurately reflect my/our personal views about any or all of the subject securities or issuers referred to in this report and (2) no part of my compensation was, or will be directly or indirectly related to the specific recommendations or views expressed in this report.

“To the extent that any of the views expressed in this research report are based on the firm’s quantitative research model, Lehman Brothers hereby certify (1) that the views expressed in this research report accurately reflect the firm’s quantitative research model and (2) that no part of the firm’s compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this report.”

Important Disclosures

Lehman Brothers Inc. and/or an affiliate thereof (the “firm”) regularly trades, generally deals as principal and generally provides liquidity (as market maker or otherwise) in the debt securities that are the subject of this research report (and related derivatives thereof). The firm’s proprietary trading accounts may have either a long and/or short position in such securities and/or derivative instruments, which may pose a conflict with the interests of investing customers.

Where permitted and subject to appropriate information barrier restrictions, the firm’s fixed income research analysts regularly interact with its trading desk personnel to determine current prices of fixed income securities. The firm’s fixed income research analyst(s) receive compensation based on various factors including, but not limited to, the quality of their work, the overall performance of the firm (including the profitability of the Investment Banking department), the profitability and revenues of the Fixed Income Division and the outstanding principal amount and trading value of, the profitability of, and the potential interest of the firms investing clients in research with respect to, the asset class covered by the analyst. Lehman Brothers generally does and seeks to do investment banking and other business with the companies discussed in its research reports. As a result, investors should be aware that the firm may have a conflict of interest.

To the extent that any historical pricing information was obtained from Lehman Brothers trading desks, the firm makes no representation that it is accurate or complete. All levels, prices and spreads are historical and do not represent current market levels, prices or spreads, some or all of which may have changed since the publication of this document. Lehman Brothers’ global policy for managing conflicts of interest in connection with investment research is available at www.lehman.com/researchconflictpolicy. To obtain copies of fixed income research reports published by Lehman Brothers please contact Valerie Monchi (vmonchi@lehman.com; 212-526-3173) or clients may go to https://live.lehman.com/.

Legal Disclaimer

This material has been prepared and/or issued by Lehman Brothers Inc., member SIPC, and/or one of its affiliates (“Lehman Brothers”). Lehman Brothers Inc. accepts responsibility for the content of this material in connection with its distribution in the United States. This material has been approved by the Financial Services Authority, in connection with its distribution in the European Economic Area. This material is distributed in Japan by Lehman Brothers Japan Inc., and in Hong Kong by Lehman Brothers Asia Limited. This material is distributed in Australia by Lehman Brothers Australia Pty Limited, and in Singapore by Lehman Brothers Inc., Singapore Branch (“LBIS”). Where this material is distributed by LBIS, please note that it is intended for general circulation only and the recommendations contained herein do not take into account the specific investment objectives, financial situation or particular needs of any particular person. An investor should consult his Lehman Brothers’ representative regarding the suitability of the product and take into account his specific investment objectives, financial situation or particular needs before he makes a commitment to purchase the investment product. This material is distributed in Korea by Lehman Brothers International (Europe) Seoul Branch. Any U.S. person who receives this material and places an order as result of information contained herein should do so only through Lehman Brothers Inc. This document is for information purposes only and it should not be regarded as an offer to sell or as a solicitation of an offer to buy the securities or other instruments mentioned in it. With exception of the disclosures relating to Lehman Brothers, this report is based on current public information that Lehman Brothers considers reliable, but we do not represent that this information, including any third party information, is accurate or complete and it should not be relied upon as such. It is provided with the understanding that Lehman Brothers is not acting in a fiduciary capacity. Opinions expressed herein reflect the opinion of Lehman Brothers’ Fixed Income Research Department and are subject to change without notice. The products mentioned in this document may not be eligible for sale in some states or countries, and they may not be suitable for all types of investors. If an investor has any doubts about product suitability, he should consult his Lehman Brothers representative. The value of and the income produced by products may fluctuate, so that an investor may get back less than he invested. Value and income may be adversely affected by exchange rates, interest rates, or other factors. Past performance is not necessarily indicative of future results. If a product is income producing, part of the capital invested may be used to pay that income. Lehman Brothers may, from time to time, perform investment banking or other services for, or solicit investment banking or other business from any company mentioned in this document. No part of this document may be reproduced in any manner without the written permission of Lehman Brothers. © 2007 Lehman Brothers. All rights reserved. Additional information is available on request. Please contact a Lehman Brothers’ entity in your home jurisdiction.