Petroleum Engineer’s Club of Dallas, October 28, 2016

Sheikhs vs. Shale: What Next for OPEC?

James L. Smith
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Multiple Choice Quiz

Which is better for society?
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a. Crude Oil at $100/barrel
Multiple Choice Quiz

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a. Crude Oil at $100/barrel

b. Crude Oil at $50/barrel
Multiple Choice Quiz

Which is better for society?

a. Crude Oil at $100/barrel

b. Crude Oil at $50/barrel

c. Neither of the above (no crude oil at all, please!)
One Key to the World Oil Market Lies in Modena
ALESSI BALSAMIC VINEGAR
SELL MORE NOW... OR SAVE FOR THE FUTURE?

Alessi Balsamic Vinegar (Modena, Italy)

A. Aged 4 years in wood $3.69 /bottle

B. Aged 20 years in wood $12.99 /bottle
SELL MORE NOW... OR SAVE FOR THE FUTURE?

Alessi Balsamic Vinegar (Modena, Italy)

A. Aged 4 years in wood $3.69 /bottle

B. Aged 20 years in wood $12.99 /bottle

Seller's Indifference:

$3.69 = $12.99 / (1.08)^{16}

Current Sale = Present Value of Future Sale
SELL MORE OIL NOW... OR SAVE FOR FUTURE?

**Saudi Arabian Light Crude Oil (Persian Gulf)**

A. Sell Today (spot market 2015) $100 /barrel

B. Sell Later (save until 2050) $1,140 /barrel (???)

Current Sale = Present Value of Future Sale
SELL MORE OIL NOW... OR SAVE FOR FUTURE?

Saudi Arabian Light Crude Oil (Persian Gulf)

A. Sell Today (spot market 2015) $100 /barrel

B. Sell Later (save until 2050) $1,140 /barrel (???)

Seller's Indifference:

$100 - $5 = ($1,140 - $5) / 1.08^{35}

Current Sale = Present Value of Future Sale
HOW DO HIGH OIL PRICES IMPACT OPEC?

**Short-Run**
Mostly favorable impacts, due to demand and supply rigidities and long lead times.

**Long-Run**
Mostly negative impacts, due to demand and supply reactions.
HOW DO HIGH OIL PRICES IMPACT OPEC?

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Multiple Choice Quiz—Part 2

“Lower for Longer” was:
Multiple Choice Quiz—Part 2

“Lower for Longer” was:

a. A surprise.
Multiple Choice Quiz—Part 2

“Lower for Longer” was:

a. A surprise.

b. A big surprise.
Multiple Choice Quiz—Part 2

“Lower for Longer” was:

a. A surprise.

b. A big surprise.

c. No surprise.
NO SURPRISE: OPEC LONG-TERM PROFITS
(circa 2008 research on optimal price)
WHICH OPEC MEMBERS LIKE HIGH PRICES?

![Graph showing profit in billions of NPV based on the world oil price. The graph plots profit against the world oil price, ranging from $35 to $60. There are three lines representing different OPEC members: Saudi Arabia (blue triangles), Other Core (red circles), and Fringe (green diamonds). The graph indicates that profit increases as the world oil price increases.]
Takeaways Regarding the Oil Price

My conclusions have hardly changed since 2005:

• The OPEC price represents a broad compromise among conflicting interests. The economic interests of OPEC members are not aligned.
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- Prior to October 2014, most of the burden of compromise fell on the Saudis, whose interest lies at the lower end of any price-band that OPEC might adopt.
Takeaways Regarding the Oil Price

My conclusions have hardly changed since 2005:

• The OPEC price represents a broad compromise among conflicting interests. The economic interests of OPEC members are not aligned.

• Prior to October 2014, most of the burden of compromise fell on the Saudis, whose interest lies at the lower end of any price-band that OPEC might adopt.

• Saudi tolerance of a high price-band is doubtful unless uncharacteristically strong cartel discipline is maintained going forward.
SO... WHAT PRICE TO KILL SHALE OIL?

• The question is not well founded... not all shale is created equal.

• Some shale was already dead even at $100/barrel.

• Saudi oil minister Ali al-Naimi: “Some US shale oil would remain commercial at prices as low as $30 per barrel.”

• IHS: “About 80% of the “tight oil” capacity to be added in the US during 2015 will remain resilient at prices as low as $70 per barrel.”
Heterogeneous Well Productivity Within a Play

Bakken Core Lognormal EUR Distribution

mean = 0.725
The “Average” Well is not “Typical”

Bakken Core Lognormal EUR Distribution

- mean = 0.725
- median = 0.402

EUR (million barrels)
At $90, Any Well Above the B/E EUR is Viable

Bakken Core Lognormal EUR Distribution

- Median: 0.402
- Mean: 0.725
- B/E @ $90: 0.504
Average Size of Those Wells is 1.406 mmb
But Only 42% of Potential Drill Sites Meet the Test

Bakken Core Lognormal EUR Distribution

- B/E @$90=0.504$
- median = 0.402
- mean = 0.725
- Pr[EUR > 0.504] = 42%
- $E[EUR | EUR > 0.504] = 1.406$
81% of Recoverable Resources are Viable at $90

Bakken Core Lognormal EUR Distribution

\[ E[\text{Reserves @ $90}] = 42\% \times 1.406 \div 0.725 = 81\% \]

\[ E.eu\text{R}|\text{EUR}>.504]=1.406 \]

\[ \text{Pr}[\text{EUR}>.504]=42\% \]

\[ \text{median}=0.402 \]

\[ \text{mean}=0.725 \]

\[ \text{B/E @$90}=0.504 \]
Breakeven Well Productivity, EUR\textsubscript{p}

![Graph showing breakeven EUR in barrels for different WTI prices. The graph includes lines for 2016 Cost, 2014 Cost, and Dynamic Cost. A section labeled Bakken Core is highlighted.]
Goal #1: Chart Reserves as Function of Price

Percent of Recoverable Resources that are Economic (Dynamic Cost scenario)

$/barrel, WTI

Bakken Core
Goal #2: Chart the Number of Viable Drill Sites

![Graph showing the number of viable drill sites as a percent of total (Dynamic Cost scenario)](image)

- **Viable Drill Sites as Percent of Total**
- **(Dynamic Cost scenario)**

- **Bakken Core**

- **$/barrel, WTI**

- **0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%**
The Price Inelasticity of Shale Oil Reserves

Figure 5: Reserve Elasticity, by Play and Price (Dynamic Cost)
The Price Elasticity of Viable Drill Sites

Figure 9: Drill Site Elasticity, by Play and Price (Dynamic Cost)
Thank You!

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