Energy Economics
ECO-4420

Lecture 3
Crude Oil Market

Asst. Prof. Dr. Istemi Berk
istemi.berk@deu.edu.tr
World Fossil Fuel Consumption
A Comparison btw. Coal, Oil and Gas

Crude Oil Market
An Introduction

UPSTREAM
EXPLORATION & PRODUCTION

MIDSTREAM
TRANSPORTATION

DOWNSTREAM
REFINING & MARKETING

Licence Agreements

END USER
Crude Oil Production and Consumption by Region
Crude Oil Supply by Countries

- OPEC, 42%
- Russia, 13%
- United States, 12%
- China, 5%
- Canada, 5%
- Mexico, 3%
- Brazil, 3%
- Indonesia, 1%
- Other Oil Producing Countries, 17%

OPEC Countries
- Saudi Arabia, 13%
- Iraq, 5%
- Iran, 4%
- UAE, 4%
- Kuwait, 3%
- Venezuela, 3%
- Nigeria, 3%
- Angola, 2%
- Qatar, 2%
- Algeria, 2%
- Ecuador, 1%
- Libya, 1%
- Gabon, 0%
Crude Oil Demand
Refinery

Typical U.S. Refinery Yield from a Barrel of Crude Oil

- 50% Gasoline
- 40% Diesel Fuel
- Heating Oil
- Jet Fuel
- Kerosene
- 10% Residual Fuel Oil

Other Processes
Main Characteristics of Upstream Crude Oil Market

- Crude Oil is not a homogenous product
- Different qualities in different regions

![Density and sulfur content of selected crude oils](chart.png)
Main Characteristics of Upstream Crude Oil Market

- Crude Oil is not a homogenous product
- Different qualities in different regions – affects refinery output

Refinery “Cut of the Barrel”: 
US vs Europe vs Japan

US Refineries Are Designed and Constructed for Gasoline Production

- Gasoline (~47%)
  - Kero/Jet
  - Diesel/Distillate
  - Other

Europe

- Gasoline
  - Kero/Jet
  - Diesel/Distillate
  - Other

Japan

- Gasoline
  - Kero/Jet
  - Diesel/Distillate
  - Other
Crude Oil Demand by Countries

Shares in global oil consumption, 2016
- USA (20.3%)
- European Union (13.4%)
- China (12.8%)
- OECD (47.9%)

Petroleum Products
- 26.2% gasoline
- 28.5% diesel
Main Characteristics of Upstream Crude Oil Market

• Crude Oil is not a homogenous product
  • Different qualities in different regions

• Supply and Demand – capacity constraints and elasticities
How do markets work? Supply and Demand

- Law of Supply: $P$ vs. $Q$ (+)
- Law of Demand: $P$ vs. $Q$ (-)
- Equilibrium: $Q_s = Q_d \Rightarrow P^*$

Assumptions
- Perfectly Competitive Market: many firms/consumers – all are price-takers
- Free entry and exit
- No externalities
- Perfect Knowledge

2014/15 oil price plunge and changing crude oil market dynamics

Istemi Berk | 03.10.2017
Supply and Demand in Crude Oil Market

- Law of Supply: $P$ vs. $Q$ (+)
- Law of Demand: $P$ vs. $Q$ (-)
- Equilibrium: $Q_s = Q_d \Rightarrow P^*$

Crude Oil (exhaustible resource) Market
- Supply Curve – Capacity Constraint
- Demand Curve – Less Elastic
- Market Imperfection: Suppliers have market power
Main Characteristics of Upstream Crude Oil Market

• Crude Oil is not a homogenous product
  • Different qualities in different regions

• Supply and Demand – capacity constraints and elasticities

• Main Actors: Companies
  • Produced in different countries but by companies
    International Oil Companies: Privately-owned
    National Oil Companies: State-owned
    Small Independent Companies: Privately-owned
Oil Companies
International and National (IOCs vs. NOCs)

- Biggest Oil (&Gas) Companies
  1. Saudi Aramco (NOC)
  2. Gazprom (NOC)
  3. National Iranian (NOC)
  4. Exxon Mobil (IOC)
  5. Rosneft (NOC)
  6. PetroChina (NOC)
  7. BP (IOC)
  8. Shell (IOC)
  9. Pemex (NOC)
  10. Kuwait Petroleum (NOC)
Crude Oil Market
A History

• 1859: first modern oil well drilled by Edwin L. Drake
• 1870: Foundation of Standard Oil Company by Rockefeller
• Till 1900s: Monopolization of Standard Oil in the USA
• Antitrust laws in the USA and dissolve of Standard Oil
• Globalization of oil market and rise of seven sisters
• Dominancy of seven sisters (IOCs): until 1960s
1870-1911 & 1920s-1960
Standard Oil Company & Seven Sisters

• Split up of Standard Oil Company – 3 reasons:
  • New oil discoveries inside and outside US
  • Internationalization of Oil Industry
  • Antitrust laws
    • Sherman Antitrust law (1890)
    • Clayton Act (1924)

• Rise of Seven Sisters
  • Anglo-Persian Oil Company (United Kingdom) - BP
  • Gulf Oil (United States) - Chevron
  • Royal Dutch Shell (Netherlands/United Kingdom) - Shell
  • Standard Oil of California (SoCal) (United States): became Chevron in 1984
  • Standard Oil of New Jersey (Esso) (United States): became Exxon
  • Standard Oil Co. of New York (Socony) (United States): became Mobil
  • Texaco (United States)
Crude Oil Market
History with prices

$ 2014/bbl

International Oil Companies

OPEC
Market Power

Market
Demand Pricing

Crude Oil Market
Prices

- Posted Prices – intracompany trade
- Low volatility especially since World War II till 1970s
- Market forces in play
- Few IOCs have largest share
  1928 Achnacarry Agreement

$ 2014/bbl

International Oil Companies
Crude Oil Market
A History

$ 2014/bbl

1960: Foundation of OPEC
OPEC

• What is OPEC? Why was it founded? What is the objective?

• 1960-1970: Resource Nationalization and rise of NOCs

• OPEC today
  • 71.5% of oil reserves
  • 42.7% of oil production
Crude Oil Market Prices

$ 2014/bbl

0 20 40 60 80 100 120 140

1973-1974 First Oil Crisis
Following Yom Kippur War – Arabian Oil Embargo
Iraq invades Kuwait
First Gulf War

1978-1979 Second Oil Crisis
Iran-Iraq War

OPEC Market Power
1970s Oil Crises
Market Power Issues

• OPEC acting as a cartel?

1970s crude oil market: commonly referred to as Cartel (many producers form up together a monopoly) & sometimes Clumsy Cartel (Adelman, 1980)
1970s Oil Crises
Market Power Issues

• OPEC acting as a cartel?

• Market Power Practice:
  • Elasticity of demand vs. elasticity of supply – Supply Driven Market
Supply Driven Market: Market Power Practice

• Supply Driven Market:
  • When demand curve cuts the supply curve below the capacity – producers are holding excess capacity of supply (Example: OPEC Spare Capacity)

Decrease in Supply will cause more price increase than same amount of increase in demand
1970s Oil Crises
Market Power Issues

• OPEC acting as a cartel?

• Market Power Practice:
  • Elasticity of demand vs. elasticity of supply – Supply Driven Market

• Monopoly, Multiplant monopoly and Dominant Firm with Competitive Fringe models
Crude Oil Market
Prices since OPEC

$ 2014/bbl

International Oil Companies
OPEC Market Power
Market Demand Pricing

Crude Oil Market
A History

• 3 main price benchmarks
  • WTI: West Texas Intermediate – American price
  • Brent: North Sea – European price
  • Arabian Light (Dubai Crude): Middle East price

• 3 distinct periods
  • 1859-1970: Posted Prices – IOC’s dominancy
  • 1970-1985: OPEC prices – NOC’s dominancy
  • 1985-...: Market prices – consumer dominancy (!)
Crude Oil Market
Prices since 2000s – a closer look

- **2000-2008**: Price increases almost steadily

- **Summer 2008**: Skyrocketed oil prices ~150$/bbl

- **Post 2008**: Temporary decline

- **2011-2014**: Persistent high prices ~100 $/bbl
Consequences of high crude oil prices

2 main consequences of 2011-2014 high prices

1) Demand:
   - Increase in renewable energy investments
   - Decrease in future expected demand for all fossil fuels

2) Supply:
   - Increase in investment in higher cost sources: e.g., shale oil
   - Supply glut
Crude Oil Market
2014/2015 Price Collapse

2014/2015 oil price collapse ~50% decline
Recent developments in oil market

Prices crashed in 2014 and kept on falling in 2015

- 52% decline from 2013 to 2015
- Crude oil production levels increased from 76 million barrels (MMbbl)/day to 80 MMbbl/day

Potential reasons

- High production levels both in non-OPEC (mostly US shale oil) and in OPEC countries
- Weakening global oil demand growth
- Appreciation of US dollar
- OPEC’s policy response – no cut in production: surprise why?

The Shift in Global Crude Oil Market Structure: A model based analysis of the price plunge in 2014
Shale Oil

- Unconventional source
- Different geological properties
- Higher cost – harder to recover
2014/2015 Price Collapse
Good or Bad news? For whom?

• Marginal Cost of oil production (oil break-even curve)
2014/2015 Price Collapse
Good or Bad news? For whom?

• Fiscal break even for OPEC
Capacity Withholding
Market Power

Price $/bbl

Quantity (million bbl/day)

Short-term Production Capacity
Demand Curve
Oil Supply Curve
Behavior of Saudi Arabia
Protecting the Market Share

![Bar Chart]

- **Short-term Production Capacity**
- **Estimated Production**
- **Observed Production**

<table>
<thead>
<tr>
<th>Year</th>
<th>Oligopolistic</th>
<th>Competitive</th>
<th>Oligopolistic</th>
<th>Competitive</th>
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<tr>
<td>2013</td>
<td>12 million bbl/day</td>
<td>12 million bbl/day</td>
<td>12 million bbl/day</td>
<td>12 million bbl/day</td>
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<tr>
<td>2015</td>
<td>12 million bbl/day</td>
<td>12 million bbl/day</td>
<td>12 million bbl/day</td>
<td>12 million bbl/day</td>
</tr>
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</table>
Prices from 2013 to 2015: More competitive oil market

Crude Oil Prices $/bbl

- Observed
- Oligopoly
- Competitive

106 $/bbl
52 $/bbl
Shale Oil Learning Curve

- Decrease in MC of shale oil production in US
2014/2015 Price Collapse
Good or Bad news? For whom?

Oil Production per barrel Cost by Country

- U.K.
- Brazil
- Canada
- United States
- Norway
- Angola
- Colombia
- Nigeria
- China
- Mexico
- Kazakhstan
- Libya
- Algeria
- Russia
- Iran
- U.A.E.
- Iraq
- Saudi Arabia
- Kuwait

Cost/Barrel (USD$)

Source: IEA, Rystad Energy

June 19th, 2017
WTI Oil Spot Price = $44.41 per Barrel
End of Lecture 3

See you next week

Asst. Prof. Dr. Istemi Berk
istemi.berk@deu.edu.tr