

Introduction to Oil

James Woods

Oil is for Cars

- ▶ Keep in mind that oil is primarily a transportation fuel.
 - ▶ Yes, some diesel and bunker oil is used for electricity production (5%), but
 - ▶ mostly we make gasoline and other commodities out of it.
- ▶ Two common measurements
 - ▶ US 42 gallon barrels when speaking to a merican or reporting numbers to them.
 - ▶ Elsewhere you talk about cubic meters
 - ▶ You will also see metric ton measurements in some areas.
 - ▶ Note this is two volume and one mass measurement and densities are not uniform.
- ▶ Barrel is abbreviated bbl
 - ▶ Mbbl is thousand barrels not a million (Breaks the metric code)
 - ▶ MMbbl is million barrels.
 - ▶ Mbd is million barrels a day but so is MMbbl/day

Oil is not a uniform commodity

- ▶ It varies specific gravity
 - ▶ Lighter oils are more valuable because it is cheaper to crack into the products you want
- ▶ Sulfur content
 - ▶ Low sulfur is cheaper to crack
- ▶ Location
 - ▶ Transportation is not cheap
 - ▶ Pipelines, train, tanker all have trad-offs with cost and safety and reliability.
 - ▶ Sometimes law and conflict can disrupt transportation

Sulfur v Density of World Oil

Density and sulfur content of selected crude oils

sulfur content (percentage)

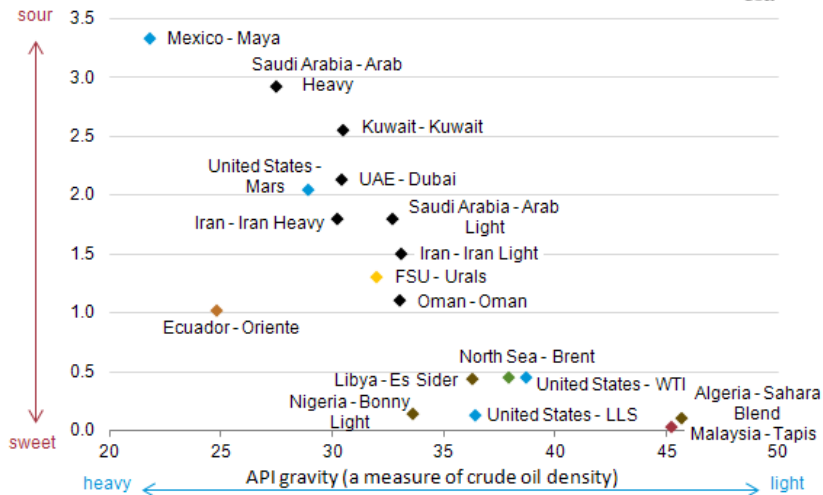


Figure 1:

Prices of oil not *Price* of oil

- ▶ Many commonly cited prices
 - ▶ Even this list is incomplete
https://en.wikipedia.org/wiki/List_of_crude_oil_products
 - ▶ Brent (North Sea) and
 - ▶ West Texas Intermediate are common for both US and international.
- ▶ WTI less so
 - ▶ Shale oil with limited transportation means WTI tends to be lower by a few dollars.
 - ▶ Will likely change
 - ▶ More pipelines
 - ▶ Recent (2016) repeal of *mostly* prohibited export of crude.
- ▶ There are smaller price points by city and region
- ▶ Many are specified as blends of typical output of various regions.

The Ban and Repeal

- ▶ Banned most exports of crude oil in 1975 as reaction to OPEC.
- ▶ Could still export products, e.g., gasoline.
- ▶ Problems
 - ▶ The US is huge.
 - ▶ Not always an easy way to get crude to refiners within the country.
 - ▶ AK refineries have 270K BBL day capacity about the same as one refiner in CA.
 - ▶ Refiners specialized in heavier sour oil.
 - ▶ Fracking produces lighter oil but you couldn't export it
- ▶ As of 2016 we export.

Location

- ▶ Refineries are tuned to a specific kind of oil
 - ▶ If density or sulfur changes too much they have to change and that costs
- ▶ Oil in new areas needs transport
 - ▶ Truck
 - ▶ Rail
 - ▶ Pipeline
 - ▶ Boat
- ▶ Safety
 - ▶ (Death, Property) Truck > Rail > Pipeline > Boat
 - ▶ (Spilled) Truck > Pipeline > Rail > Boat
 - ▶ (Environment) Boat > Pipeline > Truck > Rail

The Markets for oil are complex and odd

- ▶ The oddness comes from it being a key commodity
 - ▶ No oil, no cars
- ▶ US uses about 15 MMbd (Million Barrels a day)
 - ▶ Half domestic and half imported
 - ▶ Imports are mostly Canada, Saudi Arabia and Mexico
- ▶ We hold massive inventories of oil and gas
 - ▶ <https://www.eia.gov/petroleum/supply/weekly/pdf/table1.pdf>
 - ▶ Domestic production 9.645 MMbd
 - ▶ Imports 6.796 MMbd
 - ▶ Inventory
 - ▶ Crude 1,128.2 MMb, about 116 days of inventory
 - ▶ Gasoline 210.4 MMb at 9 MMbd or 24 days of inventory

Textbook focuses on Monopoly models and Anti-trust

- ▶ The anti-trust is great and historically relevant
 - ▶ Oil was one of the drivers of the anti-trust movement
 - ▶ It is historically relevant
- ▶ The monopoly style analysis is also historically relevant
 - ▶ When there were a few major gasoline marketers, yes
 - ▶ When there were a few international cartels, yes
- ▶ The political models of OPEC are also good for a few limited time periods

Smith, James L.. (2009) Focuses on some inventory arguments

- ▶ There is a strong desire to hold inventories of oil.
- ▶ The size of inventories depends on expectations about
 - ▶ future prices
 - ▶ and when price is fixed, expectations about supply availability
- ▶ This focus on inventories and expectations
 - ▶ Forces analysis of oil markets to use techniques from macro
 - ▶ Some work on expectations in paper
 - ▶ Does not do the full Dynamic Stochastic General Equilibrium approach

Flow and Stock Models

- ▶ Marshallian Supply and Demand are flow concepts, consumption over time.
- ▶ Not right for stock demands, which is why macro has a lot of odd models to deal with money
 - ▶ Cash in advance
 - ▶ Debt in overlapping generations
- ▶ There is a S/D approximation of a way of interpreting a Hamiltonian system but messy.
 - ▶ One version is in Knittel, Christopher R. and Robert S. Pindyck. 2016. "The Simple Economics of Commodity Price Speculation." American Economic Journal: Macroeconomics, 8(2): 85-110.
<http://stats.lib.pdx.edu/proxy.php?url=https://www.aeaweb.org/articles?id=10.1257/mac.20140033>
 - ▶ It is messy with some hand waving but easier than learning about phase diagrams.

Phase Diagram

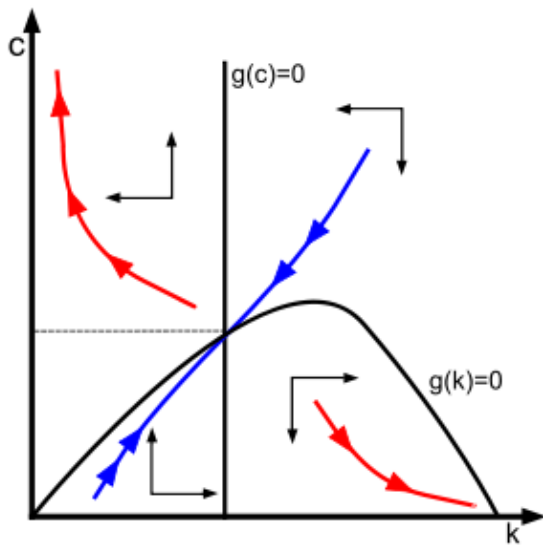


Figure 2:

Expectation Formation

- ▶ Rational Expectations: Everyone in the model has a model and on average their models make correct predictions
- ▶ Adaptive Expectations: Make guesses based on the past
- ▶ Smith, (2009) adds the idea of Who's expectations because how they form expectations is different.

VARs Vector Auto Regressions

- ▶ Adaptive, uses the past
- ▶ Choose variables and then make sure they are of the same order of integration, e.g., levels or changes.
- ▶ Look for a fixed linear relationship, cointegration
- ▶ Use past and current values of all variables to explain current values of all variables.

Use:

- ▶ Plug and chug forecasts (seen in paper fig 3)
- ▶ Impulse response. Start with a quiet system and flick one variable at a time and see how the flick propagates.

Impulse Response Example

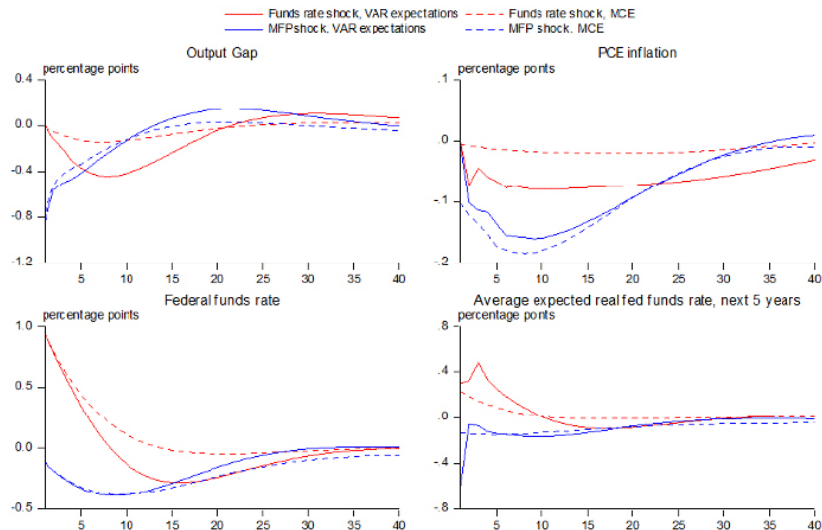


Figure 3:

Financial Markets vs Policy Makers

- ▶ Paper gives arguments about differences between the two
 - ▶ Financial market have more info than can go in models
 - ▶ Financial markets can ignore or misinterpret data.
- ▶ Futures contracts have a built in bias
 - ▶ A risk premium. The paper uses Hamilton-Wu estimates but there are others.

Bubble and pari-mutal arguments

- ▶ Lots of shared information including prices of futures
- ▶ If you see prices rising you may buy based only on that
 - ▶ Assume others know something you don't
 - ▶ How bubbles happen amplifying a small difference
- ▶ Grandpa Ish's Lesson on Betting Horses
 - ▶ Don't bet on the horse you think will win
 - ▶ Bet on the horse that pays off more than you think it should.
 - ▶ If people do this, hard to see best guess.
 - ▶ If they don't, bubbles.

Fun Fact

- ▶ Simple prediction rules work great when more sophisticated rules cost more than the benefit they bring.
- ▶ Why consumers use simple rules. Gas prices will change by about the same amount as inflation.

The Events

- ▶ The 1973/74 Oil Crisis
- ▶ The 1979/80 Oil Crises
- ▶ The 1980s and 1990s
- ▶ From the Great Surge of 2003–08 to the Global Financial Crisis

The 1973/74 Oil Crisis

- ▶ Timing and location does not work for war driven supply shock.
- ▶ Prices received by governments was fixed in the 1971 Tehran/Tripoli agreements
 - ▶ Inflation hits and real prices are low
 - ▶ Global economic boom increases commodity demand.
- ▶ With the low fixed price all but Saudi Arabia and Kuwait had no spare capacity
- ▶ October 10, 1973 Tehran/Tripoli dead
- ▶ Price increases, it is negotiated, but is it nearer competitive or monopoly price?

Competitive or Monopoly?

- ▶ Other commodities increased by about 75% as much as oil.
- ▶ Only part of the big jump was a jump because of monopoly power
- ▶ Remainder was effect of
 - ▶ Eliminating the fixed prices
 - ▶ Increase commodity demand
- ▶ Price controls and rationing in US did not help.

The 1979/80 Oil Crises

- ▶ WTI from \$15 to \$40
- ▶ Traditional story was Iranian revolution
 - ▶ Timing is off. WTI hit \$40 after revolution when Iran was back at full production.
- ▶ Two shocks
 - ▶ Commodity demand increase (2/3 increase)
 - ▶ Expectation shock (1/3 increase)
 - ▶ If a disruption can happen in Iran, then it can happen anywhere.
 - ▶ Explore more
 - ▶ Increase Inventory

The 1980s and 1990s

- ▶ Traditional argument is the Iran/Iraq war disrupted supply but there was little change in price.
 - ▶ Even with tankers being attacked.
- ▶ Hangover from the 70s events
 - ▶ Lots of exploration in new areas, e.g. North Sea
 - ▶ Lots of inventory
- ▶ First Real OPEC effort to push towards monopoly prices
 - ▶ Per Theory, everyone cheats.

There was a spike, a slump, a slump and a spike

- ▶ Gulf 1 1990
 - ▶ Iraq and Kuwait oil disrupted
 - ▶ Large inventory demand anticipating Saudi Arabia attack
- ▶ Asian Financial Crisis 1997
 - ▶ Reduced commodity demand
- ▶ Venezuela 2002
 - ▶ BTW Huge reserves of oil
- ▶ Gulf 2 2003
 - ▶ \$6 increase is hardly a shock

From the Great Surge of 2003–08 to the Global Financial Crisis

- ▶ WTI from 28 to 134
- ▶ Increased global demand for commodities including oil.
 - ▶ Wave to China
 - ▶ Small increase in inventory demand
 - ▶ Little evidence of speculation
- ▶ 2008
 - ▶ Recession and prices go down to 100
 - ▶ Why not further is confusing given the scale of the increase.
- ▶ 2014 The fall to \$47
 - ▶ \$11 of \$49 decline was commodity decline
 - ▶ \$16 because of shale boom
 - ▶ \$9 Storage (expectation) shock.