Introduction to Oil

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Oil is for Cars

- Keep in mind that oil is primarily a transportation fuel.
  - Yes, some diesel and even crude is used for electricity production (5%), but
  - mostly we make gasoline and other commodities out of it.

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

Sulfer v Density of World Oil

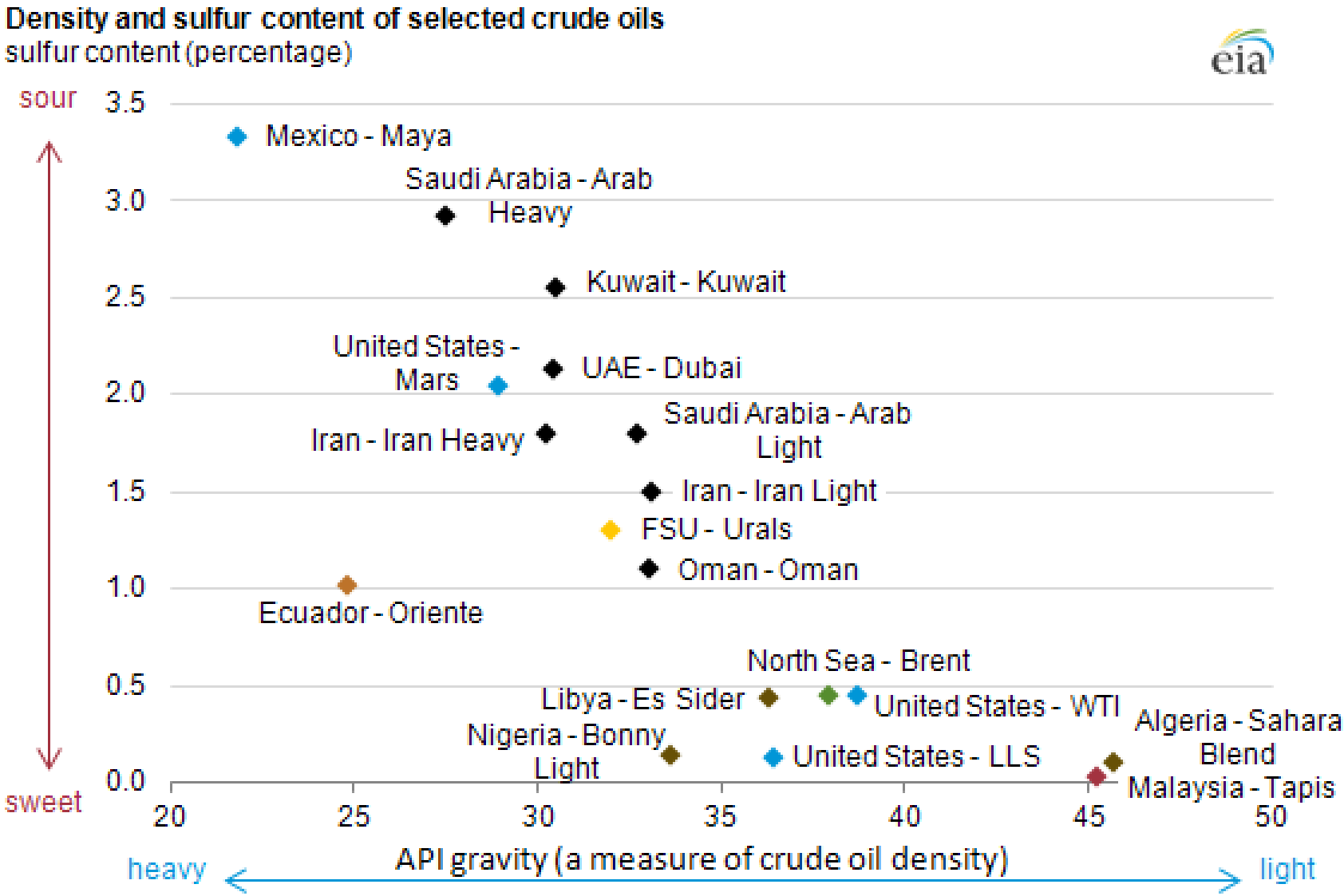

Figure 1:

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
    - Repeal of *mostly* prohibited export of crude.
- There are smaller price points by city and region
- Many are specified as blends of typical out put of various regions.

Location

- Refineries are tuned to a specific kind of oil
  - If density or sulfur changes too much they have to remodel or variable suffer a cost hit.
- Oil in new areas needs transport

```
+ Truck
+ Rail
+ Pipeline
+ Boat
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- 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 8.504 MMbd
    - Imports 6.601 MMbd
  - Inventory
    - Crude 1,162.2 MMb, about 77 days of inventory
    - Gasoline 226 MMb at 9 MMbd or 25 days of inventory

Textbook focues on Monopoloy 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

The Paper Focuses on some inventory aguments

- 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.

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
- Paper 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

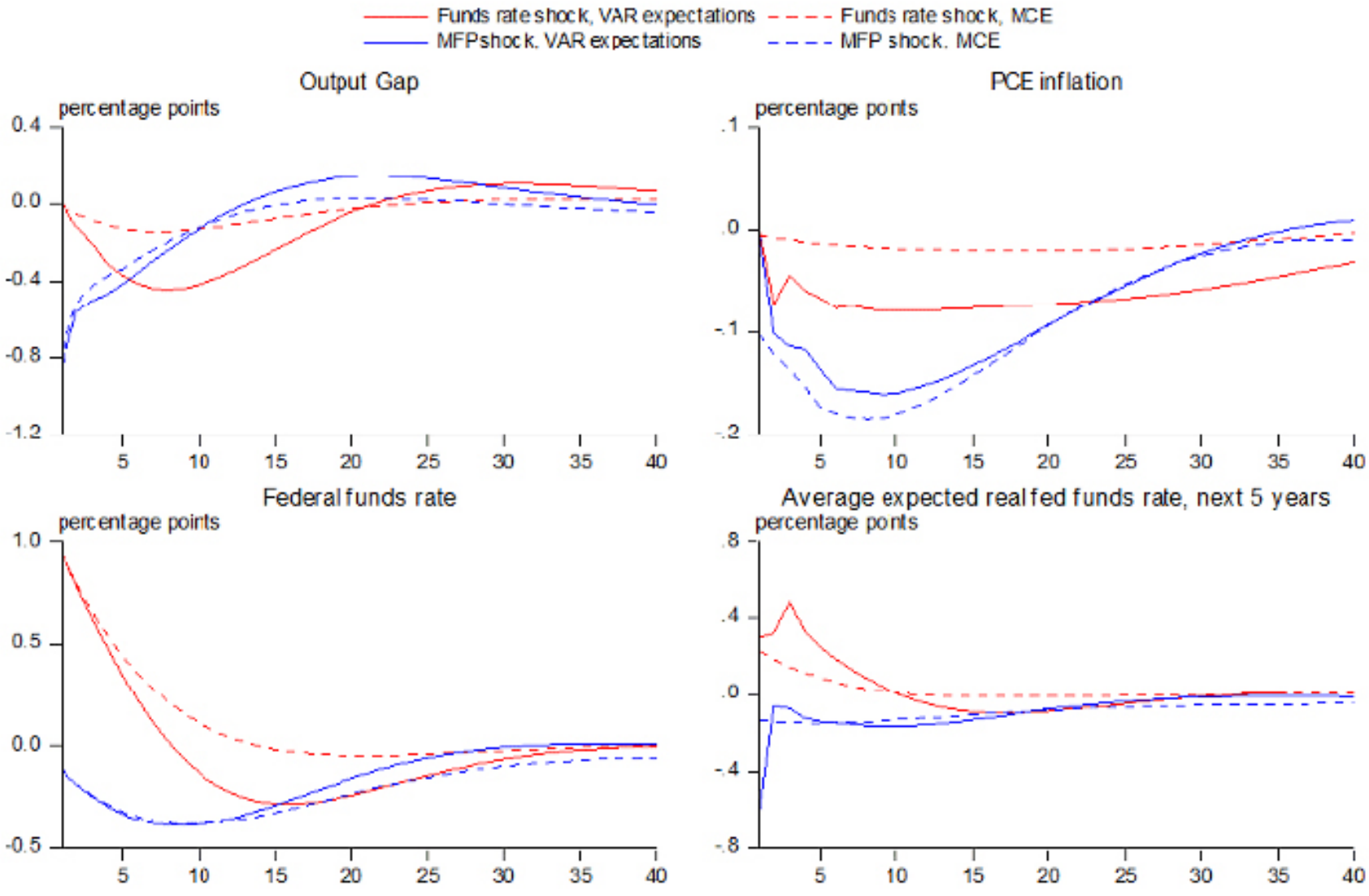

Figure 2:

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.