Oil price elasticities and oil price fluctuations

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Low Oil Prices: Causes, Consequences, and Duration
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Introduction

- Large swings in oil prices over last decade:
  - Run-up to $140 per barrel through August 2008
  - Subsequent decline to $40 per barrel through Great Recession
  - 65% decline from June 2014 to December 2015

- Two recurrent issues in the literature:
  - Nature of oil price shocks
  - Effects of oil price shocks

- This paper: New evidence on causes and consequences of oil price fluctuations b/w 1985-2015.
Methodology and Preview of Results

• Structural VAR to analyze sources and macroeconomic effects of oil price movements

• Novel data and identification to disentangle supply and demand shocks:
  o Joint restrictions on supply and demand elasticities;
  o Multiple indicators for global oil demand.

• Main findings:
  o Supply shocks:
    • Main drivers of oil prices;
    • Boost/Depress activity in advanced/emerging economies;

• Key Takeaway:
  o Selection of supply and demand elasticities is important for inference.
Measuring global demand for oil

Coincident Indicator: Industrial Production

• Requirements for global economic indicators:
  ◦ Capture key features of global business cycle;
  ◦ Have explanatory power for oil prices.

• Construct IP indexes for advanced and emerging economies (90% global GDP):
  ◦ Reliable and widely available business cycle indicator;
  ◦ Oil important input in industrial sector;
  ◦ Advanced economies net oil importers;
  ◦ Emerging economies oil independent (as a whole) and higher oil intensity.
Measuring global demand for oil

Leading Indicator: Metal Prices

- IMF Metal Price Index.
  - Metals crucial inputs in many industrial sectors.

- Captures shifts in current and expected global activity:
  - Academic literature
    - Pindyck & Rotemberg (1990); Labys & al. (1999), Barsky & Kilian (2001).
  - Popular blog entries

- Results from forecasting regressions:
  - Metal prices help predict global activity and oil prices.
VAR Model

- VAR model of oil market and global economy with 5 variables (Jan 1985 - Dec 2015):
  - IP for advanced economies;
  - IP for emerging economies;
  - IMF metal price index;
  - Brent price of crude oil (deflated by U.S. CPI);
  - Global supply of crude oil.

- Identification: Both numerical and exclusion restrictions

- Disentangling oil market-specific shocks:
  - Key role of *joint numerical* restrictions on supply and demand elasticities
Identification of the VAR

Numerical Restrictions on Oil Market Elasticities

- A simple 2-equation model of the oil market:
  \[ q_t = \eta_S p_t + u_{s,t}, \]
  \[ q_t = \eta_D p_t + u_{d,t}. \]

- Consensus is that \( \eta_S \) and \( \eta_D \) both small:
  - Estimates from meta-analysis: \( \eta_S = 0.13; \eta_D = -0.13 \);
  - \( \eta_S \) possibly even smaller: 0.02.
    Kilian & Murphy(2012)

- Insight from analytics of structural VARs:
  - VCV matrix of VAR residuals and restriction on supply elasticity imply value for demand elasticity (or vice versa).
Identification of the VAR

VAR-Implied Supply and Demand Elasticities

- Minimizing Euclidean distance b/w VAR-admissible elasticities (Red curve) and median elasticities from literature (Blue Dot)
- Selection: Supply elasticity: 0.11; Demand elasticity: $-0.11$. 
Identification of the VAR

Oil Market Interactions with Global Economy and Exclusion Restrictions

- Global Economy $\rightarrow$ Oil Market:
  - Global demand shifts oil demand curve;
  - Global demand cannot shift oil supply curve;
  - **NOTE:** Oil production moves in response to global demand shocks because supply curve is price-elastic.

- Oil Market $\rightarrow$ Global Economy:
  - IPs respond directly to changes in oil production;
  - Metal prices respond to changes in both oil prices and oil production.
Impulse Responses to Oil Market Shocks

- **Negative supply shock**: Raises prices; Depresses IP advanced; Raises IP emerging
- **Positive demand shock**: Raises prices and production; Small effects on IPs
Impulse Responses to Global Activity Shocks

- **Positive global activity shocks:** Raise oil prices and production
### Forecast Error Variance Decomposition

#### 24-Month Ahead

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<th>Shocks</th>
<th>Oil Supply</th>
<th>Oil Demand</th>
<th>AE Activity</th>
<th>EE Activity</th>
<th>Metal</th>
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</tbody>
</table>

- **Oil price fluctuations:**
  - Supply shocks account for about 50 percent
  - Demand shocks for about 15 percent
  - IP emerging and metals prices account for about 30 percent
  - Little role for IP advanced
Historical Decomposition

2014-2015 Oil Price Slump

- Most of decline attributed to supply shocks
- Early 2015: Negative oil-specific demand shocks
- 2015: Negative shocks to (1) IP emerging; (2) expectations of global activity captured by metals prices
VAR model with Oil inventories

- Extend VAR model of the oil market to include oil inventories
  Similar to Baumeister and Hamilton (2015).

- Inventories absorb differences between oil production and oil consumption

- Set of VAR-admissible supply and demand elasticities very close to baseline model.

- Selected elasticities nearly identical to baseline model

- Positive inventory-demand shock: Higher inventories and modest increase in prices

- Historical decomposition of oil price fluctuations:
  - Small contribution from inventories-demand shocks
  - Including inventories not altering contribution of remaining shocks
  - Supply shocks remain key drivers of oil price fluctuations
Concluding Remarks

• Identify VAR of oil market and global economy with *plausible joint restrictions* on oil supply and oil demand elasticities

• Supply shocks:
  ○ Key drivers of oil prices
  ○ Have economically modest effects on global activity

• 2014–2015 price slump:
  ○ Supply shocks account for substantial share
  ○ Global activity shocks started playing role in early 2015

• Also in the paper:
  ○ With lower supply elasticity → large demand elasticity:
    • Oil-specific demand shocks key drivers of oil prices
    • Oil supply shocks associated with large oil price multiplier on advanced economies activity
  ○ With only one indicator of global activity: Small contribution of global demand to oil prices