Quantifying the Role of Speculation in Oil Markets

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Expectations Shifts and Speculative Oil Demand

- A natural economic definition of a speculator in the physical market is anyone buying crude oil not for current consumption, but for future use (Fattouh, Kilian and Mahadeva, EnJ 2013).

- Speculative purchases of oil arise in the physical market for oil when the buyer is anticipating rising oil prices.

  ⇨ A shift in expectations about future excess oil demand manifests itself as a shift in the demand for oil inventories.

Limitations of Traditional Oil Market Models

Market expectations of future oil demand and oil supply conditions are equated with econometric expectations.

Problem:
Speculators may form expectations on the basis of data not available to the econometrician, rendering standard econometric models informationally deficient and invalid (see Sargent, 1980s).

Examples of Forward-Looking Elements in Expectations of Oil Demand and Supply Conditions

Supply side: New oil discoveries (Brazilian off-shore oil fields)

Anticipation of a War in the Middle East

Anticipation of "peak oil" effects

Demand side: Anticipation of a booming world economy

Anticipation of a major global recession

Anticipation of new energy-saving technologies

Both sides: Shifts in Uncertainty about Future Oil Supply

Shortfalls

Key Insights

- The inclusion of oil inventories helps overcome this informational deficiency.

- We cannot measure expectations, but we can identify shifts in the demand for inventories driven by expectations.

- Raw data on inventories are not informative. We need to model all structural determinants of oil inventories simultaneously, if we want to capture the expectations-driven component in the inventories.

Structural Model of the Global Crude Oil Market

Monthly data for 1973.2-2010.6:

1. Percent change in global crude oil production
2. Index of global real activity (business cycle index)
3. Real price of oil
4. Change in above-ground global crude oil inventories

- Vector autoregressive model with seasonal dummies

Four Structural Shocks

1. Shock to the flow of crude oil production ("flow supply shock")
2. Shock to the demand for crude oil associated with the global business cycle ("flow demand shock")
3. Shock to the demand for above-ground oil inventories arising from forward-looking behavior not already accounted for ("speculative demand shock")
4. Residual shock that captures idiosyncratic oil demand shocks not otherwise accounted for and has no direct economic interpretation (e.g., weather shocks, shocks to inventory technology or preferences, idiosyncratic changes in SPR).

1. Identifying Assumptions on Sign of Impact Responses

	Flow Supply Shock	Flow Demand Shock	Speculative Demand Shock
Oil Production	-	+	+
Real Activity	-	+	-
Real Oil Price	+	+	+
Inventories			+

2. Bound on Impact Price Elasticity of Oil Supply:

Impact elasticity is positive, but near 0.

3. Bound on Impact Price Elasticity of Oil Demand:

Impact elasticity is negative.

|Impact elasticity| < |Long-run elasticity|

4. Dynamic Sign Restrictions

An unexpected flow supply disruption is associated with a positive response of the real price of oil and a negative response of oil production and global real activity for the first year.

Why do we not include the oil futures spread?

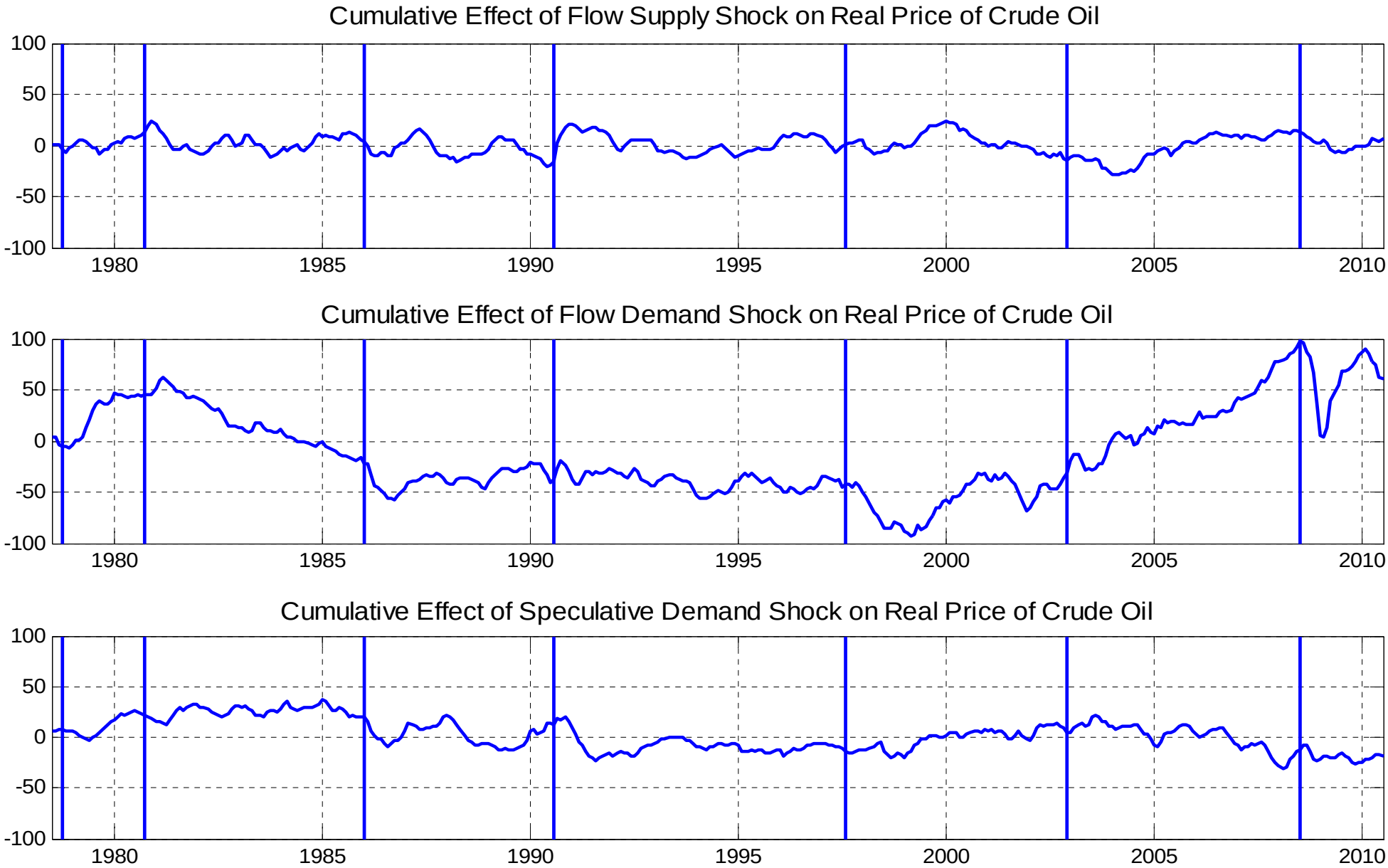
- Spot market and futures market are two distinct markets linked by an arbitrage condition (Alquist and Kilian 2010).

- Inventory data will capture spillover from oil futures market.

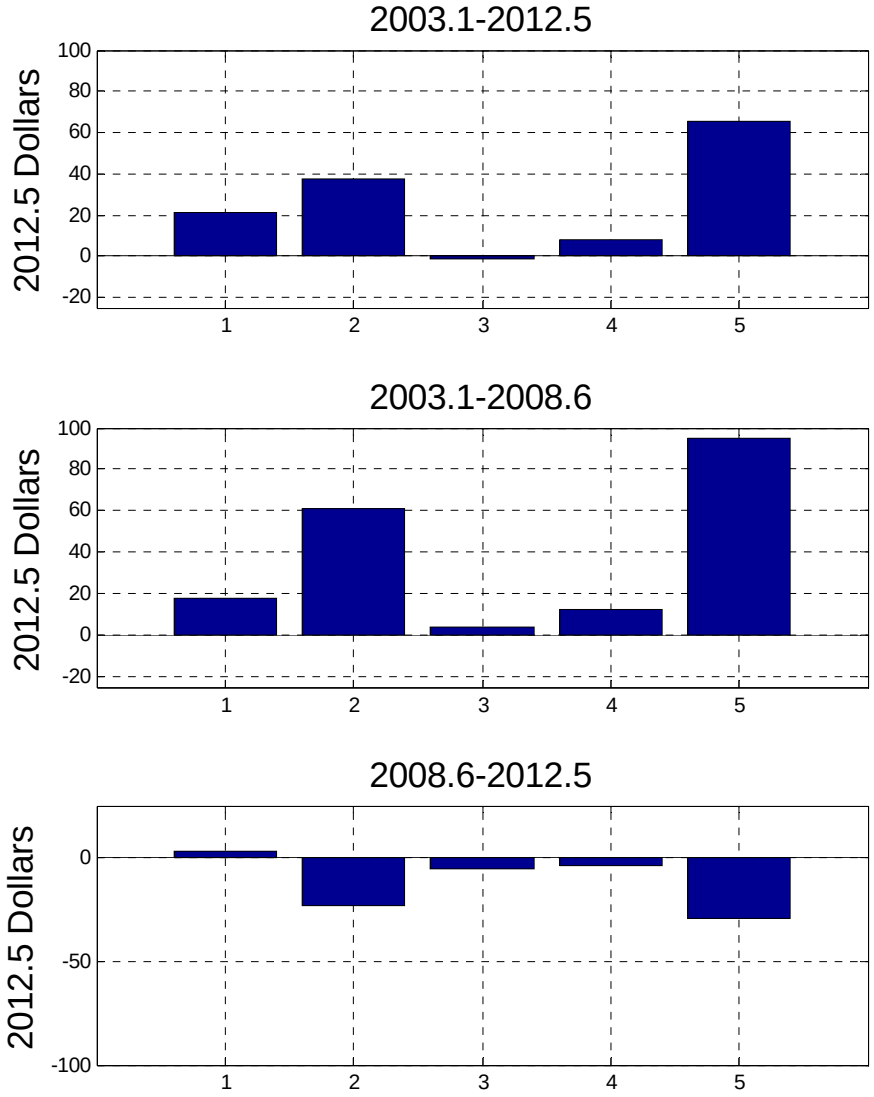
- Testable implication: Oil futures spread does not Granger-cause the variables included in the VAR model (Giannone & Reichlin JEEA 2006).

- In the absence of an oil futures market (or when arbitrage fails), our model would remain well-specified.

Historical Decompositions for 1978.6-2010.6



What Explains the Cumulative Change in Real Price of Oil since 2003?



1 = flow supply shock; 2 = flow demand shock; 3 = speculative demand shock; 4 = other demand shock; 5 = observed cumulative change in real price.

Interpreting the 2003-08 Oil Price Surge

- No evidence that speculation by oil consumers was responsible (so whether speculation is "excessive" or not is moot).
- No evidence that OPEC was behind the oil price increase.
- No evidence that "peak oil" has been the cause.
- Strong evidence that an unexpectedly booming world economy was the cause.

  Related evidence in Kilian and Hicks (2013):

  $\Rightarrow$ Systematic errors by professional forecasters

  $\Rightarrow$ Key role for emerging Asia

Is Financial Speculation Different?

Popular view:

(a) Starting in 2003, there was an influx of financial investors such as index funds into oil futures markets ("financial speculation").

(b) At about the same time, both spot and futures prices of crude oil began to surge, peaking at a record high in mid-2008.

- ⇨ Is there a causal link from (a) to (b)?
- ⇨ Has financial speculation been excessive?

What is Excessive Speculation? Definition 1

Accounting:
Traders in oil futures markets with a commercial interest in or a physical exposure to oil have been called hedgers, while those without a physical position to offset have been called non-commercial traders (often equated with speculators in the public).

Problem:
Oil futures market cannot function without speculative traders providing liquidity and assisting in the price discovery.

- ⇨ The presence of speculators (defined as non-commercial traders) tells us nothing about whether speculation is excessive.

What is Excessive Speculation? Definition 2

It is often asserted that the daily trading volume in oil futures markets is several times as high as daily physical oil production, fuelling the suspicion that speculators are dominating this market.

Problem:

This ratio – after taking account of the number of days to delivery for the oil futures contract – is a fraction of about one half of daily U.S. oil usage rather than a multiple.

What is Excessive Speculation? Definition 3

Working (1960) index: Percentage of "speculation" in excess of what is minimally necessary to meet short and long hedging demand.

Problem:

1. Index numbers for the oil market even at their peak remain in the midrange of historical experience for other commodity markets.

2. No systematic co-movement between index and oil price.

What is Excessive Speculation? Definition 4

Sometimes excessive speculation is equated with market manipulation.

Problem:

1. Market manipulation and speculation are distinct phenomena.

2. There is no evidence of widespread market manipulation in oil futures markets.

The Masters Hypothesis of How Speculation Caused a Surge in the Price of Oil in Physical Markets

Step 1:

Excessive influx of financial investors into the oil futures markets causes the oil futures price to increase.

Step 2:

Higher oil futures prices signal expectations of rising spot prices, drive up the demand for oil inventories and cause the price of oil to increase in physical markets (see Alquist and Kilian JAE 2010).

Kilian and Murphy (JAE) on Steps 2 and 1:

Speculative inventory demand shocks do not explain the oil price surge between 2003 and mid-2008. This price surge is explained by cumulative effects of flow demand shocks.

⇨ Step 2 of Masters Hypothesis Refuted

The Master hypothesis requires arbitrage between spot and futures markets. If arbitrage works, the absence of speculation in the physical market also rules out speculation in oil futures market.

⇨ Step 1 of Masters Hypothesis Refuted

Potential Caveat 1:
How Good Are the Crude Oil Inventory Data?

Kilian and Murphy (forthcoming: JAE):

1. External validation:
   Model finds speculation for episodes when industry sources indicate that it existed (1979, 1986, 1990, 2002).

2. Model passes formal test for informational sufficiency:
   Oil futures spread has no added predictive power.

Kilian and Lee (forthcoming JIMF):

Are the key results robust to the use of alternative proxies for global above-ground crude oil inventories? Yes.

Potential Caveat 2:
Speculation without a Change in Oil Inventories?

Hamilton (BPEA 2009): This is possible if the short-run price elasticity of oil demand is zero.

<u>Consensus view on short-run price elasticity of oil demand:</u>

Dahl (1993); Cooper (2003): -0.05, -0.07.

Problems with the Consensus on the Demand Elasticity

- The identification of this parameter requires an exogenous shift of the oil supply curve along the oil demand curve.

- Most of literature on estimating oil demand elasticities does not distinguish between oil demand and oil supply shocks.

- Standard reduced form approach suffers from downward bias. IV is infeasible, but our structural model provides an alternative.

Posterior Median of the
Short-Run Impact Price Elasticity of Demand for Crude Oil

$\eta^{Oil\ Production}$	$\eta^{Oil\ Use}$
-0.44	**-0.26**

Traditional reduced-from estimate based on our data:

$$\eta^{Oil\ Production} = -0.02$$

Related structural estimates in literature:

Baumeister and Peersman (2009): $\eta^{Oil\ Production} = -0.38$ (median)

Serletis (2009): $\eta^{Oil\ Production} = -0.35$

Bodenstein and Guerrieri (2011): $\eta^{Oil\ Production} = -0.41$

The Masters Hypothesis Resurrected?

Singleton (forthcoming: Management Science) reports that index fund trading helps predict higher returns on oil futures contracts.

<u>Problems:</u>

1. Inappropriate Data (Büyükşahin & Harris, EnEc 2011; Irwin & Sanders, EnJ 2012)
2. Very short sample, spurious correlations (Hamilton & Wu 2012)
3. Predictive correlation is not causation (Fattouh et al., EnJ 2013)
4. Not directly relevant for question of interest

The Consensus on the Role of Speculation after 2003

- Extensive research has produced a near-consensus among academic experts that a shift in economic fundamentals rather than speculation has been the key driver of recent oil price fluctuations.

- At best, the financialization of oil futures markets may have been associated with an amplification of the propagation of flow demand shocks.

- This finding has important implication for on-going policy efforts to regulate oil derivatives markets.

<u>Problem:</u>
Regulation is more politically opportune than conservation.