

Quantifying the Speculative Component in the
Real Price of Oil:
A Review of Recent Results

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Expectations and Speculative Oil Demand

- A natural economic definition of a speculator in the physical market is someone buying crude oil not for current consumption, but for future use (Fattouh, Kilian and Mahadeva, forthcoming: EnJ).
- 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.
- Kilian and Murphy (KM, forthcoming: JAE) quantified this speculative demand using a structural model of the global oil market.

Structural Model of the Global Crude Oil Market

- VAR model based on data since 1973.2
 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
- Four structural shocks:
 - Flow supply shock
 - Flow demand shock
 - Speculative demand shock
 - Other (idiosyncratic) oil demand shocks

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.

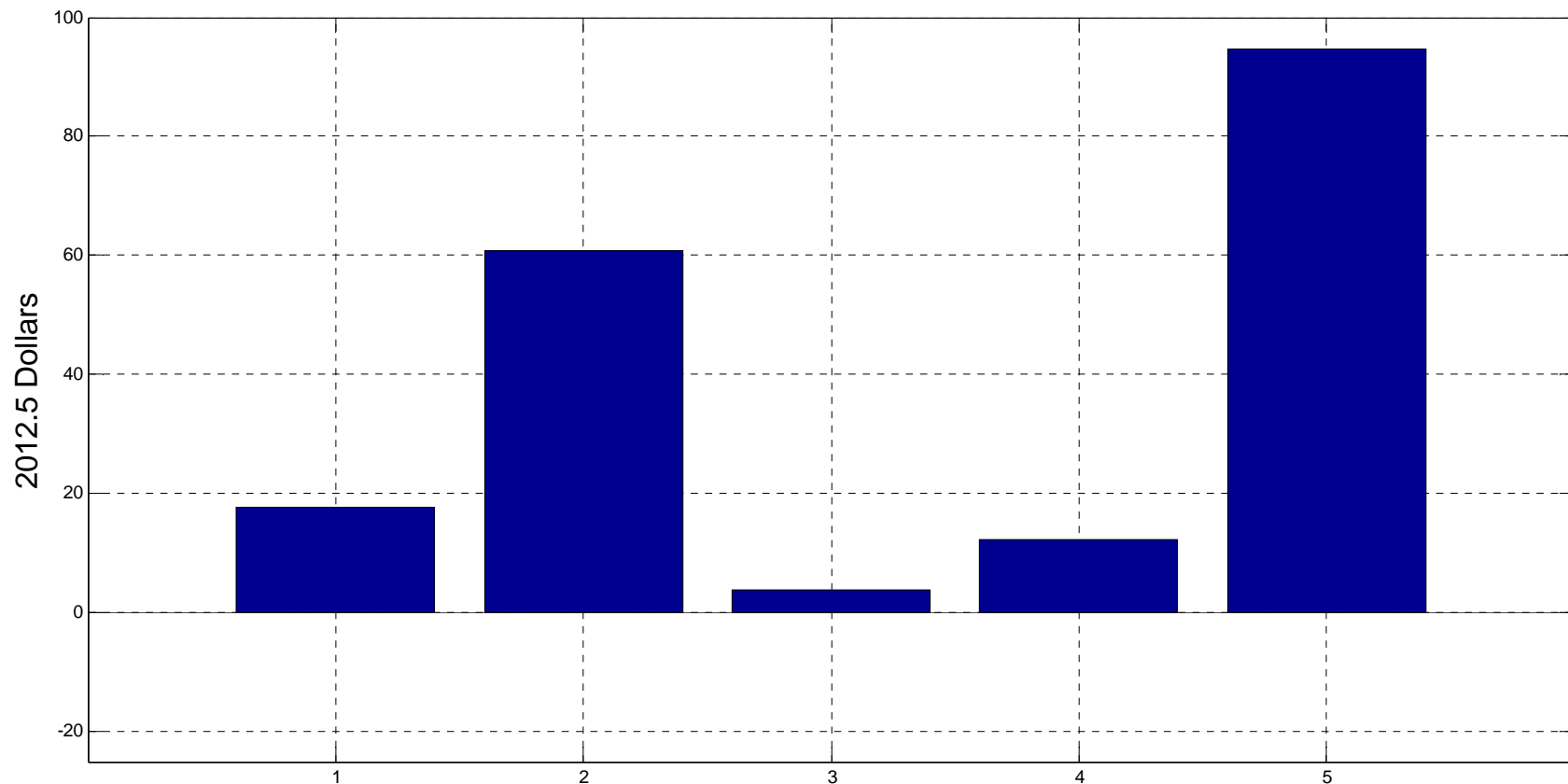
3. Bound on Impact Price Elasticity of Oil Demand:

$|\text{Impact elasticity}| < |\text{Long-run elasticity}|$

4. Dynamic Sign Restrictions

An unexpected flow supply disruption is associated with positive responses of the real price of oil for the first year; so are positive oil demand shocks.

Contribution to Cumulative Change in Real Price of Oil by Structural Shock: 2003.1-2008.6



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

Summary: What Explains the 2003-08 Oil Price Surge?

- No evidence of speculation by oil consumers.
- No evidence of speculation by oil producers.
- No evidence that “peak oil” has been the cause.
- Strong evidence that an unexpectedly booming world economy caused the surge.

Related evidence in Kilian and Hicks (J. Forecasting 2013):

⇒ Systematic errors by professional forecasters

⇒ Key role for emerging Asia

- The oil futures price and the oil price in the physical market are jointly determined and driven by the same fundamentals.

The Masters Hypothesis of How Financial Speculation Rather than Fundamentals Caused this Oil Price Surge

Step 1:

Exogenous 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 real price of oil to increase in the physical oil market (see Alquist and Kilian JAE 2010).

KM 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 Masters 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

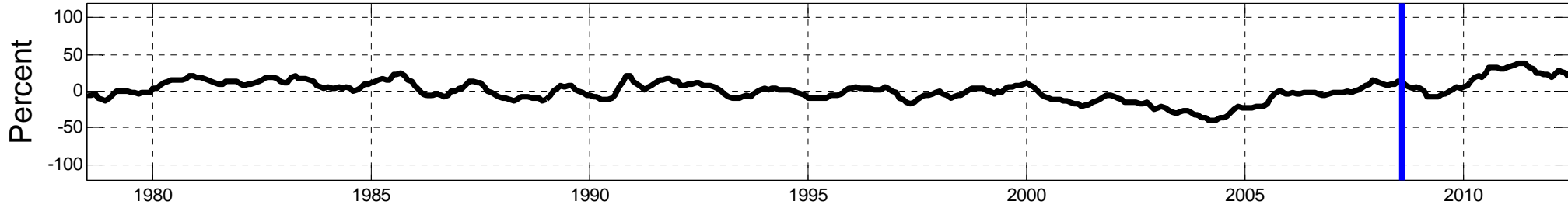
Five Defensive Reactions to KM's Explanation of the Surge in the Real Price of Oil

A. Denial:

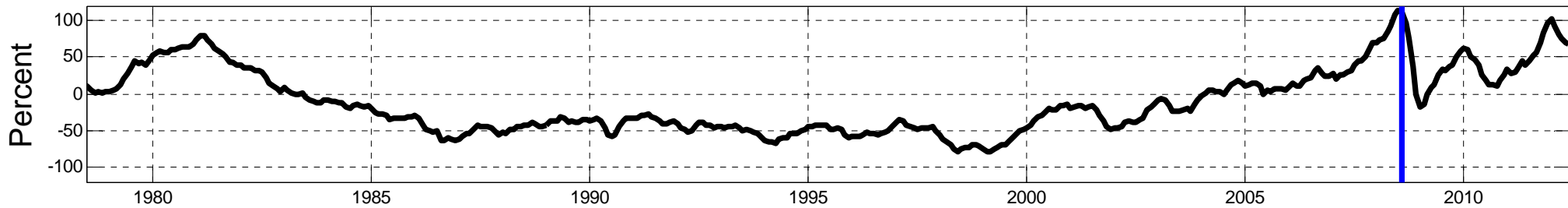
Claim: It is simply impossible for shifts in flow demand to explain the sharp increase in oil prices in 2007/08.

The Evidence for 2007/08 from the KM Structural VAR Model

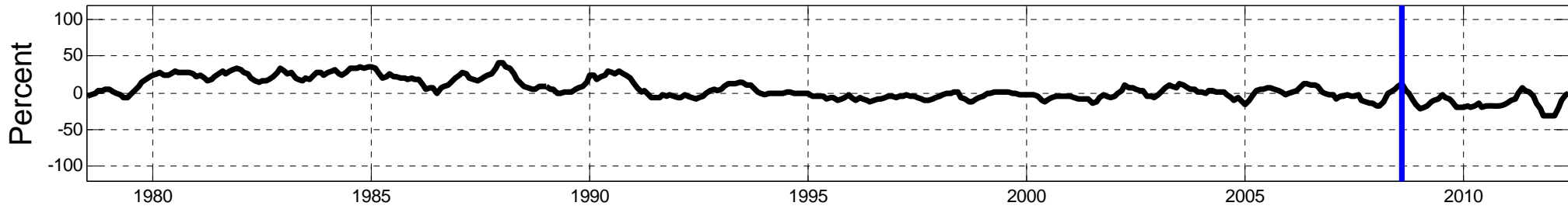
Cumulative Effect of Flow Supply Shock on Real Price of Crude Oil



Cumulative Effect of Flow Demand Shock on Real Price of Crude Oil



Cumulative Effect of Speculative Demand Shock on Real Price of Crude Oil



Source: Kilian and Lee (JIMF forthcoming).

B. Skepticism toward the empirical results:

Claim 1: This result cannot be true without unrealistically large flow demand shocks in 2007/08.

⇒ This reflects a misunderstanding of structural dynamic econometric models. It is the cumulative effect of all preceding flow demand shocks that explains the spike. No large shocks are required.

Claim 2: This result cannot be true because the quantity of oil shipped to China did not increase sharply in 2007/08.

⇒ This reflects a misunderstanding of economic theory. With a vertical supply curve, a shift in demand raises the price without any change in quantity,

C. Quibbles with the data underlying the KM model estimates

Claim 1: The global crude oil inventory data are mismeasured.

The model passes various specification tests and the results are robust to alternative inventory measures (see Kilian and Lee, JIMF forthcoming)

Claim 2: The Kilian real economic activity index is invalid because it can be shown to depend on lagged oil prices.

In the KM model, the activity index depends on lagged oil prices by construction. This fact does not invalidate the business cycle measure, and it does not affect the identification of the structural shocks.

D. Accept the structural VAR results, but reinterpret them:

Sockin and Xiong's (2012) model of informational frictions:

- Suppose that consumers of oil rely on oil futures prices as an indicator of expected future demand for oil.

If futures prices increase, flow demand shifts out.

- Now suppose that financial traders exogenously enter the oil futures market and drive up the oil futures price.
 - Consumers of oil will mistake this price increase as a sign of strong expected growth and start buying physical oil now.
- ⇒ This means that the flow demand shock in the KM model may be a speculative demand shock in disguise.

The Sockin-Xiong model relies on two key assumptions:

1. This is a model of confusion as much as informational frictions:

Oil consumers in the model do not understand that the real price of oil depends on several demand and supply shocks.

⇒ The model forces agents to act as if there were only one shock in oil markets. It is a rational expectations model only conditional on this restrictive assumption.

2. It is assumed that oil futures prices are the only source of information about the future state of the global economy, preventing agents from discovering their error.

⇒ What about the OECD global industrial production index?

⇒ Where does the unwanted domestic output go?

What's the empirical evidence for Sockin and Xiong's model?

The ECB between 2003 and mid-2008 raised its interest rate in response to the term structure of oil futures prices. Sockin & Xiong specifically cites the ECB's July 2008 decision.

Caveats:

1. These policy responses were explicitly based on many indicators pointing in the same direction (e.g., monetary and credit growth, excessive bank lending, rising past inflation) rather than just oil futures prices.
2. If the ECB decisions reflected widely held beliefs about commodity futures prices, why did other central banks not raise interest rates?

3. If the futures and spot prices of oil are driven by the same macroeconomic fundamentals, as shown in KM (forthcoming), there is nothing wrong with the ECB's decisions.

“There is now little doubt that a large part of what we are observing in the oil prices and in the commodity prices is a demand-driven process, that is, coming largely, but not exclusively, from emerging Asia.” (Trichet, December 2005)

⇒ In this interpretation, the ECB's mistake in July 2008 was not one of being confused, but of making an oil price forecasting error (and perhaps of paying insufficient attention to other global financial markets with the benefit of hindsight).

Is there alternative empirical evidence for Sockin-Xiong model?

Hu & Xiong (2013) test the hypothesis that oil futures prices reveal information about the strength of the global economy (as measured by Asian stock prices).

They exploit the fact that Asian stock markets are closed while U.S. oil futures markets are open.

- ⇒ No significant predictive relationship from U.S. oil futures returns to Asian stock returns after including lagged U.S. stock returns.
- ⇒ No support for the Sockin-Xiong model of oil market financialization.

E. Question the underlying economic model

a. Smith and Thompson (2012):

Inventory markets for oil are too thin to reveal information. Price discovery therefore takes place in the oil futures market.

⇒ The KM model allows for such frictions.

b. Many contracts in the physical market are indexed to oil futures prices, given the delays in delivery. Speculative activities may feed back to the refiners' acquisition cost directly.

⇒ Oil futures prices are reference prices, not transaction prices, so this link is not obvious.

⇒ If this were true, oil futures prices should predict the refiners' acquisition cost at the relevant horizons. This is not the case (e.g., Alquist et al., hdbk chapter, 2013).

c. Can heterogeneity in traders' expectations cause an increase in the spot price without affecting inventories?

- No, because oil is not a financial asset, but a consumable commodity.
- An increase in the spot price will lower consumption and cause inventories to be accumulated unless price elasticity of oil demand is zero (also see Hamilton BPEA 2009)
- Structural estimates of the impact price elasticity of oil demand are too high to allow for this limiting case (see KM, forthcoming).

Conclusions

- Extensive research has produced a near-consensus among academic experts that economic fundamentals have been the key driver of recent oil price fluctuations.
- There are still open questions about how exactly this shift in demand came about, how persistent it will be, and whether its effect was amplified by the financialization of oil futures markets.
- There is no evidence in support of the hypothesis that an exogenous increase in the financialization of oil markets drove up oil prices. Indeed, this explanation seems highly implausible ex ante because interest in index funds presumably was driven by earlier oil price increases caused by shocks to fundamentals. We must not confuse the cause and the propagation of shocks.