A Micro-Based Model for World Oil Markets

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What drives oil prices and the behaviour of crude price over the years?

- Outcome of high world demand? (Growth of China, India)

- Inability to increase world supply?

- Maybe a combination?

- Financial market´s Speculation?

The Answer to the question of what is driving the price of oil is ultimately an empirical one

Ok...lets estimate

Identification problem

- Literature solution...***untestable*** exclusion restrictions [See Kilian (2009)]

- We claim that it's possible to use geological, technical or even institutional limitations as **testable** exclusion restrictions

- Our exclusion restrictions are based on this fact; an increase in drilling activity precedes any increase in production. [i.e, a **testable** technical restriction]

Outline

- Data in detail

- Data challenges (seasonality and rig productivity)

- The Model

- The Anatomy of the Oil Price Bubble

- Conclusions

Data in detail

- Oil Price: West Texas Intermediate (WTI) provided by the EIA. Expressed in real terms using the average CPI of all cities in the US 2010=100 provided by BLS

- Crude Oil Production: At the country level was obtained using the IEA *Mods* database

- Drilling Activity: measured by the number of active crude oil rotary rigs obtained from Baker Hughes Inc.

- Monthly index of global real economic activity, provided by Kilian (2009)

- Our data span covers the period 1995:01–2010:12 for a group of 28 countries

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Data challenges

- Two problems severely affects the estimation of how drilling affects production

- Seasonality…

  - Weather conditions made impossible to increase or even keep constant the number of oil rigs

  - And …there's no perfect synchronization in seasonal patterns across countries

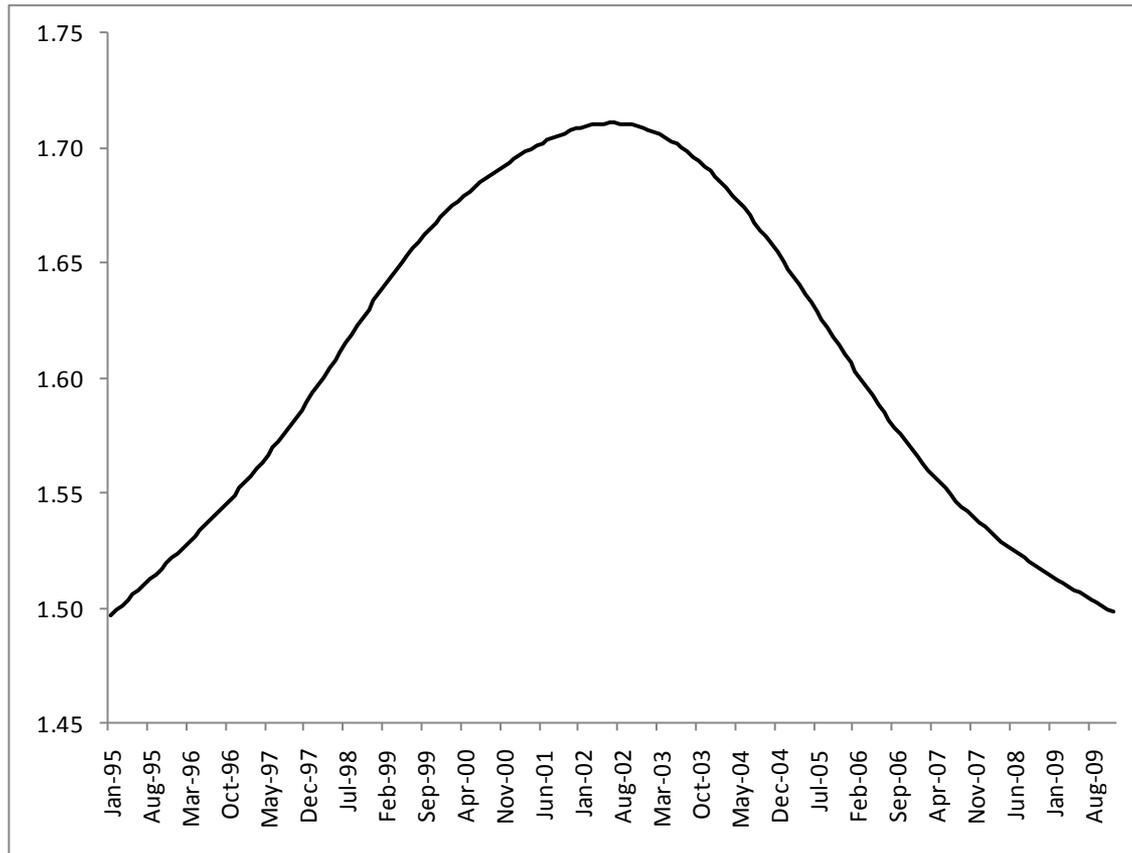# Data challenges

Canada number of crude oil rigs
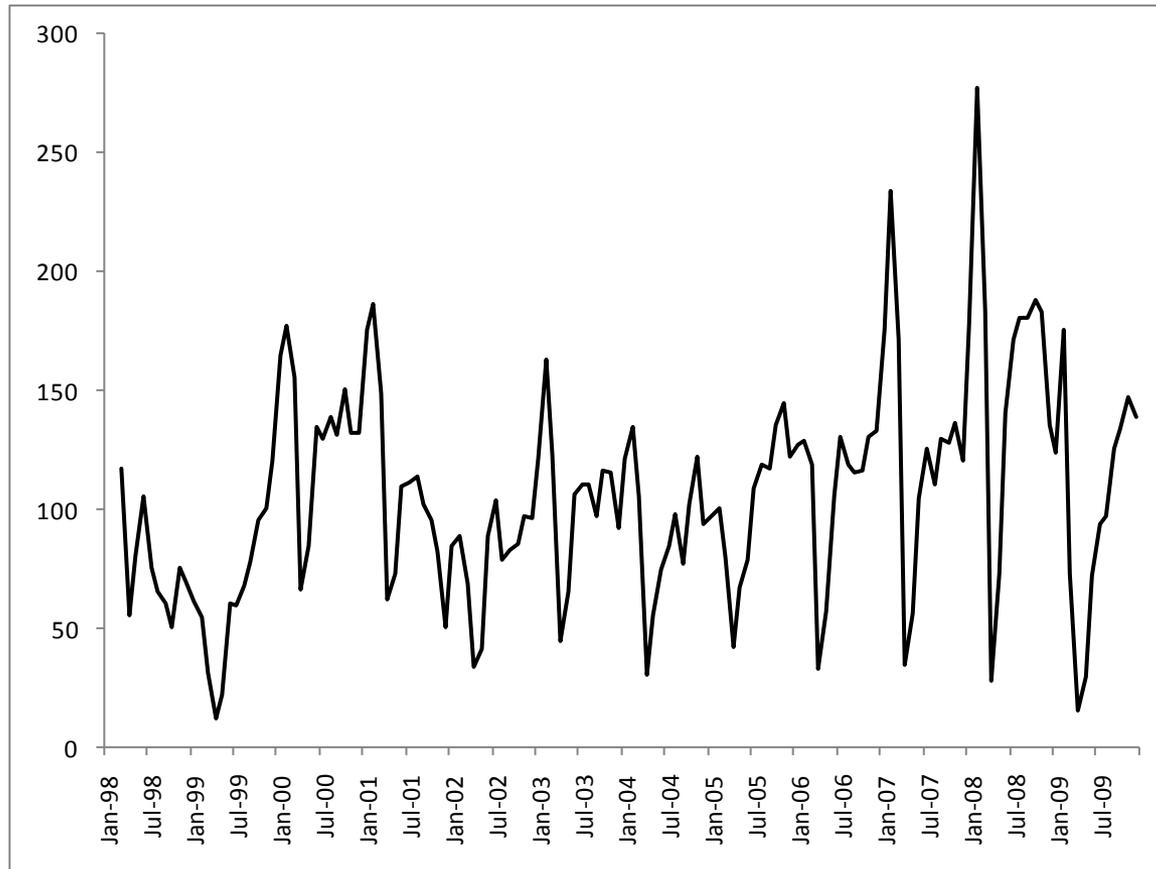
Source: Based on data from Baker Hughes Inc.

Data challenges

- Exhaustion…

  - Productivity per active rig has fluctuated through time

  - Productivity trends could be correlated with the price of oil that we observe

  - The timing and severity for this problem is not the same across regions, countries and sometimes even across fields!

Data challenges

United States Production per Rig (Hodrick-Prescott Trend)

Source: Based on data from Baker Hughes Inc.

Data challenges

- All our data is then seasonally adjusted (Tramo-Seats) and de-trended using filtering techniques (Hodrick-Prescott)

- All our estimations are made at the country level

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The Model

- We want to estimate the following system

$$Ax_t = C + \sum_{i=1}^{L} \phi_i x_{t-i} + \varepsilon_t$$

- Residuals (ε_t) represent structural innovations. They are orthogonal to each other and have economic meaning.

The Model

- However, we observe only…

$$x_t = k + \sum_{i=1}^{L} \beta_i x_{t-i} + e_t$$

- Given the set of restriction implicated by the sequential process of crude oil production…

- We were able to recover matrix of contemporaneous correlation A and the variance matrix for the vector ε_t

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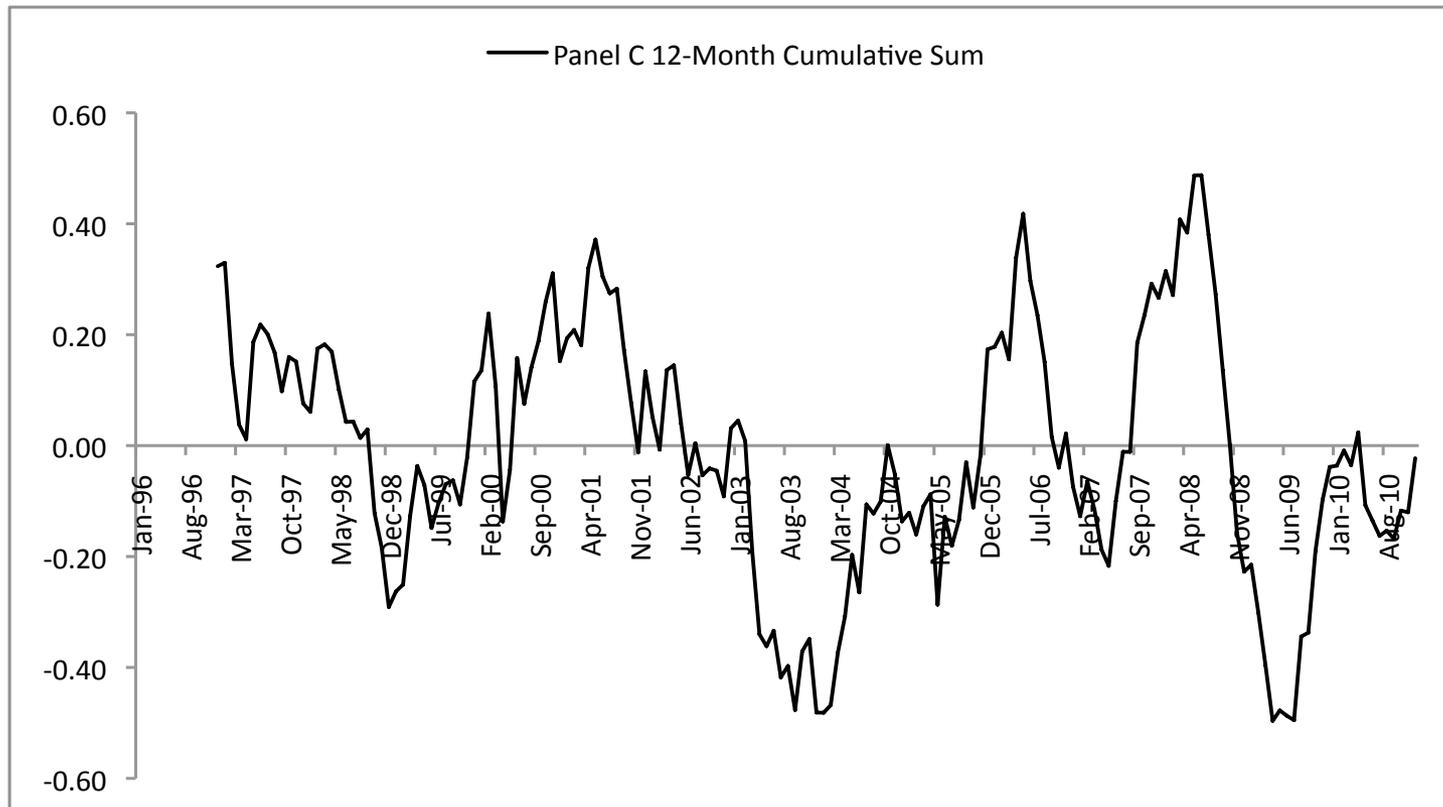- The Anatomy of the Oil Price Bubble

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The Anatomy of the Oil Price Bubble

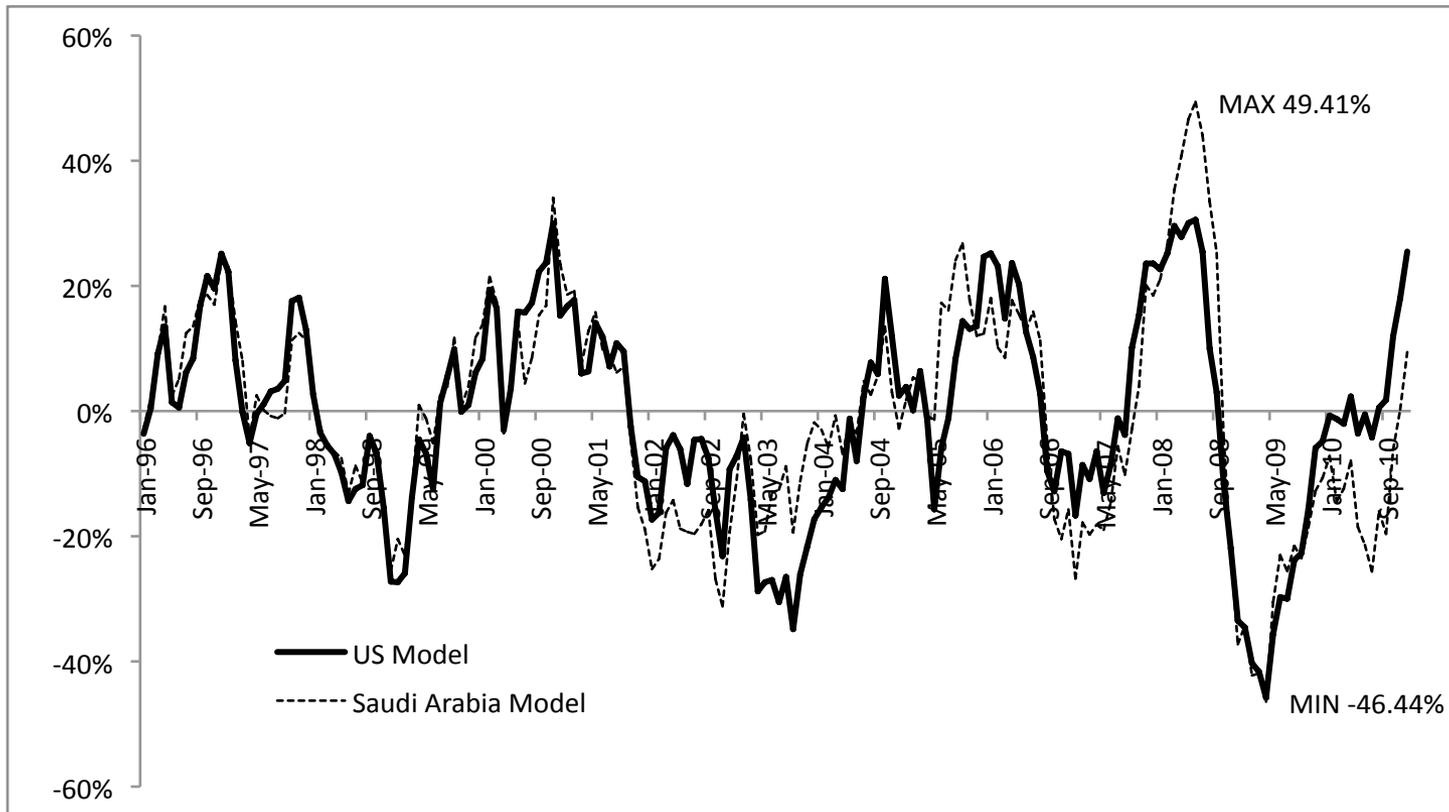**Price Equation Structural Residuals (in logs), US Model**
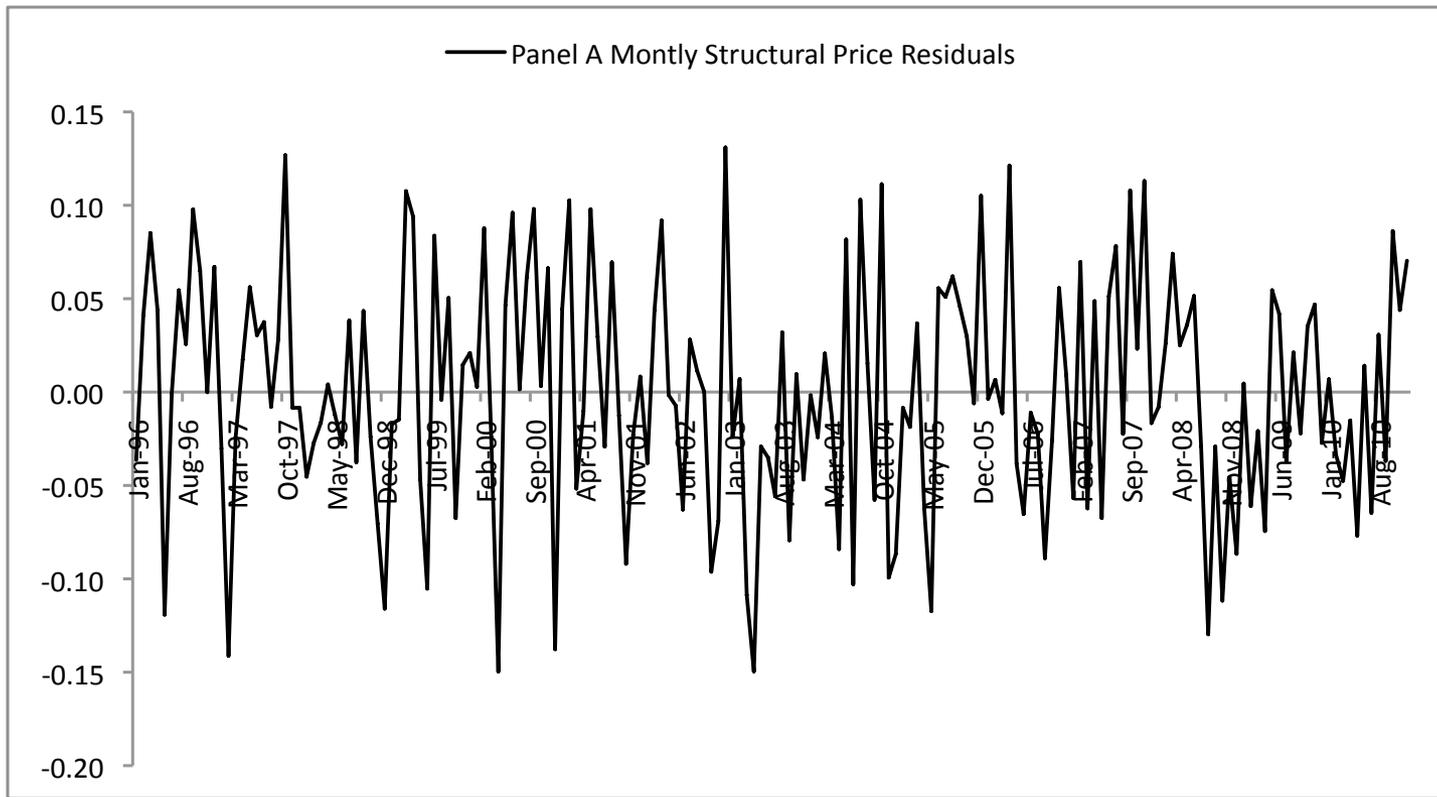
The Anatomy of the Oil Price Bubble

Price Equation Structural Residuals (in logs) 12- month cumulative sum

The Anatomy of the Oil Price Bubble

"No bubble" oil price deviations from observed oil price (S.A. and de-trended)

The Anatomy of the Oil Price Bubble

- In our "No-bubble" oil price series, we set to zero all structural shocks in the price equation of the system

- Structural residuals of the oil price equation (bubble component) are serially correlated up to 24th months.

- The greatest deviation from the observed price was observed in Jun-08, reaching 49.1% for the Saudi Arabia Model. (US Model 30.6%)

The Anatomy of the Oil Price Bubble

- If there is in fact a speculative bubble affecting the oil price, its effect is bounded both in magnitude and time horizon

- Deviations from observed oil price, US model

  - 98% lies within a ±40% interval

  - 94% lies within a ±30% interval

  - 75% lies within a ±20% interval

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Conclusions

- In this paper we test two competing hypothesis for the oil price increase that took place in the last decade (Fundamentals Vs. Speculation)

- We address the problem of identification using a novel data set at the country level that allowed us to justify exclusion restrictions imposed by the crude oil production process

- We find that at least 2/3 of this price hike can be explained using only fundamentals of the oil market

- Speculative shocks to the oil price are very volatile. They also have serial correlation, with a persistence that last two years at most.

Conclusions (cont.)

- They are also bounded in magnitude at their historical peak of US$ 40.

- Given that:

  - Oil prices that we observe today are responding to the same fundamentals than in previous years

  - Our structural analysis of the residual suggest that there's no enough evidence to support a long-term disequilibria driven by pure speculation in the world oil markets.

  - We expect real oil prices fluctuating around US$ 100 in the short and medium-term.

Thanks