Bubbles in Oil Prices - Evidence and Implications

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Motivation

- Oil is important input factor
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- Oil is exhaustible fossil resource
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- Describe and understand oil price behavior
Motivation

- Oil is important input factor
- Oil is exhaustible fossil resource
- Describe and understand oil price behavior
- Discuss implications
This paper

- Are bubbles present in the oil price?
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- Which periods are characterized by bubbles?
This paper

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- Which periods are characterized by bubbles?
- Cointegration based test for bubbles
This paper

• Are bubbles present in the oil price?
• Which periods are characterized by bubbles?
• Cointegration based test for bubbles
• GS ADF test for periodically collapsing bubbles [Shi et al., 2010]
Empirical approach

• Cointegration bases bubble tests
Empirical approach

- Cointegration bases bubble tests
  - Relationship between fundamental value and observed price
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- Order of integration of oil price fundamental value?
The GSADF test

\[
\Delta y_t = \alpha_{r_1,r_w} + \beta_{r_1,r_w} y_{t-1} + \sum_{i=1}^{k} \psi_{r_1,r_w} \Delta y_{t-i} + \epsilon_t
\] 

(1)
The GSADF test

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- with

\begin{align*}
  r_1 & : \text{Sample starting point} \\
  r_2 & : \text{Sample ending point} \\
  r_w & : \text{Sample window size} \\
  r_0 & : \text{Minimum window size}
\end{align*}
The GSADF test

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\[ r_1 : \text{Sample starting point} \]
\[ r_2 : \text{Sample ending point} \]
\[ r_w : \text{Sample window size} \]
\[ r_0 : \text{Minimum window size} \]
\[ r_w \in [r_0, 1] : \text{SADF test} \]
\[ r_1 :\in [0, 1 - r_w] : \text{GSADF test} \]
Test statistic and critical values

- Test statistic:

\[ GSADF(r_0) = \sup_{r_1 \in [0, 1-r_w]} \left\{ \sup_{r_w \in [r_0, 1]} ADF_{r_1}^{r_w} \right\} \] (2)
Test statistic and critical values

- Test statistic:

\[ GSADF(r_0) = \sup_{r_1 \in [0, 1-r_w]} \left\{ \sup_{r_w \in [r_0, 1]} ADF_{r_1}^{r_w} \right\} \]  \hspace{1cm} (2)

- Critical values are based on numerical simulations
Date stamping

• Based on a backward SADF test
Date stamping

- Based on a backward SADF test
- Test statistic: $GSADF(r_0) = \sup_{r_2 \in [r_0, 1]} \left\{ \sup_{r_w \in [r_0, r_2]} ADF_{r_2}^{r_w} \right\}$
Date stamping

- Based on a backward SADF test
- Test statistic: $GSADF(r_0) = \sup_{r_2 \in [r_0, 1]} \left\{ \sup_{r_w \in [r_0, r_2]} ADF_{r_2}^{r_w} \right\}$
- Bubble origination $\hat{r}^e$ and termination $\hat{r}^f$ points:
Date stamping

- Based on a backward SADF test
- Test statistic: $GSADF(r_0) = \sup_{r_2 \in [r_0, 1]} \{ \sup_{r_w \in [r_0, r_2]} ADF_{r_2}^{r_w} \}$
- Bubble origination $\hat{r}^e$ and termination $\hat{r}^f$ points:
  \[\hat{r}^e = \inf_{r_2 \in [r_0, 1]} \{ s : ADF_{r_2} > cv \}\]
  \[\hat{r}^f = \inf_{r_2 \in [\hat{r}^e + \log(T)/T, 1]} \{ s : ADF_{r_2} < cv \}\]
Conclusions

- Bubbles in the price of oil?
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- Newly developed cointegration based bubble test
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- Newly developed cointegration based bubble test
- Oil price is scarcity indicator [Hotelling, 1931; Sinn, 2008; Holland, 2008]