HOW PERSISTENT ARE SHOCKS TO OIL PRICES?

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Introduction

• The crude oil market can be affected by exogenous shocks that could emanate from demand and supply shocks, or policies pertaining to the Organization of the Petroleum Exporting Countries (OPEC), and geopolitical risks.

• We are interested to understand the nature of persistence of oil prices to exogenous shocks.
Motivation

• A persistent increase in the crude oil price may lead to real appreciation of the exchange rate (Chaudhuri and Daniel 1998) which puts decreasing pressure on the prices via less-expensive imports.

• The wealth effect of this kind of persistent change in the crude oil price can apply increasing pressure on prices (Ozdemir 2013).
Methodological Issues

- Method to study the persistence of oil prices is to use unit root tests.

- Given the sample size chosen in empirical studies it is likely that structural breaks may appear in the time series.

- Another problem with unit root tests is the possible presence of time varying unconditional volatility in the data.
Aims

- The literature is far from a consensus on the unit root properties of crude oil prices (low power and possible non-stationary volatility).

- We adopt a novel unit root test due to Cavaliere et al (2011), CHLT hereafter, that allows for a possible trend break and nonstationary volatility.

- The nonstationary volatility could take the form of a single or multiple abrupt variance breaks, smooth transition variance breaks or a trending variance.
Literature Review


Test for Nonstationary Volatility

\[ IT = \sup \left| \sqrt{\frac{T}{2D_k}} \right| \]

where \( D_k = \frac{C_k}{C_T} - \frac{k}{T} \)

and \( C_k = \sum_{t=1}^{k} \varepsilon_t^2 \), \( k = 1,2, \ldots, T \) is the cumulative sum of squares.
Structural Break Tests

\[ ExpW = \log \left[ T^{-1} \sum_{\lambda \in \Lambda} \exp \left( \frac{1}{2} W_{QF} (\lambda_1) \right) \right] \]

\[ ExpW(2|1) = \max_{1 \leq i \leq 2} \{ ExpW^{(i)} \} \]
CKP Unit Root Tests

\[ MZA = \left[ T^{-1} \tilde{y}_T^2 - s^2(\lambda) \right] \left( 2T^{-2} \sum_{t=2}^{T} \tilde{y}_{t-1}^2 \right)^{-1} \]

\[ MSB = \left( T^{-2} \sum_{t=2}^{T} \tilde{y}_{t-1}^2 \right)^{1/2} \sqrt{s^2(\hat{\lambda})} \]

\[ MZT = \left[ T^{-1} \tilde{y}_T^2 - s^2(\lambda) \right] \left( 4s^2(\hat{\lambda})T^{-2} \sum_{t=2}^{T} \tilde{y}_{t-1}^2 \right) \]
CHLT Method

\[ P_t = \alpha + \beta t + \gamma DT(\lambda) + \epsilon_t. \]
\[ \epsilon_t = \rho_T \epsilon_{t-1} + \eta_t; \quad t = 2,3, \ldots, T. \]
\[ \eta_t = C(L)e_t \]
\[ e_t = \sigma_t Z_t \]
CHLT Unit Root Tests

\[ MZ_a(\tau, c) = \frac{T^{-1} \varepsilon_t^2 - s_{AR}^2(p)}{2 T^{-2} \sum_{t=2}^{T} \varepsilon_{t-1}^2} \]

\[ MSB(\tau, c) = \left[ \frac{T^{-2} \sum_{t=2}^{T} \varepsilon_{t-1}^2}{s_{AR}^2(p) 2 T^{-2}} \right]^{1/2} \]

\[ MZ_t(\tau, c) = MZ_a(\tau, c) \times MSB(\tau, c) \]
Data

- The three benchmark crude oils being WTI, Brent and Dubai/Oman obtained from the *International Financial Statistics*.

- Monthly frequency spanning from January 1985 to July 2013.
## Results: Breaks in Volatility/Trend

<table>
<thead>
<tr>
<th></th>
<th>Tests for break in variance</th>
<th>Sequential Test for Structural Breaks</th>
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<tbody>
<tr>
<td></td>
<td>Inlan Tiao Test</td>
<td>Kejriwal Perron 0</td>
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<tr>
<td>WTI</td>
<td>Oct 1999, July 2004,</td>
<td>2.70* (Jun 2004)</td>
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<tr>
<td></td>
<td>Oct 1999, July 2004</td>
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<tr>
<td>Brent</td>
<td>Oct 1999, Feb 2004, Nov 2010</td>
<td>9.05* (Apr 2004)</td>
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<td>Dubai</td>
<td>Aug 1999, Apr 2004,</td>
<td>16.05* (Feb 2002)</td>
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## Unit Root Tests with Break in Trend

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<th></th>
<th>MZa statistic</th>
<th>MSB statistic</th>
<th>MZt statistic</th>
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<tr>
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<td>Bootstrapped</td>
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<td>Crit. Val.</td>
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<td>5%</td>
<td>10%</td>
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<tr>
<td><strong>W</strong></td>
<td>-16.90</td>
<td>-28.3</td>
<td>-20.8</td>
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<tr>
<td><strong>B</strong></td>
<td>-11.28</td>
<td>-28.1</td>
<td>-20.7</td>
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<tr>
<td><strong>D</strong></td>
<td>-9.60</td>
<td>-28.1</td>
<td>-20.7</td>
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# Unit Root Tests with Break in Trend and Volatility

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<tr>
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<th>MZa statistic</th>
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<th>Crit. Val.</th>
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</thead>
<tbody>
<tr>
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<td>-34.0</td>
<td>-24.6</td>
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<tr>
<td>B</td>
<td>-38.1</td>
<td>-34.6</td>
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<td>0.11</td>
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Inference

• If an energy shock has a permanent adverse effect to the real economy, countercyclical stabilization policies may become unsustainable and policy makers should adopt a strategy of long-run structural adjustment.

• If a permanent shock being addressed with counter-cyclical measures, this could invite speculative attacks on the currency. Energy import prices rise, exports become uncompetitive in world markets and dollar denominated loans used to fund the preceding prosperity could drive industries into bankruptcy.
Conclusion

• Results have consequences for econometric analysis, forecasting, macroeconomic policy, besides the implications for stabilization policies.

• Transitory shocks in two leading benchmark crude oil prices, exercise caution whether these crudes are less amenable to stabilization policies.

• We find that using a novel and more appropriate unit root test that allows for nonstationary volatility the conclusions about persistence in crude oil prices can be drastically different.