What drives oil prices? Emerging versus Developed economies

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What drives oil prices?

- Common approach: Oil prices as exogenous to macroeconomic aggregates.
  - Oil price innovations are interpreted as oil supply shocks. Negative effect on macroeconomic aggregates.

- Recently the work by Lutz Kilian (see e.g. Kilian (2009)) have stressed that oil prices are also driven by demand. **Reverse causality from macro**.

- Baumeister and Peersman (2012) find evidence of a shift in the importance of oil supply shocks towards oil demand shocks since the mid 1980s

- But demand from where?
Oil Consumption: Non-OECD as a fraction of total world oil consumption
Recent studies

- Thorsrud (2012) study the transmission of global and regional shocks
  - Asia is the most important region for the global business cycle.
  - Is Asia also an important driver for oil prices? And what about other emerging economies?

- Demand from Asia commonly thought to have played and important role in driving up commodity prices - but surprisingly few studies have established if this holds true. In fact, to our knowledge, none.

- Indirect link... Kilian and Hicks (2012) show that recent forecast surprises were associated with unexpected growth in emerging economies and that these shocks were central in driving up the real price of oil during the mid 2000s
We ask: What drives oil prices? Emerging vs. Developed economies.

Focus in particular on the role of Asia and South America (including South Africa).

Estimate a FAVAR model with separate Emerging and Developed activity factors, in addition to the global oil production and the real price of oil.

Use a variety of different identification schemes to study the responses of the real price of oil and oil production after activity shocks in emerging and developed economies, but also the responses of activity in emerging and developed economies after shocks in the oil market.
Contribution and results

- To our knowledge, first paper to explicitly analyze the contribution of developed and emerging countries on oil variables.

- Emerging markets shocks and developed economies shocks account for between 50 and 60 percent of the fluctuations in the real price of oil.

- For all the different model specifications, emerging markets (in particular Emerging Asia) shocks are by far more important than developed economies shocks for fluctuations in the real price of oil as well as in oil production.

- Emerging and developed economies also respond differently to the various oil shocks.
The big emergence

Oil prices without emerging activity shocks

ABT (BI and Norges Bank)
The model: FAVAR

Transition equation:

\[ F_t = \beta(L)F_{t-1} + u_t, \]

\( F_t = [\Delta oilPrd_t \hspace{1em} devAct_t \hspace{1em} emeAct_t \hspace{1em} \Delta oilPri_t], \) where oilPrd and oilPri are observed oil production and oil prices. devAct and emeAct are unobserved activity factors representing respectively developed and emerging market specific activity factors extracted from a large data set and \( u_t \) is the reduced form residuals.

Structural disturbances follow \( u_t = \Omega^{1/2}\varepsilon_t, \) with \( \varepsilon \sim N(0, 1) \) and \( \Omega = A_0(A_0)'. \)

Observation equation:

\[ X_t = \Lambda F_t + e_t, \]

\( X_t \) is a \( N \times 1 \) vector of observables, \( \Lambda \) is a \( N \times K \) matrix of factor loadings and \( e_t \) is a \( N \times 1 \) vector of idiosyncratic, zero mean, disturbances.
Data and model specification

- Unobserved factors are estimated by principal components.
- Large panel of GDP and industrial production:
  - Developed economy: 19 different OECD member countries
  - Emerging economy: 14 different emerging economies (Argentina, Brazil, China, Chile, India, Korea, Malaysia, Mexico, Peru, Singapore, South Africa, Taiwan, Thailand, Indonesia).
- VAR with 4 lags
- Quarterly data
- Stationary, and normalised
- Sample: 1992Q1 – 2009Q4
Identifying the factors

Rewriting observation equation:

\[ X = F\Lambda' + e, \quad (F = T \times r) \quad (\Lambda = N \times r) \]  

(3)

But, NOT identified because:

\[ X = F^*\Lambda^* + e, \]  

(4)

for any invertible \((r \times r)\) matrix \(R\), such that \(F^* = FR'\) and \(\Lambda^* = \Lambda R^{-1}\).

- NEED \(r^2\) identifying restrictions!
Identifying the factors cont’d

Let:

\[ \Lambda^{id} = [I_r \quad \Lambda_2]^{'}, \]

where \( I_r \) is \( r \times r \) identity matrix, and \( \Lambda_2 \) is a \((N - r) \times r\) loading matrix.

- Gives \( r^2 \) restrictions. All on loadings. Identification unique (globally)!
- Identified factors can be correlated!

Estimation: \( F^{id} = F \Lambda_r^{'}, \) and \( \Lambda^{id} = \Lambda \Lambda_r^{-1} \), with \( \Lambda_r \) the top \( r \times r \) part of \( \Lambda \).

- Identifying (normalizing) variables:
  \( X_r = [\Delta oilPrd\quad \Delta USGDP\quad \Delta ChinaGDP\quad \Delta oilPri] \)
Identified factors

Emerging activity

Developed activity

ABT (BI and Norges Bank)
Identified factors

Oil prices

Oil production
Identifying the shocks. A combination of short run and sign restrictions

4 shocks: oil supply, developed demand, emerging demand and oil specific demand

<table>
<thead>
<tr>
<th></th>
<th>Short run</th>
<th></th>
<th>Sign Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varepsilon_{\text{oilSup}}$</td>
<td>+</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{\text{devDem}}$</td>
<td>+</td>
<td>+</td>
<td>$\varepsilon_{\text{devD}}$: $\text{devAct} - \text{emeAct} &gt; 0$</td>
</tr>
<tr>
<td>$\varepsilon_{\text{emeDem}}$</td>
<td>x</td>
<td>+</td>
<td>$\varepsilon_{\text{emeD}}$: $\text{emeAct} - \text{devAct} &gt; 0$</td>
</tr>
<tr>
<td>$\varepsilon_{\text{oilDem}}$</td>
<td>x</td>
<td>x</td>
<td>+</td>
</tr>
</tbody>
</table>

Note: $u_t = A_0 \varepsilon_t$, the short run restrictions refers to the structure of $A_0$. The sign restrictions are imposed to hold for 2 quarters.
Impulse responses

S: OilProd

Oil Prod

S: DevD

Develop

S: EmeD

Emerg

S: OilD

Oil Price

ABT (BI and Norges Bank)
Note: The bars display the variance decomposition with respect to the shocks for horizons 4, 8 and 12 quarters. The widest bars correspond to the shorter horizon.
Effect of oil supply and oil specific demand shocks on GDP in different regions (median)

Note: y-axis (vertical axis) measures impulse responses after eight quarters. All shocks are normalized to increase oil prices.
What is it with emerging (Asia)?

Table: Regional structure

<table>
<thead>
<tr>
<th></th>
<th>kc</th>
<th>ki</th>
<th>openk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging Asia</td>
<td>55</td>
<td>33</td>
<td>145</td>
</tr>
<tr>
<td>Developed</td>
<td>66</td>
<td>23</td>
<td>60</td>
</tr>
<tr>
<td>Emerging South America</td>
<td>70</td>
<td>22</td>
<td>50</td>
</tr>
</tbody>
</table>

Table: Correlations between country structure and IRF levels

<table>
<thead>
<tr>
<th></th>
<th>kc</th>
<th>ki</th>
<th>openk</th>
<th>eint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>-0.47</td>
<td>0.61</td>
<td>0.45</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Demand</td>
<td>-0.29</td>
<td>0.47</td>
<td>0.21</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.01)</td>
<td>(0.23)</td>
<td>(0.19)</td>
</tr>
</tbody>
</table>

Note: \( kc = \) consumption, \( ki = \) investment. openk = openness at 2005 constant prices (%). eint = energy intensity of GDP at purchasing power parities. Results are based on the mean of the indicators (over the sample period 1992 - 2009). The second row for each shock are p-values.
Regression of oil supply shocks on observable GDP
Demand from emerging economies impact oil production and oil prices substantially more than developed economies.

Developed economies are more negatively affected by oil supply and oil demand shocks than emerging economies.

Emerging Asia the most import driver
Sign restriction procedure

1. Let $\Omega = PP'$ be the Cholesky decomposition of the VAR covariance matrix $\Omega$, and $\tilde{A}_0 = P$.

2. Draw an independent standard normal $n \times k$ matrix $J$, where $n$ is the size of the block (e.g. world or regional block) and $k$ is the number of shocks affecting that block according to the block exogenous structure outlined in equation ???. Let $J = QR$ be the “economy size” QR decomposition of $J$ with the diagonal of $R$ normalized to be positive.

3. Compute a candidate structural impact matrix $A_0 = \tilde{A}_0 \cdot \tilde{Q}$, where $\tilde{Q}$ is a $N \times N$ identity matrix with $Q'$ in the $n \times k$ block associated with either the world or regional block in equation ??.

4. Redo step 1-3 for the next block of data.