What Drives Commodity Prices More: Oil Demand or Supply Shocks?

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WHAT DRIVES COMMODITY PRICES MORE? OIL DEMAND OR SUPPLY SHOCKS?

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INTRODUCTION

The literature on the relationship between crude oil and agricultural commodity prices, besides being limited, render several features and issues:

1. All are couched within the vector autoregressive/variance-correction framework tested for cointegration. In most occasions, VAR models are reduced-form models without reference to a specific economic structure that depict preferences, technologies and optimizing behavior (Greifeng, Briggsmann, and Lohfetp, 2004).

2. With the exception of Ashraf and Hameed (2009), Chaudhuri (2001), and Babee (2007), the remains studies used data from January 2000 to the earliest such that observations span less than ten years. When Johansen cointegration tests are conducted with a log VAR model on a small number of annual observations, the conclusions are subject to over- or under-estimation due to the problem of size distortion (Zhou 2001; Haijsele and Rush 1991).

3. There is no consensus in the empirical evidence across studies. Some studies did not find co-integrating relations between crude oil and commodity prices (Campbell et al., 2007; Zang et Reek, 2006; Yu, Beesly and Fuller, 2008) while others found significant long-run relationships (Rappoportans and Kaldor, 2006; Acem, Nalny and Hutter, 2009; Chaudhuri, 2001; Ashraf and Hameed, 2009).

4. Whenever the effect of higher crude oil prices is assessed in most studies, the cointegration assumption is upheld. A problem with this maintained assumption is that in the same manner that global activity is influenced by the price of oil, oil prices are, in turn, driven by aggregate demand shocks so that the cause and effect is no longer well defined (Kilian, 2007). In this case, structural shocks need to be identified appropriately make use of the cointegration assumption.

OBJECTIVES

This study improves on the first feature of a lack of economic structure in VAR models employed so far, and on the second feature of short datasets, contributes to the growing empirical evidence in the third, and addresses the fourth issue by specifying structural vector autoregressive model (SVAR) model where structural equations for the errors (instead of the coefficients of the system are formulated guided by economic theory. SVAR allows us to disentangle shocks to the crude oil market according to supply- and demand-side to appropriately use the cointegration assumption. A longer span of data monthly observations from 1975 to 2009 is used.

STRUCTURAL VECTOR AUTOREGRESSION

Following Kilian and Park (2009), we adopt a SVAR model that relates U.S. commodity prices to measures of demand and supply shocks in the global crude oil market. Specifically, we estimate a SVAR model based on monthly data for the vector time series, 2, consisting of the change in global oil production, the change in the measure of real activity in global industry commodity markets, the change in the real price of crude oil, and the change in U.S. commodity prices. The structural representation of this model is

\[ A_2 \Delta z_t = \alpha + \sum_{i=1}^n \beta_i \Delta z_{t-i} + \epsilon_t, \]

where \( \epsilon_t \) denotes the vector of serially and mutually uncorrelated structural innovations. Let \( \alpha \) denote the reduced form VAR innovations such that, \( \epsilon_t = \gamma_t - \gamma_t^{-1} \beta \Delta z_{t-1} \). The structural innovations are defined from the reduced form innovations by imposing exclusion restrictions on \( \gamma_t \). The model implies an autoregressive structure on the contemporaneous relationship between the reduced-form disturbances and the underlying structural disturbances:

\[ e_t = \begin{bmatrix} e_{t-1} \\ e_{t-2} \\ e_{t-3} \\ e_{t-4} \\ e_{t-5} \\ e_{t-6} \\ e_{t-7} \\ e_{t-8} \\ e_{t-9} \\ e_{t-10} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & \gamma_{t-1} & \gamma_{t-2} & \gamma_{t-3} & \gamma_{t-4} & \gamma_{t-5} & \gamma_{t-6} & \gamma_{t-7} & \gamma_{t-8} & \gamma_{t-9} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} e_{t-1} \\ e_{t-2} \\ e_{t-3} \\ e_{t-4} \\ e_{t-5} \\ e_{t-6} \\ e_{t-7} \\ e_{t-8} \\ e_{t-9} \\ e_{t-10} \end{bmatrix} = \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & \gamma_{t-1} & \gamma_{t-2} & \gamma_{t-3} & \gamma_{t-4} & \gamma_{t-5} & \gamma_{t-6} & \gamma_{t-7} & \gamma_{t-8} & \gamma_{t-9} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} e_{t-1} \\ e_{t-2} \\ e_{t-3} \\ e_{t-4} \\ e_{t-5} \\ e_{t-6} \\ e_{t-7} \\ e_{t-8} \\ e_{t-9} \\ e_{t-10} \end{bmatrix} \]

Global crude oil production, global real activity and the real price of oil are predetermined with respect to U.S. commodity price. U.S. commodity price is allowed to respond to all these oil demand and supply shocks while does not affect global oil market at least within a given month. Shocks enter the equations successively so that the additional shock of the second equation does not affect the variable explained by the first equation in the same period. In the same manner, the third shock does not affect the variables explained by the first two equations in the current time period.

RESULTS: FORECAST ERROR VARIANCE DECOMPOSITIONS

<table>
<thead>
<tr>
<th>Month</th>
<th>Oil supply shock</th>
<th>Aggregate demand shock</th>
<th>Oil-specific demand shock</th>
<th>Other shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.94</td>
<td>0.59</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>2</td>
<td>0.93</td>
<td>0.81</td>
<td>0.93</td>
<td>0.93</td>
</tr>
<tr>
<td>3</td>
<td>0.92</td>
<td>0.80</td>
<td>0.92</td>
<td>0.92</td>
</tr>
<tr>
<td>4</td>
<td>0.91</td>
<td>0.79</td>
<td>0.91</td>
<td>0.91</td>
</tr>
<tr>
<td>5</td>
<td>0.90</td>
<td>0.79</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>6</td>
<td>0.90</td>
<td>0.79</td>
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<tr>
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<tr>
<td>10</td>
<td>0.90</td>
<td>0.79</td>
<td>0.90</td>
<td>0.90</td>
</tr>
</tbody>
</table>

RESULTS: IMPULSE RESPONSE FUNCTIONS

CONCLUSION

Using SVAR in differences, it apparent that monthly changes in cotton, soybeans, corn, and wheat prices are affected by unexpected increases in global oil demand driven by increased global real economic activity. However, oil supply shocks and precautionary oil demand shocks have no significant influence on commodity price movements. In general, shocks to global oil prices emanating from increased global activity can explain from 2.7 percent of the long-run variation in real commodity prices in the U.S. cotton market.