Volatility Spillover Effects and Cross Hedging in the U.S. Oil Market and the Energy Pipeline Sector Index

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Selected Poster prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, MA, July 31- Aug. 2

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Objectives

- Examine the mean and volatility spillover effects between the U.S. oil, overall stocks markets and the U.S. energy pipeline market.
- Study the impact of the liquidity crisis in the financial market on the volatility spillovers.
- Evaluate the new cross-hedging strategy to manage the risk on the oil market by including the Dow Jones U.S. Pipeline Index (DJUSPL).

Background

ENERGY PIPELINE INDUSTRY includes energy pipeline companies, which are the operators of pipelines carrying oil, gas or other forms of fuel for distribution instead of direct sales to end users that are not solely focused on production.

The energy pipeline industry plays an important role in the growth and stabilization of U.S. economy, which heavily depends on the oil (Elyasiani, Mansur, & Odusami, 2011).

The U.S. energy pipeline network assists the distribution of the energy to support the operation of other industries, to meet the basic needs of the consumers, and to reduce the impact of the energy price hikes. From 2004 to 2013 the energy pipeline mileage increased 15.4 percent, and the crude oil delivered by U.S. energy pipeline rose 19.4 percent.

Linkages between the U.S. energy pipeline industry and the U.S. economy and the oil market are interesting to investigate with recent, increased investment in the sub-sector pipeline industry.

Data


- The Dow Jones Industrial Average (DJIA) in points is denoted as \( DJIA \), and the returns is labeled as \( \Delta DJIA \).
- The S&P500 in points is denoted as \( DJUSPL \), and the returns is labeled as \( \Delta DJUSPL \).

U.S. oil market (WTI):

- The West Texas Intermediate (WTI) is denoted as \( WTI \), and the returns is labeled as \( \Delta WTI \).
- The U.S. pipeline market (DJUSPL):
  - DJUSPL is denoted as \( DJUSPL \), and the returns is labeled as \( \Delta DJUSPL \).

Model

U.S. Oil-Stock System

- Conditional Mean: VAR(2)

\[
\Delta WTI = \phi_{1, WTI} \Delta WTI_{t-1} + \phi_{2, WTI} \Delta WTI_{t-2} + \epsilon_{WTI,t}
\]

U.S. Energy Pipeline Market

- Conditional mean: AR(2)

\[
\Delta DJUSPL = \theta_{1, DJUSPL} \Delta DJUSPL_{t-1} + \theta_{2, DJUSPL} \Delta DJUSPL_{t-2} + \epsilon_{DJUSPL,t}
\]

Conditional Variance: BEKK-VGARCH(1,1)

\[
\begin{align*}
\Delta \sigma^2_{DJUSPL} &= \gamma_{1, DJUSPL} \Delta \sigma^2_{DJUSPL_{t-1}} + \gamma_{2, DJUSPL} \epsilon_{DJUSPL_{t-1}}^2 + \lambda_{1, DJUSPL} \epsilon_{DJUSPL_{t-1}}^2 \\
\Delta \sigma^2_{WTI} &= \gamma_{1, WTI} \Delta \sigma^2_{WTI_{t-1}} + \gamma_{2, WTI} \epsilon_{WTI_{t-1}}^2 + \lambda_{1, WTI} \epsilon_{WTI_{t-1}}^2
\end{align*}
\]

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\[
\begin{align*}
\sigma^2_{DJUSPL} &= \omega_{1, DJUSPL} + \lambda_{1, DJUSPL} \epsilon_{DJUSPL_{t-1}}^2 + \lambda_{2, DJUSPL} \epsilon_{DJUSPL_{t-2}}^2 + \gamma_{1, DJUSPL} \Delta \sigma^2_{DJUSPL_{t-1}} + \gamma_{2, DJUSPL} \epsilon_{DJUSPL_{t-1}}^2 \\
\sigma^2_{WTI} &= \omega_{1, WTI} + \lambda_{1, WTI} \epsilon_{WTI_{t-1}}^2 + \lambda_{2, WTI} \epsilon_{WTI_{t-2}}^2 + \gamma_{1, WTI} \Delta \sigma^2_{WTI_{t-1}} + \gamma_{2, WTI} \epsilon_{WTI_{t-1}}^2
\end{align*}
\]

Results

Constant Spillover and Event-dummy Spillover Models

<table>
<thead>
<tr>
<th>Spillover Coefficients</th>
<th>DJIA as Proxy</th>
<th>S&amp;P500 as Proxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta_{1, DJUSPL} )</td>
<td>0.04***</td>
<td>0.03***</td>
</tr>
<tr>
<td>( \theta_{2, DJUSPL} )</td>
<td>0.04***</td>
<td>0.04**</td>
</tr>
</tbody>
</table>

Event-dummy Spillover Model

<table>
<thead>
<tr>
<th>Spillover Coefficients</th>
<th>DJIA as Proxy</th>
<th>S&amp;P500 as Proxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta_{1, DJUSPL} )</td>
<td>-0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td>( \theta_{2, DJUSPL} )</td>
<td>-0.04</td>
<td>-0.13***</td>
</tr>
</tbody>
</table>

Volatility Spillover Model

| \( \psi_{DJUSPL} \) | 0.14*** | 0.12*** |
| \( \psi_{WTI} \) | 0.11*** | 0.12*** |

** ** ** Significant at the five and one percent level, respectively

P-LB-Q (30) indicates that there is no autocorrelation

References


Concluding Remarks

- Both WTI and DJIA/S&P500 have statistically significant volatility-spillover effect on DJUSPL.
- The raising illiquidity in the financial market is associated with the statistically significant increase in the volatility transmission from the U.S. oil and overall stock markets to the U.S. energy pipeline market.
- The new cross-hedging strategy for managing oil price risk using DJUSPL improves the performance of the oil-stock hedging strategy.