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Price Volatility and Spillovers in Food and Fuel Markets

Henry An
Department of Resource Economics & Environmental Sociology
University of Alberta
E-mail: henry.an@ualberta.ca

Feng Qiu
Department of Resource Economics & Environmental Sociology
University of Alberta
E-mail: feng.qiu@ualberta.ca

James Rude
Department of Resource Economics & Environmental Sociology
University of Alberta
E-mail: jrude@ualberta.ca

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Price Volatility and Spillovers in Food and Fuel Markets

Henry An, Feng Qiu and James Rude

Department of Resource Economics & Environmental Sociology, University of Alberta

UNIVERSITY OF ALBERTA
DEPARTMENT OF RESOURCE ECONOMICS AND ENVIRONMENTAL SOCIOLOGY

Motivation

- In recent years, prices of agricultural commodities have experienced major spikes and greater volatility.
- The growth of the biofuels market has led many researchers to examine the relationship between food and biofuel prices.
- Evidence suggests that there is a closer relationship between food and fuel prices, which can be attributed to U.S. biofuel policy.
- However, there have been comparatively few studies that have examined the extent to which price volatility is transmitted across different markets.
- In addition, no study as far as we know has investigated the effect of a binding blend wall on nature of the relationship.

- Our objective is to characterize the nature of price volatility spillovers between the corn, crude oil and ethanol markets across a time period that includes both a non-binding and binding blend mandate.

Background

- U.S. policy has played an important role in promoting the production of corn as the primary feedstock for ethanol.
- One of the key policy instruments has been the Renewable Fuel Standard (RFS), which mandates a minimum quantity of biofuel to be used each year.
- In November 2013, the Environmental Protection Agency (EPA) announced that the RFS was no longer tenable and that the blend wall had been reached.

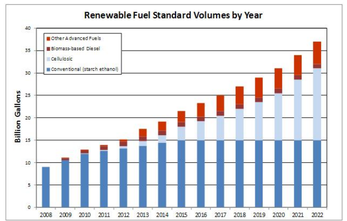

Figure 1. Renewable Fuel Standard mandates by year and fuel type, 2008-2022.
Source: www.afdc.energy.gov

Data

- We use weekly price data between October 2005 and December 2014 for corn, ethanol and crude oil.

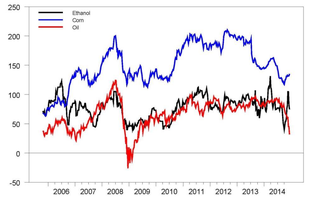

Figure 2. Weekly price series: ethanol, corn and crude oil, 2005-2014.
Note: $\text{price}_t = 100 * \ln P_t$.

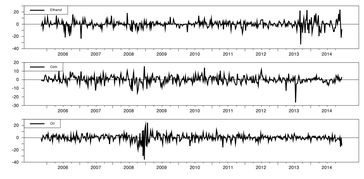

Figure 3. Weekly price variation series: ethanol, corn and crude oil, 2005-2014.
Note: $\Delta p_t = 100 * \ln\left(\frac{P_t}{P_{t-1}}\right)$

Methods

- Our empirical approach consists of three steps:

1. Identifying a long run price relationship;
2. Estimating a conditional means model that shows the relationship between price changes; and
3. Estimating a conditional variances model that shows the relationship between price volatilities.

- Step 1 involves conducting Johansen trace tests for cointegration among the three unique pairs.

- Steps 2 and 3 are estimated simultaneously using a *t*-BEKK model (Engle and Kroner, 1995), which has the form:

$$\Delta \log(P_t) = c_0 + \Sigma_{j=1}^{n} \theta_j \Delta \log(P_{t-j}) + \gamma ECT_{t-1} I_{cointeg} + \varepsilon_t$$

$$H_t = KK' + A'\varepsilon_{t-1}\varepsilon_{t-1}' + B'H_{t-1}B + C'\varepsilon_{t-1}^{*}\varepsilon_{t-1}^{*\prime}C$$

- Where $\varepsilon_t \sim (0, H_t)$, K is a lower triangular matrix; A, B and C are square matrices; and $\varepsilon_t^{*} = \min(\varepsilon_t, 0)$.

Results I

Cointegration results

- Only ethanol and crude oil prices are cointegrated.

- Ethanol price responds to the error correction term but crude oil price does not, which suggests that ethanol price follows the crude oil market but not vice versa.

- Ethanol and crude oil prices respond to corn prices.

Volatility for single markets

- Volatility persistency *B*(i,i): ethanol and oil are both very high and corn is relatively low.

- Vulnerability to market shocks *A*(i,i): ethanol is relatively high, other two are low.

- Asymmetric effects (i.e., impacts of negative market shocks on volatility *C*(i,i)): All three have large asymmetric effects. Corn *C*(2,2)> oil *C*(3,3)> ethanol *C*(1,1).

Results II

Market interdependency (dynamic correlations)

- Ethanol & corn: Strong in 2008/09, relatively constant from 2009 – mid 2013, and drop to zero since mid 2013.
- Ethanol & oil: Strong in 2009, and relatively weak other than that period.
- Corn & oil: Strong between 2008/09, drop to about zero since 2013.

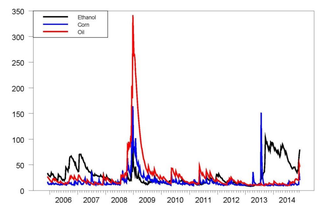

Figure 4. Conditional volatility results from *t*-BEKK model.

Spillover results

- Ethanol → corn : none
- Ethanol → crude oil: none
- Corn → ethanol: previous corn volatility affects current ethanol volatility
- Corn → crude oil: none
- Crude oil → corn: previous crude oil volatility and previous crude oil market shocks affect the corn market. Effects are asymmetric.
- Crude oil → ethanol: previous crude oil volatility and previous crude oil market shocks affect the ethanol market. Effects are asymmetric.

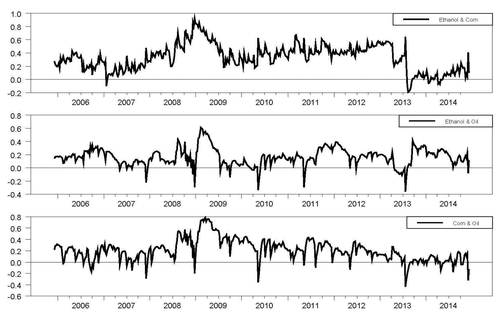

Figure 5. Dynamic conditional correlation results from *t*-BEKK model.

Conclusions

- We find similar results to existing studies regarding the nature of spillover effects between the corn and crude oil markets.

- Using a more recent dataset, the key result we find is the absence of a relationship between ethanol and corn and ethanol and crude oil. This is in contrast to the existing literature.

- We believe this result is due to the reaching of the blend wall mandate some time in late 2013.

- If the blend wall mandate continues to be met, this suggests that the close relationship between the ethanol and traditional food and fuel markets may be weakening.

Contact information:
Henry An: henry.an@ualberta.ca