

Energy and Agricultural Commodity Markets Interaction: An Analysis of Crude Oil, Natural Gas, Corn, Soybean, and Ethanol Prices[†]

Song-Zan Chiou-Wei, Sheng-Hung Chen,** and Zhen Zhu,****

Executive summary

This paper studies five energy and agricultural commodities: oil, natural gas, ethanol, corn, and soybean and these commodities are selected based on the linkages among them, utilizing the multivariate GARCH (MGARCH) approach to study the dynamics and cross-dynamics of price and price volatility for the period from 2005 to 2017. It is generally accepted that oil and gas are highly connected as they are both substitutable to a certain degree in technology. Among the five variables we consider, ethanol is the variable that connects the energy and commodity markets explicitly as ethanol is used as an alternative to traditional energy. We include corn and soybean in the system as ethanol can be extracted from corn as well as soybeans even though the extraction of ethanol from soybean is to a much lesser degree. The agricultural commodity markets can also be connected to the energy market through other links as oil and natural gas can be the energy used in the agricultural commodity production process.

We focus these interactions for separate markets – spot and futures. As spot market is more influenced by physical supply of and demand for the commodity, the differentiation of the impacts from both the spot and futures markets may be an indication that the financial (futures) markets may be impacted differently by the financialization than the spot market. Based on our empirical results, the price interactions are captured by the mean equation of the variables, and the volatility connections are measured by the conditional variance correlations. In modeling the volatility interaction, we estimate the time-varying or dynamic conditional correlation (DCC). The estimated conditional correlations from the DCC-MGARCH model are then examined further to study the patterns in the volatility interactions among the five commodities. In this process, we investigate specifically how energy price and price volatility stimulate price and price volatility in the corn and soybean markets. We also model directly how the ethanol price is intertwined in between the energy and agricultural commodities. Our approach would enable us to find whether the degree of interconnection across markets changes over time. Furthermore, to understand better the interactions between the markets, we control for the effects of several variables that have been cited to influence these commodities.

Our main contributions are several folds. First, past studies mostly focused on a smaller set of commodities (mostly oil and gas or oil, ethanol, and corn). We include a more comprehensive list of relevant commodities. Our study covers oil, natural gas, and ethanol along with corn and soybean. Our study also directly measures the possible influence of some exogenous variables such as exchange rate, interest rate, inventory, and economic activity. Directly controlling for the effects of these variables would enable us to see how the commodity prices can be influenced by these economic variables. In addition, it would enable us to better understand the interaction of the commodities after we account for the influence of these exogenous variables. Thirdly, we also model our systems using spot and futures prices. Even though we will not be able to detect the “feedback effect” of the futures market on the spot market directly, our study would enable us to compare the results obtained from the futures market and spot market and detect any significant differences. Fourth, our study provides a direct measure of time-varying volatility connections among the commodity price variables. These connections would reflect better connections among commodities since we control for the impact of some common economic variables.

Keywords: Volatility Spillover; Commodity Markets Connections; Oil and Gas Prices; Ethanol; Corn, and Soy Bean Prices; Ethanol Policy; DCC-MGARCH.

JEL Codes: C32; C58; Q13; Q40

[†] We would like to thank three anonymous referees for valuable comments and suggestions which substantially improved the quality of the paper. Zhen Zhu would like to acknowledge the support from Dr. Michael Metzger Foundation.

* Corresponding author. Professor, Department of International Business, National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan. E-mail: chiouwei@nkust.edu.tw.

** Associate Professor, Department of International Business, National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan. E-mail: shchenib@nkust.edu.tw.

*** Professor, Department of Economics, University of Central Oklahoma, Oklahoma, USA. E-mail: zzhu@uco.edu.