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# Are the S&P 500 Index and Crude Oil, Natural Gas and Ethanol Futures Related for Intra-Day Data?

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## Abstract

The energy sector is one of the most important in the world, so that time series fluctuations in leading energy sources have been analysed widely. As the leading energy commodities are traded on international stock exchanges, the analysis of the fluctuations in stock and financial derivatives prices and returns have also been investigated extensively in recent years. Much of the empirical analysis has concentrated on using daily, weekly or monthly data, with little research based on intra-day data. The paper analyses the relationships among the S&P 500 Index and futures prices, returns and volatility of three leading energy commodities, namely crude oil, natural gas and ethanol, using intra-day data. The detailed analysis of intra-day temporal aggregation in examining returns relationships and volatility spillovers across the equity and energy futures markets, and the effects of overnight returns, volume, realized volatility, asymmetry, and spillovers across the four financial markets, leads to interesting and useful results for decision making and hedging strategies. The empirical results relating to alternative models of mean and variance feedback and asymmetry for intra-daily returns, asymmetry and volatility spillovers, and dynamic conditional correlations and covariances, show that the relationships between the stock market and alternative energy financial derivatives, specifically futures prices and returns, can and do vary according to the trading range, whether daily or overnight effects are considered, and the temporal aggregation and time frequencies that are used.

## Keywords

Trading range, Intra-day prices and returns, S&P 500 Index, Crude oil futures, Natural gas futures, Ethanol futures, Overnight returns, Overnight volume, Overnight realized volatility, Asymmetry, Spillovers.

## JL Classification

C22, C32, C58, G12, G15.

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