Asymmetric Volatility in Commodity Markets

Xiaoyi Mu, University of Dundee, x.mu@dundee.ac.uk

Overview

It is well-documented in the finance literature that the volatility in equity markets is asymmetric in the sense that the conditional volatility of equity returns increases as the equity price decreases. This is called the "leverage effect" because as the stock price decreases firms' leverage (debt to equity ratio) naturally increases. Surprisingly, there are few studies of the price-volatility relationship in commodity markets. This paper fills in the gap in the literature by studying a range of commodities including energy, agriculture, industrial and precious metals.

We develop a simple commodity price model and show that the volatility of price changes can be positively or negatively related to demand shocks depending on the demand and supply elasticities. We empirically examine the behaviour of volatility using both time-series conditional volatility models and historical volatility measures for a range of commodities including agricultural products, energy, industrial metals and precious metals. An "inverse leverage effect" – the conditional volatility is higher following a positive shock -- is found in about half of the daily spot price series. The effect becomes more prevalent when jumps were modelled, but largely disappears in 3-month futures market. Only crude oil is found to exhibit a "leverage effect" – a higher volatility follows a negative shock. The reason why crude oil behave differently is explained in the context of its special market structure.

Methods

Time-series Garch model and historical volatility measures based on econometric estimation.

Results

There are two major findings in this paper. First, we develop a commodity price volatility framework in which the equilibrium price is determined by a stochastic demand and an upward sloping cost curve. We show that the volatility of price changes can be positively or negatively related to demand shocks depending on the demand and supply elasticities. This model of volatility is more general compared to earlier models of commodity volatility which often rely on storage or constrained to a particular sector.

Second, we empirically document the pattern of asymmetric volatility using both time-series techniques and monthly historical volatility measures. Employing asymmetric GARCH models, we find a statistically significant "inverse leverage effect" – the volatility is higher following a positive return shock – in more than half of the spot price series. The effect is more pronounced when jumps were accounted for, but largely disappear in 3-month futures. Only crude oil is found to have a "leverage effect" – the volatility is higher following a negative return shock. Both results could be consistent our theoretical predictions. The historical volatility measures based on monthly standard deviations of daily returns also broadly conforms to the time series results.

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