

On the links between stock and commodity markets' volatility

Anna Creti¹ Marc Joëts² Valérie Mignon³

¹U. Paris Dauphine, LeDA-CGMP, CEEM&Ecole Polytechnique ²IPAG Business School

³Université Paris Ouest Nanterre la Défense, EconomiX

May 15th 2014, Seminar PSL Research un Energy Economics

The context: "financialization" of commodities (I)

- Financialization: a situation in which the price of an individual commodity is not only determined by its primary supply and demand, but also by several financial factors and investors' behavior in derivative markets.
- Since early 2000s, commodity futures are a popular asset class.
 - the total value of various commodity index-related instruments purchased by institutional investors increased from \$15 billion in 2003 to at least \$200 billion in mid-2008 (Commodity Futures Trading Commission, 2008);
 - index investment as form of financial speculation might have caused unwarranted increases in the cost of energy and food and excessive price volatility (Barone, 2008).
 - speculative buying by financial players in commodity futures and over-the-counter (OTC) derivatives markets created a "commodity bubble", with commodity prices above fundamental values (Masters, White, 2008).



The context: "financialization" of commodities (II)

Return behavior: stock market vs commodity market index

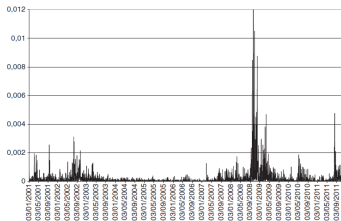


Fig. 1. S&P 500 stock returns volatility (01/03/2001-11/28/2011).

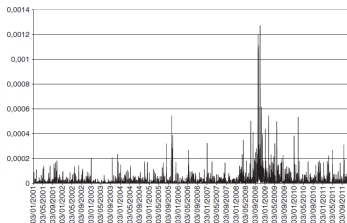


Fig. 2. Commodity price returns volatility (01/03/2001-11/28/2011).

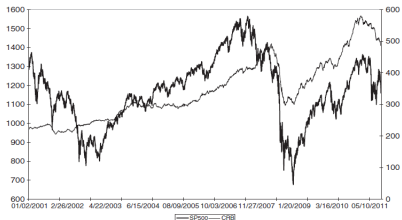


Fig. 3. Evolution of S&P 500 and CRB indexes (01/03/2001-11/28/2011).

Main results

- We look at the dynamics of the correlations between commodity and stock markets, and analyze whether those correlations evolve according to the situation, bullish or bearish, in the stock market.
 - with particular attention to the financial crisis and to energy commodities
- Methodology: dynamic conditional correlation (DCC) GARCH approach introduced by Engle (2002)
- Results: in our panel of 25 commodities over the period from January 2001 to November 2011:
 - the correlations between commodity and stock returns evolve through time, being highly volatile, particularly since the 2007–2008 crisis;
 - some commodities are characterized by a speculation phenomenon, especially oil, coffee and cocoa;
 - the safe-haven role of gold is evidenced, as its correlations with stock returns are mostly negative and diminish in times of declining stock prices;
 - commodities cannot be considered as a homogeneous asset class.

Outline of the presentation

- The model
 - related literature; statistical properties; DCC-GARCH
- Results on different commodity markets
- An aside on financialization:
 - ...in the aftermath of our paper
 - ...in the institutional debate
- Conclusion: room for regulation?



The model and related literature

- Financialization has been studied by focusing on oil (comovements between stock and oil markets)
 - negative relationship between oil price and stock market returns (Filiset al. 2011).
 - techniques: cointegration, VAR, ARCH-type models and volatility transmission
- We follow the dynamic conditional correlation DCC GARCH to assess the changes in correlations between commodity and stock returns over time.
 - similar to Choi and Hammoudeh (2010) but with a considerably larger sample and over a longer period.
 - 25 different commodities covering the following various sectors: energy, precious metals, agricultural, non-ferrous metals, food, oleaginous, exotic and livestock;
 - an aggregate commodity price index, the Commodity Research Bureau (CRB) index and the S&P 500 index.

- Analysis of returns series, defined as $r_t = \ln(P_t/P_{t-1})$, where P_t denotes the price index at time t :
 - the variance of electricity, gas and to a lesser extent oil price returns is higher than that obtained for the other commodities (Pindyck, 2004) being also higher than those of S&P 500 and CRB returns;
 - the electricity series is extremely volatile, as its high kurtosis value shows.
 - the group of energy commodities exhibits low returns on average, leading to the lowest benefit-risk trade off compared to the S&P 500 and the CRB indexes,
 - the group of food and oleaginous commodities are very profitable on the return-risk basis.
 - all series are characterized by a time-varying volatility (ARCH effect)
 - returns tend to be autocorrelated, especially for the energy and the precious metals groups, indicating some persistence phenomenon.

- Let r_t be the vector composed of two returns series, $r_t = (r_{1t}, r_{2t})'$. Denoting by $A(L)$ the lag polynomial, we have $A(L)r_t = \mu + e_t$, where e_t is the error-term vector.
- The DCC model is based on the hypothesis that the conditional returns are normally distributed with zero mean and conditional covariance matrix $H_t = E \left[r_t r_t' | I_{t-1} \right]$. The covariance matrix is expressed as follows:

$$H_t = D_t R_t D_t$$

where $D_t = \text{diag} \left[\sqrt{h_{1t}}, \sqrt{h_{2t}} \right]$ is a diagonal matrix of time-varying standard deviations issued from the estimation of univariate GARCH(1,1) processes $h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$ and R_t is the conditional correlation matrix of the standardized returns ε_t , with $\varepsilon_t = D_t^{-1} r_t$

- The matrix R_t is decomposed into:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1}$$

where Q_t is the positive definite matrix containing the conditional variances-covariances of ε_t , and Q_t^{*-1} is the inverted diagonal matrix with the square root of the diagonal elements of Q_t :

$$Q_t^{*-1} = \begin{bmatrix} 1/\sqrt{q_{11t}} & 0 \\ 0 & 1/\sqrt{q_{22t}} \end{bmatrix}$$

- The DCC(1,1) model is then given by:

$$Q_t = \omega + \alpha \varepsilon_{t-1} \varepsilon'_{t-1} + \beta Q_{t-1}$$

where $\omega = (1 - \alpha - \beta) \bar{Q}$.

- Dynamic conditional correlations:

$$\rho_{12t} = \frac{q_{12t}}{\sqrt{q_{11t} q_{22t}}}$$

- Estimation: two-step maximum likelihood.

Results(I) Dynamic conditional correlations

Common trends

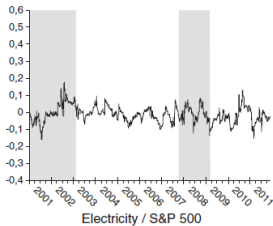
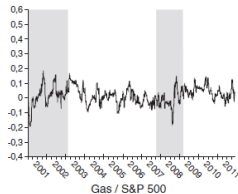
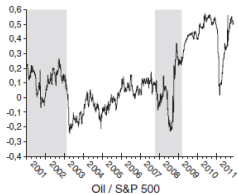
- Investment in equities constitutes an alternative to commodities, providing a mechanism for substitution between asset classes
 - correlations are highly volatile throughout the period, especially during the financial crisis
- The stock market collapse has loosened the conditional links between stock and commodity price returns, but only in the very short run.
 - flight-to-quality phenomenon: when risk market rises, the benefits of diversification are most appreciated and investors tend to choose commodities as refuge instruments (Silvennoinen and Thorp, 2010; Chong and Miffre, 2010).

Results (II) The energy commodities

- Oil is the commodity the most related to the stock market (Jones and Kaul, 1996; Hammoudeh et al., 2004; Filis et al., 2011).
 - in times of rising stock prices, the correlations between stock and oil markets increase. During periods of declining stock prices, correlations tend to decrease and become negative during the 2007-2008 crisis.
 - due to "speculation", oil cannot be seen as a means of portfolio diversification.
- Gas and electricity:
 - correlations tend to increase at the beginning of the period under study and then remain relatively stable
 - correlations are often negative between stock and electricity markets, putting forward that the behavior of the electricity market is mainly driven by its own market fundamentals

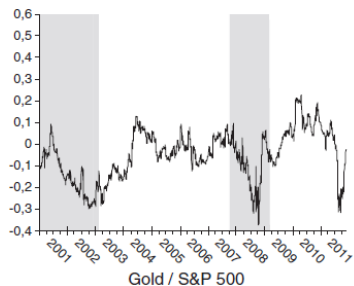
Results (II) The energy commodities: graphs

Grey band: periods of bearish stock market; white stripes: periods of bullish stock market



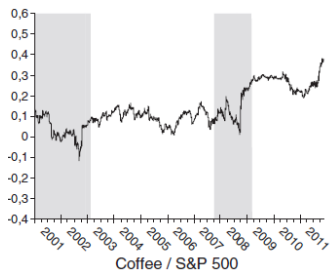
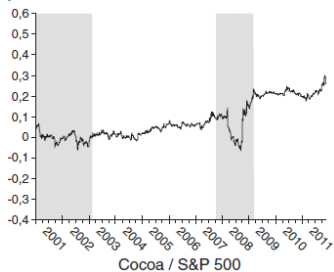
Results (II) Precious Metals:graphs

Gold as a safe haven



Results (III) Exotic commodities:graphs

Speculation for coffee and cocoa



An aside on financialization

...in the aftermath of our paper (I)

Insights from the papers that cite ours

- El Haouri et al (2013): nine energy and precious metal markets; tests for short- and long-run efficiency using linear and nonlinear models. The authors show that futures prices are not unbiased predictors of future spot prices, but the hypothesis of risk neutrality is rejected.
- Laihani et al. (2013): existence of substantial volatility spillover linkages between agricultural commodity returns and their volatilities.

An aside on financialization

...in the aftermath of our paper

Insights from the papers that cite ours (II)

- Ferrara et al. (2014): mixing daily financial volatilities and monthly industrial production is useful at the time of predicting gross domestic product growth over the Great Recession period.
- Sadorsky (2014): volatility effect of emerging markets stock prices, copper prices, oil prices and wheat prices; leverage effects detected for oil; correlations between these assets increased considerably after 2008.
- Mensi et al. (2014): return and volatility spillovers across international energy and cereal commodity markets; evidence of significant linkages between the energy and cereal markets; OPEC announcements exert influence on the energy markets as well as on the energy–cereal links.

An aside on financialization

...in the institutional debate

Topics under discussion

- Changing structure of commodity markets by different types of participants: commercial and non-commercial (U.S. Commodity Futures Trading Commission, 2011).
- Role of speculation: impact of short-term volatility.
- Link with prices of non-energy commodities and oil prices: trend significantly more pronounced for the S&P GSCI and the DJ-UBSCI.
- Financialization has had a damaging impact on the price discovery and on risk management activities conducted by commercial actors on futures markets (UNCTAD, 2012)
- Monetary policy reacting to price pressure stemming from rising commodity prices points to a worrying aspect of the impact of financialization that has so far been underestimated.

- Is there room for regulation?
 - as a measure of last resort to avert or deflate speculative bubbles, market authorities in charge of surveillance could be mandated to intervene directly in exchange trading on an occasional basis by buying or selling derivatives contracts.
 - tighter restrictions on financial participants of commodity markets
 - public disclosure of harmonised position information in commodities markets

Thank you!