## On the links between stock and commodity markets

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# 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).



Do financial investors have affected commodity prices?

- Yes, the bubble view: commodity index investors had caused a gigantic bubble in energy and agricultural commodities in 2007-2008 (Masters, 2008; US Senate Report, 2009; Kennedy, 2012).
- Yes, the asset view: emergence of commodities as an asset class, which has become widely held by institutional investors seeking diversification benefits (Buyuksahin and Robe, 2012; Singleton, 2014).
- No, the business-as-usual view: there was no bubble and thus no problem (Krugman, 2008; Stoll and Whaley, 2010; Irwin and Sanders, 2012; Fattouh, Kilian and Mahadeva, 2012).

### Some empirical evidence

#### 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).

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Still few attempts to understand financialization from a theoretical point of view

- Cheng-Xiong (2014)
- Excessive focus on speculative storage as the only channel for futures markets speculation to affect commodity markets
  - Spread between futures and spot prices acts as the incentive for speculative storage (Routledge et al. 2001; Alquist and Kilian, 2010)
  - Speculation is often defined by anyone buying crude oil not for current consumption, but for future sale or use.
    - Based on this definition, Kilian and Murphy (2013), Juvenal and Petrella (2012), Knittel and Pindyck (2013) find that the WTI price boom was not accompanied by inventory spike (i.e. intensified speculative activity)

# Does theory matter? (II)

#### Other channels:

- Informational channel
  - Difficult for market participants to separate demand shocks, supply shocks, and financial market shocks.
  - High futures prices signal stronger economy, leading to larger commodity demand.
  - Futures market trading can affect prices without driving up inventory in short run.
- Risk sharing channel
  - Investment inflow to futures markets mitigates hedging pressure, but also brings in their own stress.
  - Helps explain the largely increased price volatility during crises.

# Does theory matter? (III)

- Basak-Pavolova (2014) explore the effects of financialization in a model that features institutional investors alongside traditional futures markets participants.
- The institutional investors care about their performance relative to a commodity index.
- Main results:
  - in the presence of institutional investors prices and volatilities of all commodity futures go up, but more so for the index futures than for nonindex ones.
  - the correlations amongst commodity futures as well as in equity-commodity correlations also increase, with higher increases for index commodities.
  - within a framework additionally incorporating storage, commodity spot prices and inventories go up with financialization.
  - in the presence of institutional investors shocks to any index commodity spill over to all storable commodity prices and inventories.

- Commodities and Stock Markets
  - Creti, Joëts, Mignon (2013): US markets; volatility analysis
- Oil and Stock Markets
  - Creti, Guesmi, Ftiti (2014): oil-importers and oil-exporters countries; multivariate (cospectral) analysis
- An aside on financialization:
  - ...in the aftermath of our papers
  - ...in the institutional debate
- Conclusion: room for regulation?



## Commodities and Stock Markets: 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.

- 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.

## Statistical properties

- 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  $D_t = diag \left[ \sqrt{h_{1t}}, \sqrt{h_{2t}} \right]$  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  $\varepsilon_t$ , 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  $\varepsilon_t$ , and  $Q_t^{*-1}$  is the inverted diagonal matrix with the square root of the diagonal elements of  $Q_t$ :

$$Q_t^{*-1} = \left[ egin{array}{cc} 1/\sqrt{q_{11t}} & 0 \ 0 & 1/\sqrt{q_{22t}} \end{array} 
ight]$$

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

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

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

• Dynamic conditional correlations:

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

Estimation: two-step maximum likelihood.

- 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 (IIa) 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.
    - "Speculation": a situation in which investors (i) engage in transactions to profit from short-term fluctuations in the market value of an asset/product, and (ii) focus only on price movements rather than on fundamentals.
    - Empirical measure: increasing correlations with stock prices in times of rising oil prices, and decreasing-and even negative-correlations during periods of declining stock prices.

- 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 (IIc) The energy commodities: graphs

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



# Results (III) Precious Metals

#### Gold as a safe heaven



GUIU / 30F 500

## Results (III) Exotic commodities:graphs





• Oil price can impact stock markets trough several channels :

- ~ oil prices ⇒ increase interest rate to limit inflationary pressure
   ⇒ increase the cost of doing business ⇒ increase output prices thus
   decreasing profits (Jones et al., 2004 and Kilian and Park, 2009)
- High interest rates also make bond investments more attractive than stock ones (Chittedi, 2012)
- These effects generally trigger a negative relationship between oil and stock markets (Hamilton, 1996 and 2005)
- Oil financialization has been studied by using several techniques: cointegration, VAR, ARCH-type models and volatility transmission

# Frequency Analysis (co-spectral analysis: Priestley and Tong, 1973)

- Why the frequency domain and not the time domain?
  - it does not depend on any particular detrending technique.
  - we do not have an "'end-point problem"' : no future information is used, implied or required as in band-pass or trend projection methods.
  - this approach can be applied to stationary or non-stationary processes and gives informations about the nature of interdependance: short-run (10 months) and medium-run (3y and one quarter).
  - we also apply cointegration for long-run (time series) relationships

- We use monthly data for oil prices and stock market indices.
- The sample consists of oil-importing (US, Italy, Germany, the Netherlands and France) and exporting countries (United Arab Emirates, Kuwait, Saudi Arabia and Venezuela).
- The data range from 03/09/2000 to 03/12/2010.

- Oil price shocks in periods of world turmoil or during fluctuations of the global business cycle (downturn or expansion) have a significant impact on the relationship between oil and stock market prices, both in oil-importing and oil-exporting countries.
  - In exporting countries, our analysis unveils higher and multiple peaks that coincide with important events, such as the oil price crisis that occurred in 2008.
  - In the case of importing countries, the pattern of interaction is clearly smoothed.

- All the oil price shocks originating from OPEC's production cuts, hurricanes, etc. do not have a significant impact on the coherence between oil and stock markets in importing countries.
- The interdependency between oil and stock markets is not very strong in the 10-month horizon, but it is more clearly apparent in the medium-term.
  - In the short term, the average interdependence does not exceed 10%, while in the medium-term, on average, it exceeds 40%.
- The cointegration analysis shows that the long-term relationship is significant for all studied importing countries and non-significant for some cases of exporting countries.
  - The long-term and medium-term relationships display similar patterns.

#### Results: selected oil importing countries



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#### Results: selected oil exporting countries



Financialization

#### 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. *Futures prices are not unbiased predictors of 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.
- 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.

Insights from the papers that cite ours (II)

- 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.
- Olson et al (2014): from volatility impulse response functions, the authors find that *low S&P 500 returns cause substantial increases in the volatility of the energy index*; weak response from S&P 500 volatility to energy price shocks.
- Blot et al. (2015): by using simple correlations, VAR and Dynamic Conditional Correlation, the authors find *no evidence that price stability* (CPI index) is positively correlated to financial stability (financial stress index); the time-varying approach indicates that the relationship is unstable.

#### 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 and price forecasting
- Link with prices of non-energy commodities and oil prices: trend significantly more pronounced for the S&P Goldman Sachs CI and the Dow Jones-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!

- Energy Policy, forthcoming in April
  - "Energy Markets' Financialization, Risk Spillovers, and Pricing Models"
- Energy Economics: call for contributions as from April 28th
  - "Energy, Commodities and Geopolitics: Modelling Issues"