



Commodity and equity markets: Some stylized facts from a copula approach



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ABSTRACT

In this paper, we propose to identify the dependence structure that exists between returns on equity and commodity futures and its development over the past 20 years. The key point is that we do not impose any dependence structure, but let the data select it. To do so, we model the dependence between commodity (metal, agriculture and energy) and stock markets using a flexible approach that allows us to investigate whether the co-movement is: (i) symmetrical and frequent, (ii) (a) symmetrical and mostly present during extreme events and (iii) asymmetrical and mostly present during extreme events. We also allow for this dependence to be time-varying from January 1990 to February 2012. Our analysis uncovers three major stylized facts. First, we find that the dependence between commodity and stock markets is time-varying, symmetrical and occurs most of the time (as opposed to mostly during extreme events). Second, not allowing for time-varying parameters in the dependence distribution generates a bias towards an evidence of tail dependence. Similarly, considering only tail dependence may lead to false evidence of asymmetry. Third, a growing co-movement between industrial metals and equity markets is identified as early as 2003; this co-movement spreads to all commodity classes and becomes unambiguously stronger with the global financial crisis after Fall 2008.

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1. Introduction

After almost 30 years of low and moderately fluctuating prices, non-oil commodity prices have grown threefold since 2000. The dramatic price spike has attracted the regulators' attention because it has been contemporaneous to a massive arrival of financial investors seeking to diversify their portfolio. The number of futures and options contracts outstanding on commodity exchanges increased fivefold between 2003 and 2012, and physical hedgers, which represented almost 80% of positions in commodity futures markets in 1998, accounted for less than 30% in 2012, according to the Commodity Futures Trading Commission (CFTC). Have these developments affected the behavior of commodity returns? In particular, what can we say about the cross-market linkages between traditional assets and commodities since the 2000s? Does the diversification argument still hold?

Theory predicts no common factor driving equity and commodity markets, an argument in favor of diversification benefits of commodity futures. Gorton and Rouwenhorst (2006) examined

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the relationship between equity and commodity assets over the period 1959–2004. They found that commodity futures contracts have the same average returns as equities along with a negative correlation between bonds and equities, and present less volatile returns. Chong and Miffre (2010) and Hong and Yogo (2009) reached similar conclusions over a more recent period and found an asymmetric dependence: the negative correlation is different in bearish and bullish markets (see also Buyuksahin et al. (2010), Kat and Oomen (2007), and Erb and Harvey (2006)). However, more recently, Büyüksahin and Robe (2011), Daskalaki and Skiadopoulos (2011), Silvennoinen and Thorp (2010), and Tang and Xiong (2010), among others, have found evidence of integration among traditional and commodity markets.

A possible explanation for this lack of consensus is the different dependence measures considered. While it is now well-documented that asset classes are not normally distributed (Erb et al., 1994; Longin and Solnik, 2001), still very few empirical studies on commodities challenge the correlation coefficient as a measure of the dependence structure between two returns. In addition empirical studies usually impose time-stability in the timed relationship. We find these assumptions unrealistic.

To relax both assumptions, we propose an alternative copula approach that provides a measure of financial market co-move-

ments addressing the limits raised above. First, it disentangles the characteristics of each return series from the dependence structure that links them together. This approach allows for a wide range of models that capture different types of dependence between variables, such as tail and asymmetrical dependence. Second, it does not require elliptically distributed returns. Third, the dependence captured by a copula is invariant with respect to increasing and continuous transformations in the marginal distributions, i.e. the copula does not change with returns or log returns. To our knowledge, no academic work uses copula to model the co-movement between commodities and traditional assets.²

In this paper, we propose to identify the dependence structure that exists between the returns on equity and commodity futures over the past 20 years. The key point is that we adopt a totally agnostic approach, letting the data select the dependence structure. Clearly, we rely on Patton's (2006) extension of Sklar's (1959) theorem to the conditional case and his parametric model on the development of the copula. That is, we consider three types of dependence structures ((i) symmetrical and frequent, (ii) (a) symmetrical or asymmetrical and mostly present during extreme events and (iii) mostly present during extreme and negative events, i.e. asymmetrical) and allow the strength of the relationship to be constant and time-varying within each structure. Finally, we retain the two most likely types of dependence out of the six considered.

As half of the exposure to commodity price movements is based on commodity index investment, we first investigate the dependence between the total returns of the two most popular commodity indices and their sub-indices (the Goldman Sachs Commodity Index (SP-GSCI) and the Dow-Jones UBS Commodity Index (DJ-UBS)) and four major equity indices (SP500, FTSE100, CAC40, DAX30).³ Second, we account for the heterogeneity among commodities by focusing on a sample of individual commodity futures covering the agricultural, industrial metals and energy markets. We study daily data over the period January 1990–February 2012.

Our analysis uncovers three stylized facts. First, we find that the dependence between commodity and stock markets is time varying, symmetrical and is present most of the time (as opposed to mostly in extreme events). This result holds for the indices as well as for the 21 commodities under investigation. This result leads to the second stylized fact: not allowing for time-varying parameters in the dependence distribution generates a bias towards an evidence of tail-dependence. Similarly, considering only tail-dependence may falsely lead to evidence of an asymmetrical relation between the returns. Finally, the last stylized fact highlights the impact of the 2008 crisis: the time-varying parameter shows that the co-movement between commodity and asset markets becomes stronger from September 2008 with the bankruptcy of Lehman Brothers and the strengthening of the financial crisis.

This paper is organized as follows. Section 1 presents the main results in the recent empirical literature on co-movements between commodity and traditional asset markets. Section 2 focuses on presenting the concept of copulas and the different models considered, while Section 3 describes the data and discusses the results. Section 4 concludes.

2. A brief literature review on co-movement

Most questions raised in the empirical literature dealing with commodities and traditional assets focus on the diversification benefits of commodities: are these asset markets related to each other? What is the sign of the relationship? How does the relationship evolve over time? Is the relationship symmetrical? Is there tail-dependence? Answers vary substantially.

Gorton and Rouwenhorst (2006) are among the first to produce some stylized facts to characterize commodity futures after the 2000s. They construct an index of commodity futures covering the period between July 1959 and December 2004. During their sample period, the standard deviation of commodity futures returns is lower than that of stocks and bond returns. The distribution of their commodity index returns is positively skewed contrary to equity returns. They uncover two patterns suggesting that commodities provide positive diversification benefits. First, they find a negative correlation between stocks and commodity returns, as well as bonds and commodity returns. Second, they emphasize asymmetrical dependence between equity and commodity markets: commodity futures earn above average returns while equity earn below average returns.⁴ The benefits of diversification have been confirmed by several authors since then, a benefit relying on negative correlation and asymmetrical dependence. In particular, Chong and Miffre (2010) find that correlations between equities and commodities fall over time and tend to fall in turbulent periods, an asymmetrical pattern attributed to investors' flight-to-quality strategy (see also Kat and Oomen (2007)).

However, more recent studies tend to contradict these findings. For example, Silvennoinen and Thorp (2010) report time-varying correlations between commodity futures and stock markets that increase in volatile markets. They show that a higher proportion of non-commercial traders raises the correlations with stock and oil markets. A few more studies find that the diversification benefits work until 2008 only. On the one hand, Büyüksahin and Robe (2011) find that the co-movement between equities and commodities did not increase until 2008, providing substantial diversification opportunities. However, they show a positive correlation between returns after Fall 2008. On the other hand, Daskalaki and Skiadopoulos (2011) show that including commodity indices in investor's portfolio yield significant diversification benefits during the 2005–2008 commodity boom period, a benefit that dramatically vanishes after 2008 (see also Bichetti and Maystre (2012)). Lastly, Tang and Xiong (2010) uncover a growing dependence between commodity futures markets: they report an increase in the correlations between the returns of different commodity futures, starting in the 2000s. In particular, they show that this trend is significantly more pronounced for commodities in the two popular SP-GSCI and DJ-UBS commodity indices, a result attributed to the growing importance of index trading.

Overall, there is a lack of consensus in the literature on the arrival of financial investors on commodity markets: while many emphasize the asymmetrical aspect of the co-movement between commodities and equities, there is no consensus on the timing of the strengthening of that relation. One possible explanation is the different dependence measures considered and the fact that strong hypotheses are imposed regarding the joint distribution of the series. In the next section, we present an alternative that circumvent these limitations.

² Studies that use copula to model the dependence structure across financial markets include Ning (2010), Chollete et al. (2011), and Desmoulin-Lebeault and Kharoubi (2012), among others.

³ Commodity indices are weighted averages of selected commodity prices, based on future prices.

⁴ The robustness of these results has been questioned by Smith (2006) who argues that Gorton and Rouwenhorst's index is equally-weighted and rebalanced, and hence bears no resemblance to any existing index, a fact that most probably influences its performance.

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