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Investigating the leverage effect in commodity markets with a recursive estimation approach

Julien Chevallier[a,*], Florian Ielpo[b]

[a] IPAG Business School, IPAG Lab, 184 Boulevard Saint-Germain, 75006 Paris, France
[b] Lombard Odier Asset Management, and University Paris 1 (CES), France

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ABSTRACT

This paper investigates the presence of the leverage effect in commodities, in comparison with financial markets. The EGARCH model with a Mixture of Normals distribution (EGARCH-MN) is used to capture (i) heavy tails and skewness in the conditional returns, and (ii) leverage effects and time-varying long-term component in the volatility specification. Besides, the estimation strategy relies on an innovative recursive (REC) method, which allows disentangling the leverage effect from the unconditional skewness as an empirical result. When applied to a broadly diversified dataset of assets during 1995–2012, the EGARCH-MN models offers state-of-the-art specifications with leverage and fat-tailed skewed densities, that allow to contrast the specific characteristics of commodities with traditional assets (equities, bonds, FX).

1. Introduction

Three characteristics that are often exhibited by financial returns are leverage (i.e. volatility asymmetry), conditional fat-tailedness (i.e. the standardized conditional return is more fat-tailed than the Gaussian), and conditional skewness (i.e. the standardized return is not symmetric). For stock returns, the skewness is typically negative, which means the probability of a large negative return is

* Corresponding author. Tel.: +33 0149407386; fax: +33 0149407255.
E-mail addresses: julien.chevallier04@univ-paris8.fr (J. Chevallier), florian.ielpo@ensae.org (F. Ielpo).

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greater than a large positive return, even after controlling or adjusting for the recent level of volatility. This paper extends the scope of investigation of these stylized facts to the sphere of commodities. Asset managers pay increasing attention to the nature and persistence of returns on commodities, against the wider background of market interdependencies in the aftermath of the 2008 financial crisis. One of the first attempts to bring together cross asset conclusions regarding commodities can be found in Kat and Oomen (2007a,b). Investigating dozens of commodities over the period 1965–2005, they reach the following empirical findings. First of all – and consistently with the results of Erb and Harvey (2006) – individual commodities do not provide investors with a risk premium on average. This conclusion has to be differentiated from the basket of commodities case: Gorton and Rouwenhorst (2005) show how such a risk premium is associated to a basket of equally-weighted commodities by using the Commodity Research Bureau dataset covering the 1959–2005 period and including thirty six commodities.

Second, the persistence in commodities is found to be important: a positive or a negative shock to commodity prices has usually long lasting effects, unlike equities and bonds. This is an essential feature for trend-following investment strategies. Third, the volatility of commodities is not found to be excessive when compared to the volatility of equities over the period under consideration. Fourth, there is a limited asymmetry of returns in their dataset: the skewness of commodity returns is usually found to be close to zero. One key property of commodities is the frequency at which extreme events occur. Kurtosis being a natural way to measuring such a tail event activity, there exists excess kurtosis for most of commodity markets.

More recently, by using various kinds of continuous-time models encompassing time-varying volatility and jumps in the returns and volatility dynamics, Brooks and Prokopczuk (2013) studied in a more quantitative way the law of motion of commodities' returns. Their empirical findings show that jumps are an essential building block to the underlying data-generating process of such markets. The frequency of appearance and the size of the jumps in returns are found to be very different from one market to another. Finally, the correlation between returns and their volatility is found to a have a sign that is specific to each market: for example, a large negative return in the crude oil price should trigger a surge in its volatility that is larger than in the case of a similar but positive return. Such a pattern does not hold in the case of gold, silver and soybean.

Two additional aspects need to be mentioned here. First, as for any financial market, commodity markets are affected by time-varying volatility. This stylized fact has been investigated in many research articles such as Serletis (1994), Ng and Pirrong (1996), Haigh and Holt (2002), Pindyck (2004), Sadorsky (2006), Alizadeh et al. (2008) and Wang et al. (2008). Most of them use various specifications close to the Generalized Autoregressive Conditional Heteroskedastic (GARCH) model initially presented in Engle (1982) and Bollerslev (1986). Bernard et al. (2008) present results regarding the aluminum market. Whereas these contributions were based on discrete time models, continuous-time finance also focused on the addition of stochastic volatility to the basic model by Schwartz (1997), as presented in Geman and Nguyen (2005) and Trolle and Schwartz (2009).

Second, the tail and jump issues that seem to be so important in the literature drove many attempts to build models combining time-varying volatility, persistence through the convenience yield, and jumps. Deaton and Laroque (1992) found empirical evidence that agricultural prices are agitated by jumps, while Duffie et al. (1995) also reported fat tails in the dynamics of commodities returns. Pindyck (2001) finds jumps both in the commodity prices, and in the inventory levels. This triggered numerous theoretical contributions based on the continuous time finance models proposed in Brennan and Schwartz (1985), Gibson and Schwartz (1990), Schwartz (1997), and Schwartz and Smith (2000). The key interest of the paper lies in investigating the presence of leverage effects in commodities. This research question matters for several reasons: the first one being risk management, and the computation of the Value-at-Risk (VaR). Forecasting accurately the volatility of commodities is essential to meet this objective – and leverage effects make a difference. Besides, the estimation of volatility is central for the computation of hedge ratios, as illustrated in Kroner and Sultan (1993), Lien and Tse (2000) and Chen et al. (2001). Hedging a position requires to correctly estimate the ratio of the hedging instrument's volatility to the asset to be hedged. The presence of leverage effects can have a marked impact here. Finally, Giamouridis and Tamvakis (2001) raise an interesting point: the addition to an equity portfolio – with a negative returns to volatility spillover – of assets with positive leverage

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