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Information spillover dynamics of the energy futures market sector: A novel common factor approach

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ABSTRACT

We investigate sector level information spillovers from energy to other futures market sectors using a novel conditionally heteroscedastic common factor (CHCF). CHCF represents common trends of macroeconomic influences on futures markets. We find that energy sector has the highest degree of commonality compared to other sectors. Conditional correlations between energy and non-energy sectors are highly persistent. The volatility spillover from the energy sector is prominent compared with mean and extreme market risk spillovers. Extreme risk spillovers from the energy to other sectors have an asymmetric effect. Shocks to energy futures have a significant potential impact on other markets during crises.

1. Introduction

Over the past three decades, the behaviour of futures markets has undergone significant changes due to alterations in their own market fundamentals and also to macroeconomic challenges they faced. Supporting this view, Tang and Xiong (2012) argue that a speculative component may be behind the recent boom in commodity prices while Gorton and Rouwenhorst (2006) document that the commodities have become a recognized asset class within the investment portfolios of financial institutions as a means to diversify risks such as inflation or equity market weakness. Focusing on the last decade's futures market fundamentals, Fig. 1 illustrates the conditional variance estimates from an AR(1)-TARCH(1,1,1) model of daily returns of leading nearby futures contracts selected from six popular futures market sectors (energy, agricultural, precious metals, industrial metals, equity index, currency) over the period 2005–2011.

In Fig. 1, all sectors (except gold and GBP/USD) experienced exceptionally high volatility fluctuations during the global financial crisis (GFC, Dec. 2007–June 2009) and the Eurozone crisis (EUC, April 2010–Dec. 2011), and overall the pattern and the intensity of volatility fluctuations over the period vary across market sectors, implying that they have different levels of sensitivity to changes in global macroeconomic fundamentals. Investigating the dynamics of such volatilities provides very valuable information on how the information is transmitted across markets. Several authors have addressed the spillover[1] of price volatilities, with a special focus on the energy futures market sector. But, most studies focus on the spillovers from one asset to another asset rather than from one market sector to another market sector. For example, Creti et al. (2013) investigate the spillover effect between individual commodities and S&P500 index using contemporaneous conditional correlations. Wang and McPhail (2014) document that energy shocks contribute to most of the commodity price's variations. Sadorsky (2014) arrives at a similar conclusion with respect to stock

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[1] Researchers use the term "spillover" to demonstrate the process of information flow among financial markets (see for example, Creti et al., 2013; Nazlioglu et al., 2013; Hong, 2001; among others). In line with this strand of literature, the term "spillover" in this paper denotes the information flow between energy and non-energy futures market sectors.

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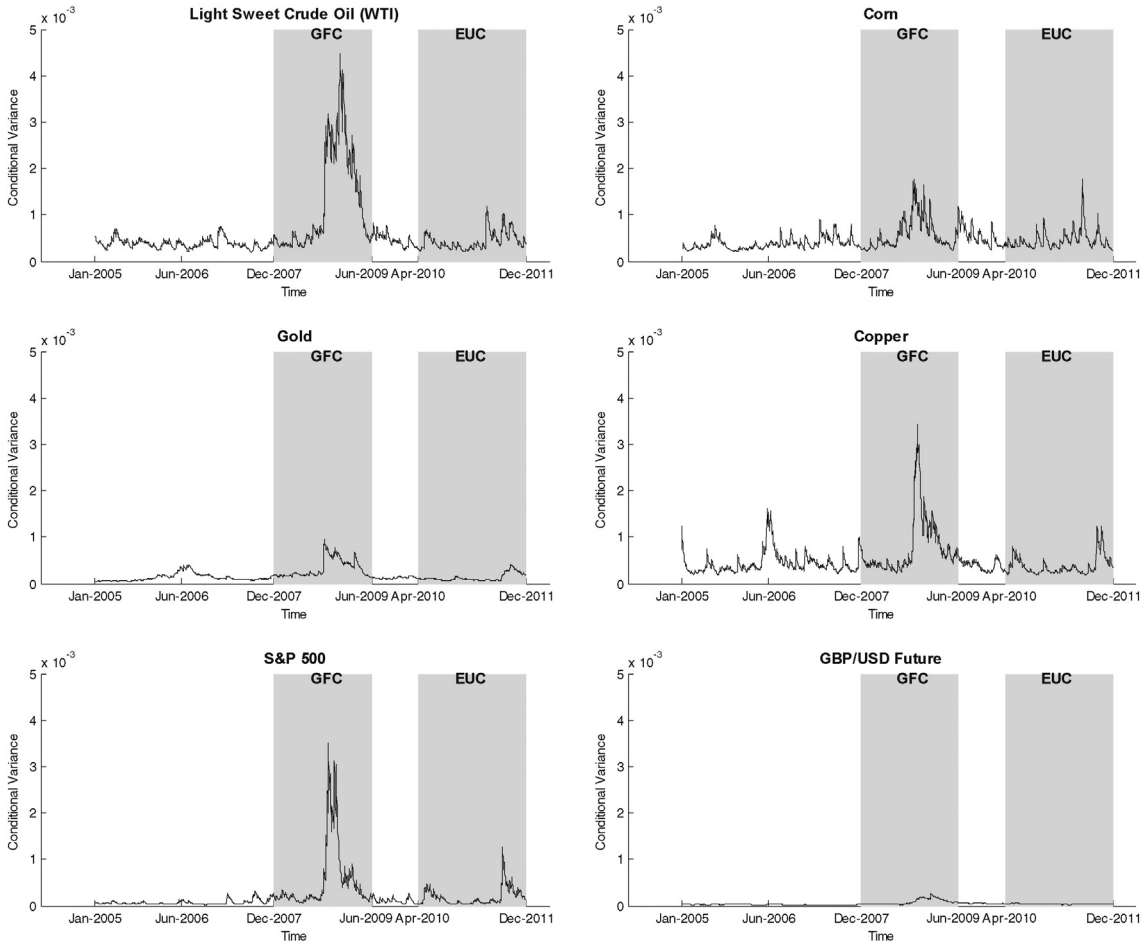

Fig. 1. Conditional volatilities of daily returns. This figure plots conditional variances of WTI crude oil, corn, gold, copper, S&P500, and GBP/USD futures returns from the contracts traded on CME. Conditional variances are estimated using an AR(1)-TARCH(1,1,1) model. Two shaded areas represent the GFC from 2007/12/01 to 2009/6/30 and the EUC from 2010/04/01 onwards respectively.

price variations. Zhang and Chen (2014) document that the impact of unexpected oil price's volatilities has become more complex after 2007, shedding light on the importance of volatility spillover effect between market sectors. Fattouh et al. (2013) document that there is clear evidence on the increased financialization of oil futures markets during the period 2003–2008 and that financialization of the energy markets is responsible for changes in price volatility and increased comovement between energy and other market sectors. An et al. (2014) study the macroeconomic effect of oil price shock and document that over the last 20 years oil prices have fluctuated dramatically and the volatility of oil prices have been considered by many economists as a main source of macroeconomic fluctuations. Hamilton (2011) find that 10 out of 11 post World War II recessions have followed or have been accompanied by a sharp rise in oil prices.

Motivated by these findings, this paper extends the current literature by investigating sector[2] level information spillover dynamics rather than individual asset level with a special focus on the energy sector. We investigate information spillover dynamics between energy and fuels sector daily returns and other futures market sectors, such as industrial materials, precious metals, agricultural and livestock, equity, and currency, using a comprehensive sample of 179 futures contracts traded on exchanges globally over the period 2005–2011. More specifically, we attempt to address the following important research questions which have not been satisfactorily debated in the literature so far: (i) Are the futures market sectors exposed to common global macroeconomic factors specific to each sector? If yes, to what extent do futures prices/returns explain this commonality? (ii) Can these common factors be used to explain contemporaneous and lead–lag relationships (spillovers) between the entire energy sector and other market sectors? (iii) Is there a significant lead–lag information spillover in terms of market volatility (small risk) and extreme up- and down-side risks (due to high and low price spikes) between the energy and fuel sector and other sectors? (iv) Is there a potential impact from shocks to the energy and fuel sector on other sectors? If yes, how susceptible are these markets to such shocks and how quickly do they absorb such shocks? As a leading sector with the highest growth over the period 2005–2011 (see for example the survey paper by Acworth, 2014), gaining a comprehensive picture on the links between the entire energy and fuel futures market sector and other futures market sectors is important for financial players and policy makers in making their investment decisions.

Investigating the spillover effects of shocks at the sector level has several advantages over the traditional commodity level spillover approach. First, the market specific common factors used in the analysis are constructed by filtering out (see equation (A.1) in Appendix A) the contemporaneous idiosyncratic component from returns of individual commodities of each sector. Therefore, the common factor can be identified as a source of systematic variations of returns in an entire sector which are uncorrelated with commodity specific contemporaneous idiosyncratic return variations. The idiosyncratic shocks can exert an influence on the proposed common factors only through their lag-links with macroeconomic variables (see Table 3). Such links have already been investigated by several authors (see for example, Finn, 2000, and

[2] Sector level spillover refers to the spillover of macroeconomic shocks to an entire sector to other sectors whereas asset level spillovers could be due to idiosyncratic shocks specific to an asset.