Energy Economics 43 (2014) 225–243

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneco

Dynamic spillovers among major energy and cereal commodity prices

Walid Mensi [a], Shawkat Hammoudeh [b,c,*], Duc Khuong Nguyen [c], Seong-Min Yoon [d]

[a] Department of Finance and Accounting, El Manar University, B.P. 248, C.P. 2092 Tunis Cedex, Tunisia
[b] Lebow College of Business, Drexel University, Philadelphia, PA 19104-2875, United States
[c] IPAG Lab, IPAG Business School, 184 Boulevard Saint-Germain, 75006 Paris, France
[d] Department of Economics, Pusan National University, Busan 609-735, Republic of Korea

ARTICLE INFO

Article history:
Received 22 July 2013
Received in revised form 3 March 2014
Accepted 4 March 2014
Available online 13 March 2014

JEL classification:
G14
G15

Keywords:
Cereal
Energy
OPEC meetings
Volatility spillovers
Multivariate GARCH

ABSTRACT

Over the past decade, the sharp increases in the prices of oil and agricultural commodities have raised serious concerns about the heightened volatility of these markets and the possible negative interactions between them. This article deals with the dynamic return and volatility spillovers across international energy and cereal commodity markets. It also examines the impacts of three types of OPEC news announcements on the volatility spillovers and persistence in these markets. For this purpose, we make use of the VAR-BEKK-GARCH and VAR-DCC-GARCH models for the daily spot prices of eight major commodities including WTI oil, Europe Brent oil, gasoline, heating oil, barley, corn, sorghum, and wheat. Our results provide evidence of significant linkages between these energy and cereal markets. Moreover, the OPEC news announcements are found to exert influence on the oil markets as well as on the oil–cereal relationships. Finally, we show that the persistence of volatility decreases (increases) for the crude oil and heating oil (gasoline) returns after accounting for the OPEC announcements in these multivariate GARCH models. However, the results are more mixed for the cereal markets. Overall, our results can be used to improve the risk-adjusted performance by having more diversified portfolios and also serve to hedge the oil risk more effectively.

1. Introduction

The growing interest in research on the price and volatility dynamics of energy and agricultural commodity markets has attracted more attention following the recent surges in both the energy and food prices. Moreover, the energy and agricultural commodity prices have also experienced long swings and sharp fluctuations over the last decade, which are likely to have been driven be driven more by changes in macroeconomic uncertainties, economic and financial crises, and regulations to combat dangerous climate warming. Recent statistics show that international nominal prices of all major food commodities reached their highest levels in nearly 50 years during the first quarter of 2008. These unprecedented increases in prices of commodities, coupled with substantial increases in their volatility, reflect uncertain markets and volatile environment.[1] Sumner (2009) shows that the percentage price increases for grains from 2006 through mid-2008 are among the largest changes in the agricultural commodity history. According to the International Grains Council (IGC), a dramatically increased trend in cereal prices is observed during the period 2000–2008, particularly during the 2007/2008 food crisis.[2]

The recent spikes in agricultural commodity prices can be explained by at least three factors.[3] First, the energy and agricultural prices have become increasingly intertwined since biofuels can be derived from agricultural commodities. On the other hand, higher energy prices can make the production of agricultural goods more expensive by raising the costs of mechanical cultivation, energy-related inputs like fertilizers and pesticides, and transportation of both inputs and outputs. Second, the growing and more prosperous world population is demanding not only more food but also more diversified agricultural products. Rapid economic growth in many emerging and developing countries has led to increases in consumption, thereby driving up food prices. The two factors reinforce each other. Finally, the adverse effects of the global

* Corresponding author at: Lebow College of Business, Drexel University, 3200 Market Street, Philadelphia, PA 19104-2875, United States. Fax: +1 215 895 6975.
E-mail addresses: walid.mensi@fsegt.rnu.tn (W. Mensi), hammousm@drexel.edu (S. Hammoudeh), duc.nguyen@ipag.fr (D.K. Nguyen), smyoon@pusan.ac.kr (S.-M. Yoon).

[1] FAO's (2008) report "Soaring food prices: facts, perspectives, impacts and actions required", June, 2008.

[2] The IGC statistics indicate that the wheat FOB price increased from US$ 107 per ton on January 3, 2000 to US$ 532 per ton on March 12, 2008, while the corn price rose from US$ 90 per ton on January 3, 2000 to US$ 241 per ton on March 12, 2008. On the other hand, the crude oil markets have also experienced an unprecedented boom and unstable period following the 1997–1998 financial crisis and the 2001 Dot com bubble burst. As an illustration, the West Texas Intermediate (WTI) crude oil spot price closed at $20.74 per barrel in January 2002 but broke a record level of $133.93 per barrel in June 2008.

[3] International Food Policy Research Institute (April 2008). Rising food prices: what should be done?

http://dx.doi.org/10.1016/j.eneco.2014.03.004
0140-9883/

warming of the climate change, together with the flows of speculative capital into commodity markets, have also been responsible for the spikes in the food and energy prices. For example, the severe drought in 2002–2003 in Australia, one of the world's largest wheat producers, significantly cut down the global wheat production, thereby leading to rising wheat prices.

The above-mentioned facts suggest that there are significant interactions between energy and agricultural commodity markets. Not only the fluctuations in energy prices affect commodity prices, but also the rising commodity prices have various effects on energy markets as the energy demand and supply depend on agricultural production. With increasing globalization, the gradual liberalization of financial markets, the rapid development of advanced communication technologies, and the financialization of commodity markets, the markets of different goods and assets have become more and more interlinked. In this context, it is clearly important for policy-makers and global investors to understand the cross-market relationships, particularly between the energy and commodity markets.

The idea thus consists of gaining valuable insights into the commodity price development process, the price interaction mechanisms, the proper diversification opportunities, the portfolio optimization, and the future regulation frameworks. If, for example, the return and volatility are found to spread from one market to another, portfolio managers and policymakers would have to adjust their actions to essentially prevent contagion risks in the advent of market crashes or crises. The specific patterns of volatility in the agricultural commodity markets also render the study of return and volatility spillovers more attractive. Wright (2011) reports that agricultural commodity prices fell sharply during the summer of 2008, but recovered swiftly, and have exhibited unusually large and sustained volatility. This volatile pattern is potentially due to a number of factors including the increasing demand in developing countries, the depreciation of the US dollar, the supply shocks in the key producing regions, the irregular climate conditions, different stock market phases, recurring wars, higher transaction costs, increased market depth, and the development of the biofuel industry in the United States (Baffes, 2011; Gilbert and Morgan, 2010; Kym and Signe, 2012; Martine et al., 2013; Richards et al., 2012).

The objectives of this study are twofold. We first provide a comprehensive framework to examine the volatility transmission among the increasingly connected oil and cereal markets. The oil commodities include WTI, European Brent, gasoline and heating oil, while the cereal products comprise barley, corn, sorghum and wheat.[4] We then analyze the impacts of three types of the OPEC news announcements on the oil markets as well as on the relationship between the oil and cereal markets under consideration in order to discern if these different announcements induce asymmetric market signals for decision makers.

Several reasons motivate this study. First, over the last 10 years, the cereal markets have experienced rapid growth in liquidity and a number of investors are questioning the interest of cereal commodities as an integrative part of portfolio investments. Second, the recurring large fluctuations of cereal prices have also caused great concerns among researchers, policy makers and market participants. Policymakers in developing countries often do not have sufficient information to gage the likely adverse effects of higher global food prices on their countries and also design appropriate policy actions (Benson et al., 2013). They therefore require better information to assess the impact of higher cereal prices on the real and financial aspects of their economies, and thereby appropriately design and implement national policies and programs to smooth out the associated risks. Finally, our empirical framework allows us to explicitly take into account the impact of the periodic OPEC announcements on the shock and volatility transmission between the energy and cereal markets, which is not always the case in related past studies (e.g., Demirer and Kutan, 2010; Schmidbauer and Rösch, 2012; and references therein).

Empirically, we use the flexible multivariate GARCH (MGARCH) specifications, namely the VAR-BEKK-GARCH and the VAR-DCC-GARCH models to explore the return and volatility interactions among eight major energy and cereal commodities.[5] These models allow one to simultaneously estimate the return and volatility cross-effects across the commodities under consideration. On the other word, the multivariate GARCH approach provides further explanations of the origins, directions and transmission intensity of the shocks in at least two markets. The BEKK models capture the effects on the current conditional volatility of own innovations and lagged volatility as well as the cross market shocks and the volatility transmission of other markets. The DCC models drop the unrealistic hypothesis of time-invariance of the conditional correlations over time.

Interestingly, the DCC models are commonly used to create and evaluate a portfolio, while the BEKK models and covariance models are employed to forecast the Value-at-Risk (VaR) thresholds. The information revealed from these methods allows for an optimal asset allocation, construction of global hedging policies and the development of various regulatory requirements. Caporin and McAleer (2009) show many similarities and dissimilarities between the BEKK and DCC models.[6] In this study, we look at the relevance role of OPEC announcements as a possible driver of the returns and volatility of the fuel and cereal group of commodities.

Using daily data from 3 January 2000 to 29 January 2013, our main results provide evidence of significant volatility transmission among the oil and cereal markets. More interestingly, the OPEC news announcements are found to exert influence on the oil markets as well as on the oil–cereal relationships. Finally, we show that the persistence of commodity volatility decreases (increases) for the crude oil and heating (gasoline) returns. However, the results are more mixed for the cereal markets after accounting for the OPEC announcements in the multivariate GARCH models.

The rest of this article is organized as follows. Section 2 presents a brief review of the major studies in the related literature. Section 3 introduces the econometric methodology. Section 4 describes the data and some preliminary analysis. Section 5 reports and discusses the empirical results. We provide concluding remarks in Section 6.

2. Literature review

There is now an emerging strand of the literature that focuses on the shock transmission and volatility spillovers between the energy and agricultural commodity markets, using different datasets and various econometric methods (e.g., Chen et al., 2010; Creti et al., 2013; Du et al., 2011; Hammoudeh et al., 2012; Ji and Fan, 2012; Mensi et al., 2013; Nazlioglu, 2011; Nazlioglu and Soytas, 2011; Nazlioglu et al., 2013; Serra, 2011). This growing literature has generally demonstrated significant interactions of the return and volatility between the energy and agricultural commodity markets, but the strength of these interactions typically depends on the pairs of markets considered.

For instance, Chen et al. (2010) examine the relationships between the crude oil WTI futures price and the global grain prices for corn, soybean and wheat and conclude that the grain price changes are significantly influenced by the changes in the price of crude oil and other

[4] We consider the New York Harbor No. 2 heating oil which is a liquid petroleum distillate used as fuel for burning in furnaces and boilers in buildings.

[5] The acronym BEKK refers to Baba, Engle, Kraft and Kroner, while DCC means Dynamic Conditional Correlations.

[6] For more details on convergence and divergence points between the BEKK and DCC models, see Caporin and McAleer (2009).