Energy Economics 43 (2014) 297–305

Contents lists available at ScienceDirect

Energy Economics

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

The relationship between energy and equity markets: Evidence from volatility impulse response functions

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ARTICLE INFO

Article history:
Received 20 August 2013
Received in revised form 24 January 2014
Accepted 25 January 2014
Available online 1 February 2014

JEL classification:
C12
C32
G10
Q00

Keywords:
Volatility impulse response functions
Dynamic hedge ratios
Volatility spillovers
Conditional correlation
Commodity market
Equity index

ABSTRACT

This paper examines the relationship between the energy and equity markets by estimating volatility impulse response functions from a multivariate BEKK model of the Goldman Sach's Energy Index and the S&P 500; in addition, we also calculate the time varying conditional correlations and time varying dynamic hedge ratios. From volatility impulse response functions, we find that low S&P 500 returns cause substantial increases in the volatility of the energy index; however, we find only a weak response from S&P 500 volatility to energy price shocks. Moreover, our dynamic hedge ratio analysis suggests that the energy index is generally a poor hedging instrument.

1. Introduction

Commodity markets are highly liquid and have a substantial proportion of investors who view commodities purely as Investments (financial assets/securities) rather than as a means to support "real" economic activity via hedging and risk management (Vivian and Wohar, 2012). The motivation behind including commodities in an investment portfolio is captured well by the promotional material listed on the website of PIMCO Commodity Real Return Strategy Fund.

> "Because commodities are "real" assets like oil, metal or grain, they are sensitive to different economic factors and tend to perform differently, as evidenced by their low or negative correlation (tendency to move in tandem) with stocks and bonds. Adding commodities to a balanced portfolio may enhance overall diversification. Of course, diversification does not guarantee a profit or protect against loss. [1]"

As noted in Stoll and Whaley (2010), inclusion of commodities or commodity exchange traded funds as diversifying assets in traditional portfolios has become much more common since 1998. This increase in speculative market players who view commodities purely as an investment asset has been termed the "financialization" of commodities and is a departure from the traditional environment which primarily involved producers and consumers of the commodity.

Given this "financialization" of commodities, there is currently a debate over the role of speculative traders in commodity markets and whether they contribute to the rise of commodity prices since 2000. This position has been echoed by Michael Masters, George Soros, and more recently by former Congressman Joe Kennedy in a New York Times OpEd piece.[2] Soros (2008) stated, "You have a generalized commodity bubble due to commodities having become an asset class that institutions use." In fact, the role of speculators in commodity markets was one of the most controversial aspects of the 2010 Dodd–Frank legislation; the legislation gave the Commodity Futures Trading Commission (CTFC) the authority to limit trading in over-the-counter

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[1] http://investments.pimco.com/Products/pages/287.aspx.

[2] http://www.nytimes.com/2012/04/11/opinion/ban-pure-speculators-of-oil-futures.html.

http://dx.doi.org/10.1016/j.eneco.2014.01.009
0140-9883/

swaps. The CFTC used their new authority and voted on October 18th 2011 to limit positions in 28 physical commodity futures or financial equivalents.[3] It should be noted that the "financialization" of commodities is pointed to as a partial explanation for the rise in correlations between commodities and equities during the financial crisis. However, this increase in correlations could also be partly due to global economic conditions impacting both the equity market and commodity market. While it is not the objective of the paper to provide formal evidence on this point, we do examine the impact of changing correlations for diversification and hedging. This paper importantly extends prior literature by examining volatility impulse responses to equity return shocks and to energy return shocks.

There is growing evidence that equity and commodity markets are inter-connected and that the correlations between commodities and equities have increased since the early 2000s (see for example Creti et al., 2013; Gilbert, 2010; Silvennoinen and Thorp, 2013). This evidence is cited to support the assertion that speculators have had a significant effect on commodity prices since the early 2000s, although whether speculators have had a material impact on the properties of commodity time series is disputed (Hamilton and Wu, 2012; Valiante, 2011; Vivian and Wohar, 2012). In fact, the correlation between energy commodities and equities may not be driven by the "financialization" of commodities but rather may reflect other factors. For example, it is plausible global economic conditions play a major role; the deterioration in global economic conditions could have been an important contributing factor to the spike in correlations between the stock market and energy prices during 2008–9 when stock market falls accompanied energy price falls. Regardless of the reason, if the correlation between traditional asset classes and commodities has increased, then the usefulness of commodities as a diversification tool (as suggested in the above PIMCO material) has become much more limited.[4] However, much prior literature appears to have overlooked the fact that increased correlations will actually make commodities a better hedge for equity (provided the absolute value of the correlation coefficient increases). Given that hedging typically involves taking a long position in one asset (here equity) and a short position in another asset (here a commodity), the rise in correlations suggests that a move in equity price will be better offset by a short position in the commodity; thus, the hedge has become more effective. Nevertheless, the relationship between commodities and equities is certainly a pertinent question that attracts attention from policymakers, producers, academics, investors, the media and consumers.

Creti et al. (2013) note that "volatility of commodity prices is thus a central issue for the world economy, as notably illustrated by the G20 which addressed the question of excessive fluctuations and volatility of commodity prices in its September 2009 Pittsburgh summit" (p16). This begs the questions of i) How quickly does a volatility shock dissipate and ii) What is the response of commodity volatility to a shock to equity volatility (or vice-versa)? To our knowledge these questions have not yet been examined using volatility impulse response functions in the equity–energy market context. An important contribution of this paper is to fill this gap in the literature. We meet this objective by estimating volatility impulse response functions from a multivariate BEKK model of the Goldman Sach's Energy Index and the S&P 500; in addition, we also calculate the time varying conditional correlations and time varying dynamic hedge ratios. We focus on the energy index since it is a widely used benchmark for investment performance in the energy commodity market[5]; it is consequently a useful overall barometer for the energy market. To generate the volatility impulse response functions, we employ the methodology outlined in Hafner and Herwartz (2006). One benefit of their methodological approach is that it allows one to pick "shocks" from a specific time period. As such, we utilize this feature to examine how the variance of each of variable (energy index, S&P 500 index) respond to "low", "median", and "high" shocks. Put another way, we are able to show how the variance of the S&P 500 (energy index) responds to small and large price shocks in the energy (S&P 500) sector.

To preview our results, first, we find that low S&P 500 returns cause substantial increases in the volatility of the energy index; however, we do not find any substantial effects on the volatility of the S&P 500 that result from positive energy returns. Secondly, we find that the conditional correlation increased substantially during the financial crisis (2008–2010) but was approximately zero beforehand; this is broadly consistent with Creti et al.'s (2013) finding for Oil and S&P 500 using an alternative modeling approach. Thirdly, the analysis of dynamic hedge ratios suggests that the energy index is a poor hedging instrument for equity movements, apart from during the financial crisis (2008–2010). Consequently our evidence suggests that the impact of financial crisis had a differing impact depending upon whether the market participant was looking to diversify an investment portfolio or hedge an equity position. For a speculative investor attempting to achieve diversification benefits by using the energy index during the crisis will have found these were much smaller when they were needed most; in contrast the usefulness of the energy index to hedge equity movements greatly increased during the financial crisis.

The remainder of this paper is organized as follows. Section 2 summarizes recent literature. Section 3 discusses our data and methodology. Section 4 presents our model results and evaluates the time-varying conditional correlations and time varying hedge ratios. Section 5 concludes.

2. Literature review

A number of studies have investigated the effects of energy price changes on real economic variables since the 1970s oil price shocks (Hamilton, 1983, 2003; Kilian, 2008; and references therein). It is generally shown that oil price changes significantly affect economic activity for various developed and emerging countries. In contrast, the strand of research on the potential links between oil prices and stock markets has gained ground only recently, and its focus is essentially on broad market indices. The study by Jones and Kaul (1996) is amongst the first to examine the reaction of stock markets to oil shocks and find that changes in stock prices can be partially accounted for by the effect of oil price movements on current and future cash flows.

A large body of subsequent literature confirm significant responses of stock returns to oil shocks using a wide range of different econometric techniques including vector autoregressive (VAR) models (Apergis and Miller, 2009; Fayyad and Daly, 2011; Huang et al., 1996; Park and Ratti, 2008; Sadorsky, 1999), cointegration (Park and Ratti, 2008; Sadorsky, 1999), and vector error–correction models (VECM) (Apergis and Miller, 2009). Apergis and Miller (2009) also note that while the effect of oil shocks on stock prices are statistically significant they are of small magnitude. Fayyad and Daly (2011) emphasize that during the global financial crisis period i) the predictive power of oil for stock returns increased and ii) stock returns become more sensitive to oil shocks. Huang et al. (1996) find that oil prices only affect the stock market returns of energy companies; the effect is i) the lead length is one day and ii) the economic significance is limited given potential profits cannot cover trading costs. Park and Ratti (2008) compare the effects of world oil price shocks and national oil price shocks, interestingly they find that world oil price shocks have stronger effects than national shocks. Park and Ratti's (2008) evidence also suggests that the oil price shocks are incorporated into stock prices within a month. Sadorsky (1999) reports that oil price shocks depress real stock returns; in contrast real stock returns shocks do not impact oil prices but do affect interest rates and industrial production. Wang et al. (2013)

[3] The commodities include contracts for corn, wheat, soybeans, oats, cotton, oil, heating oil, gasoline, cocoa, milk, sugar, silver, palladium and platinum.

[4] If the correlation has unexpectedly increased then the benefits of diversification will be smaller than originally anticipated.

[5] http://us.spindices.com/indices/commodities/sp-gsci-energy.