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How do the stock prices of new energy and fossil fuel companies correlate? Evidence from China

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ABSTRACT

This study documents the return and volatility spillover effect between the stock prices of Chinese new energy and fossil fuel companies using the asymmetric BEKK model. Based on daily samples taken from August 30, 2006 to September 11, 2012, the dynamics of new energy/fossil fuel stock spillover are found to be significant and asymmetric. Compared with positive news, negative news about new energy and fossil fuel stock returns leads to larger return changes in their counter assets. News about both new energy and fossil fuel stock returns spills over into variances of their counter assets, and the volatility spillovers depend complexly on the respective signs of the return shocks of each asset. The empirical results demonstrate that new energy and fossil fuel stocks are generally viewed as competing assets, that positive news about new energy stocks could affect the attractiveness of fossil fuel stocks and that new energy stock investment is more speculative and riskier than fossil fuel stock investment. These results have potential implications for asset allocation, financial risk management and energy policymaking.

1. Introduction

China's dizzying pace of economic development over the past decades could be largely attributed to an extensive use of fossil fuel (e.g., Bloch et al., 2012; Shahbaz et al., 2013; Yuan et al., 2008; Zhang and Xu, 2012). However, as the energy shortage and environmental pollution have become increasingly severe, the Chinese government has tried to find greener ways to develop its economy in recent years. Because cutting energy consumption and carbon emissions at the cost of economic growth is not an option, policymakers have taken great interest in exploring new energy (nuclear and renewable energy) as an alternative to fossil fuel (oil, coal and natural gas) to ensure energy security, reduce carbon dioxide emissions and maintain fast and stable economic growth. A rapidly growing number of policies encouraging new energy development have been published since the release of China's 11th Five-year Plan in 2006, such as the Medium to Long-term Development Plan for Renewable Energy, the 11th Five-year Plan for Renewable Energy Development, the amended Renewable Energy Law, the National 12th Five-year Plan for Environmental Protection and so on.

In line with this energy policy interest, Chinese new energy stocks have received much attention recently. The Chinese stock market is characterized as government and speculation driven. Although fossil fuel companies are more mature and perform better financially, the emerging new energy stocks are able to introduce much more satisfying returns in many cases. This has challenged the general perception that fossil fuel stocks are the optimal investment of the energy sector, and has made fossil fuel stock investors afraid that any positive news about new energy stocks makes fossil fuel stocks less attractive. However, those who enthusiastically invest in new energy stocks also pay much attention to the potential downsides. Beyond the previously noted advantages of fossil fuel companies, fossil fuel still dominates China's current energy use while new energy is much more underdeveloped. Investors worry that once positive news about fossil fuel stocks or negative news about new energy stocks emerges, the investment funds will largely switch from the new energy stocks to the fossil fuel stocks, thus dampening their returns. From this viewpoint, within the present energy policy context, the behavior of new energy stock prices and the relationships between the stock prices of new energy and fossil fuel companies draw equal attention from stock investors. However,

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relevant empirical evidence has not yet been provided. To facilitate the asset allocation and financial risk management of stock investors in the energy sector, this study aims to capture the spillover effects that occur in the stock returns and volatilities of Chinese new energy and fossil fuel companies, taking into account that the effect may be asymmetric.

Although the literature on fossil fuel stocks is older and more abundant than the literature on new energy stocks, they have both focused mainly on how energy-related (fossil fuel or new energy) stock prices are correlated with important economic variables and concentrated on advanced economies. As the price of oil is the primary driver of how fossil fuel company (mainly the oil and gas companies) stock prices are perceived, many scholars have focused on the oil price effect (e.g., Arouri, 2011; El-Sharif et al., 2005; Elyasiani et al., 2011; Faff and Brailsford, 1999; Ghouri, 2006; Hammoudeh and Li, 2005; Hammoudeh et al., 2004; Hilliard and Danielsen, 1984; Huang et al., 1996; Scholtens and Yurtsever, 2012), despite that there are also some researchers having paid almost equal attention to other common factors such as market returns, exchange rates, interest rates and natural gas prices, or fundamental factors such as debt levels and operational cash flows (e.g., Boyer and Filion, 2007; Hammoudeh et al., 2010; Lanza et al., 2005; Oberndorfer, 2009; Sadorsky, 2001).[1] Many studies have identified a significant positive effect of oil price appreciation on oil and gas stock returns; in contrast, the volatility linkage of oil prices and oil/gas stock prices and the asymmetry of oil price shocks have been relatively under-researched. Hammoudeh et al. (2004) provide evidence of the oil price–oil/gas stock price volatility linkage. They use univariate and multivariate GARCH models to report that oil volatility has a dampening effect on the volatility of stocks for certain U.S. oil-related sectors such as oil and gas refining, but increases volatility for companies engaged in oil production and exploration. This is similar to studies by Hammoudeh et al. (2004) and Elyasiani et al. (2011), which combine the Fama–French factors model with the GARCH model to suggest that oil return volatility negatively affects the conditional volatility of oil-substitute (coal) and oil-related (oil and gas extraction and petroleum refinery) industry returns. Hammoudeh et al. (2010) use the asymmetric power GARCH model to test the asymmetric effects of oil price shocks. They show that both oil price increases and decreases lessen the return volatility of the U.S. oil-related sectors and that the effects of oil are asymmetric. Arouri (2011) finds no asymmetric effects of oil prices on European oil and gas stock returns with different oil price specifications (linear, scaled and net specification). In terms of new energy (mainly clean energy) company stock prices, the literature has attached great importance to the effects of oil prices. However, studies have found that whether oil price has a significant effect on alternative energy stock returns depends on the sample period, and that the stock prices of technology companies are more highly correlated with those of alternative energy companies (e.g., Henriques and Sadorsky, 2008; Kumar et al., 2012; Managi and Okimoto, 2013). Interest rates are also considered along with these two risk factors. Kumar et al. (2012) investigate the effects of carbon price. In terms of the volatility linkage of new energy stock prices and other economic variables, only Sadorsky (2012) uses four multivariate GARCH models (BEKK, Diagonal, CCC and DCC) to investigate volatility spillovers between the oil and stock prices of clean energy and technology companies, again confirming that the stock prices of clean energy and technology companies are more closely related.

Compared with the rich literature on advanced economies, few studies have focused specifically to emerging countries. To the best of our knowledge, only the following studies have specifically examined the relationship between China's energy-related stock market and other important economic variables. Cong et al. (2008) use a VAR model to investigate the effects of oil shocks on the stock market (including 2 composite indices, 10 classification indices and 4 oil company stock prices), and find that although the stock returns of some oil companies increase due to oil shocks, some “important” oil shocks decrease oil company stock prices. The asymmetric effects of oil price shocks on oil companies' stock returns have not been supported by statistical evidence. Broadstock et al. (2012) adopt a time-varying conditional correlation and asset pricing models to discover how the dynamics of international oil prices affect Chinese energy-related (including fossil fuel and new energy sector) stock returns, and demonstrate a much stronger correlation following the 2008 financial crisis.

This study follows the general research direction of the aforementioned literature and concentrates particularly on China. In addition to filling the research gap, it extends the literature in two ways. First, unlike the studies that have analyzed the volatility linkage of energy stock prices and economic variables using a symmetric univariate/multivariate GARCH model, this study implements the asymmetric BEKK model used by Kroner and Ng (1998) to investigate the volatility linkage of Chinese new energy and fossil fuel stock prices while considering that the volatility spillover effects may be asymmetric. The asymmetric BEKK model allows the conditional variances of both returns to spill over into each other, and permits time variations and spillovers in the conditional covariance. It could well capture three forms of asymmetric behavior (i.e., negative return innovations affect volatility more than positive shocks) in variances and covariances, including own variance asymmetry, cross variance asymmetry and covariance asymmetry. Further, it has been thought to represent the most reasonable compromise between model complexity and estimation tractability (Dean et al., 2010). Second, instead of commenting on the effects of individual parameters, we use news impact surfaces to identify asymmetries and the volatility spillover effect. Although we restrict the use of news impact surfaces to the quadratic form of the parameters in the asymmetric BEKK model to some extent, doing so allows us to investigate the market volatility spillover more comprehensively and vividly.[2]

The main findings of this study are summarized as follows. First, evidence of significant and asymmetric return spillovers between Chinese new energy and fossil fuel stock prices is found based on daily samples taken from August 30, 2006 to September 11, 2012. Further, negative news about new energy and fossil fuel stock returns both spill over into higher returns of their counter assets. Although good news about new energy stock returns causes fossil fuel returns to fall on the following day, good news about fossil fuel stock returns leads to a rise in new energy returns on the subsequent trading day. Compared with positive news, negative news about new energy (fossil fuel) stock returns causes larger changes in the fossil fuel (new energy) stock returns. Second, in terms of volatility spillover, both new energy and fossil fuel stock news spills over into variances of their counter assets. The increases in fossil fuel stock return volatilities are higher for the negative shocks of the fossil fuel stock returns than for the positive ones. Volatility spillovers depend complexly on the respective signs of the return shocks of each asset. For example, the spillover is greater when the new energy and fossil fuel stock return shocks have different signs.

The empirical results have potential implications for stock investors' asset allocations and financial risk management. The patterns of the new energy/fossil fuel stock returns and volatility spillovers both demonstrate that new energy and fossil fuel stocks are generally viewed as

[1] In papers focusing on the effect of oil price changes on energy-related company stock prices, risk factors such as market returns, exchange rates, interest rates, inflation and industrial production are included in the empirical models to keep the empirical results robust (e.g., Arouri, 2011; El-sharif et al., 2005; Elyasiani et al., 2011; Faff and Brailsford, 1999; Scholtens and Yurtsever, 2012).

[2] The asymmetric BEKK model has already been applied in studies of the correlations between traditional financial markets (e.g., Ang and Chen, 2002; Brooks and Henry, 2000; Dean et al., 2010; Goeij and Marquering, 2005; Li and Majerowska, 2008). However, it is still very novel for investigations specific to the energy-related stock markets. Meanwhile, few of the studies that implement the asymmetric BEKK model have used news impact surfaces to analyze market volatility spillovers.