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# Can investors of Chinese energy stocks benefit from diversification into commodity futures?

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## ABSTRACT

We attempt to evaluate the diversification potential of commodity futures for energy stocks in China. With a variety of copula functions and three risk-based dynamic measures, our results show that even though commodity futures are not helpful in improving the risk-adjusted returns of energy stocks, they can significantly reduce the volatilities and expected-shortfalls of the diversified portfolios. Such diversification benefits are much larger during large market downturns than during normal times. In particular, gold (copper) futures are the most (least) attractive in diversifying risks of energy stocks in most cases. The results also highlight that the non-linear dependence cannot be ignored when estimating the diversification benefits, and more various risk hedging strategies are expected for investors holding energy stocks, especially coal company stocks.

## 1. Introduction

The “golden decade” of Chinese coal industry came to an end in 2012 with severe problems of sluggish demand and production over-capacity which have led to the collapse of domestic coal prices and coal companies trapped into a long period of winter. Meanwhile, along with the bearish mood of Chinese stock market and slumps of the world oil price since June 2014, oil and gas stock prices obviously experienced long-lasting falls as well. Since the renewable energy is an alternative to the fossil fuels, investment enthusiasm of renewable energy company stocks can also be dampened by the low coal and oil prices. Even though the Chinese stock market turned into a bull run with unexpected interest rate cuts by China's central bank in November 2014, the energy stocks are far less attractive than some other sector stocks (e.g., banking, transportation or machinery), despite the continuously crucial role of the energy sector in China economy. A natural emerging question is whether there is a way to diversify the investment risks of Chinese energy company stocks?

The potential of diversification benefits offered by the commodity futures has been extensively investigated in recent years as far as

investors are concerned about the stock volatility and firms' lower profitability during financial turbulences and crises. Low correlations between stock and commodity futures markets as well as distinct factors driving their price dynamics have been identified as diversifying feature (e.g., Gorton and Rouwenhorst, 2006; Daskalaki and Skiadopoulos, 2011; Belousova and Dorfleiner, 2012; Hammoudeh et al., 2014). With the fast pace of financialization of commodity markets, several studies have shown evidence of reduced diversification benefits with commodity futures given their increasing co-movement with stocks (e.g., Delatte and Lopez, 2013; Tang and Xiong, 2012; Cheung and Miu, 2010).

In spite of the rapidly growing literature about the diversification benefits of commodity futures for stocks, little attention has been paid to such issue for energy stocks. Most of the recent studies focus on how the stock returns/volatilities of energy companies are affected by economic variables, in particular by the oil prices (e.g., Henriques and Sadorsky, 2008; Hammoudeh et al., 2010; Degiannakis et al., 2014; Alsaman and Herrera, 2015; Kang et al., 2017) and on estimating the stock investment risk of energy companies (e.g., Hernandez, 2014; Peng et al., 2017). The limited

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research about the diversification potential of commodity futures for energy stocks may be explained by the fact that stocks in the energy sector are generally thought to be more closely related to commodity prices than stocks in other sectors, which drives down interests in using commodity futures to hedge energy stock investment risk. However, as is suggested by [Gorton and Rouwenhorst \(2006\)](#), stocks of commodity-related companies behave more like other stocks in equity markets than like commodities. Expectedly, there is still diversification potential of the commodity futures for Chinese energy stocks. For instance, [Hammoudeh et al. \(2014\)](#) identify the diversification benefits of commodity futures for stock market in general in China.

Measuring diversification benefits is, however, challenging since optimal asset allocation models require the accurate modeling of cross-asset dependence patterns under various market conditions (normal, bullish, and bearish markets), the choice of appropriate return distributions, and the identification of suitable risk measures (e.g., semi-variance, VaR and CoVaR). At present, among the different multivariate models, multivariate GARCH-type models are very popular in assessing the relationship between stock and commodity markets, as these models consider the heteroskedasticity problem, enable clear interactive links and provide a mechanism to trace time-varying correlations between markets (e.g., [Büyüksahin et al., 2010](#); [Chong and Miffre, 2010](#)). Additionally, in order to capture various market circumstances, regime-switching mechanisms are introduced into the multivariate GARCH models (e.g., [Silvennoinen and Thorpy, 2013](#); [Gao and Liu, 2014](#)). However, the multivariate GARCH-type models often assume a fit to symmetric multivariate normal or Student-t distribution, asymmetric tail dependence behavior between markets is then neglected and portfolio risks can thus be wrongly identified. Facing with these shortcomings, copula functions have some obvious advantages. They are more flexible than multivariate distributions and allow one to separately model the marginal behavior of asset returns and the dependence structure. In addition, they can capture the non-linearity in market dependence including rich patterns of tail dependence. Some studies have applied copula functions in market dependence modeling and portfolio analysis (e.g., [Wen et al., 2012](#); [Aloui et al., 2013a,b](#); [Reboredo, 2013](#); [Hammoudeh et al., 2014](#); [Hernandez, 2014](#); [Jäschke, 2014](#); [Babaei et al., 2016](#); [Wen et al., 2017](#)). Diversification benefits of portfolios within copula framework are generally measured via the return increase or variance/extreme risk decrease of diversified portfolios compared to the undiversified portfolio (e.g., [Reboredo 2013](#); [Hammoudeh et al., 2014](#); [Wen et al., 2017](#)).

Based on all the above discussions, this paper contributes to the existing literature in the following two main dimensions. First, unlike studies which only investigate the risks and risk factors of energy stocks, we shift our focus on the risk diversification tools for energy stocks.<sup>2</sup> Our study constitutes the first attempt to seek diversification potential of commodity futures for Chinese energy stocks, which complements some works on the risks of Chinese energy stocks (e.g., [Broadstock et al., 2012, 2016](#); [Peng et al., 2017](#)). Second, since copula functions are advantageous in modeling the market dependence, we conduct our risk diversification analysis in a copula framework. More precisely, based on the estimates of a wide range of copula functions, we assess the diversification potential of commodity futures for Chinese energy stocks by measuring how better the diversified portfolios behave than the case of no diversi-

fication benefits ([Christoffersen et al., 2012](#)). Generally, our approach compares the return increase or risk reductions once returns and variances of the portfolio and of its individual assets are obtained. In this scheme of things, [Christoffersen et al. \(2012\)](#)'s approach is not only convenient to analyze two-asset portfolios, but also facilitates multi-asset portfolio analysis when necessary. It simplifies the measurement and provides a more general way for measuring diversification benefits. However, when extending [Christoffersen et al. \(2012\)](#)'s work, we evaluate the diversification benefits not only in terms of expected-shortfall, but also in terms of risk-adjusted return and volatility, thus leading to a more comprehensive measurement.

Unlike [Hammoudeh et al. \(2014\)](#) using the general commodity futures market indices in China, price indices of representative individual commodity futures (including the copper, gold, soybean, and cotton futures) are employed.<sup>3</sup> For the Chinese energy stocks, not only stock market indices of the fossil fuel and new energy sectors, individual stocks of large stated-owned energy companies (Shenhua Group, China National Coal Group, PetroChina, Sinopec, and GD Power Development Company) are also considered. This representative sample allows us to provide the stock investors with more specific diversification strategies. We mainly find evidence of significant diversification potential of commodity futures for energy stocks in China in terms of both volatility-based and expected shortfall-based measures (i.e., volatility and extreme downside risk reductions) over the sample period from 15 November 2010 to 28 January 2015. In particular, diversified portfolios with the gold futures provide the largest diversification potential, while those with the copper futures offer the smallest in most cases. Another important finding is that expected-shortfall-based conditional diversification benefits are much more pronounced than volatility-based conditional diversification benefits. These results confirm the safety of gold provided to the financial assets and also imply that gauging the pattern of tail dependence with appropriate non-linear dependence modeling provides the possibility to achieve more diversification gains.

The remainder of this article is organized as follows. [Section 2](#) describes the data used is provided in [Section 2](#). [Section 3](#) presents the methodology with respect to marginal distribution models, copula functions, and correlations and dynamic measures of diversification benefits. [Section 4](#) reports the empirical results. [Section 5](#) concludes the article.

## 2. Data

Daily closing prices for Chinese energy stocks and commodity futures are used in this study. As for energy stocks, China's coal and oil index (CO) and new energy index (NE) are firstly employed because they reflect the general performance of fossil fuel and new energy companies in China's stock market, respectively. Then, stock prices of several large stated-owned energy enterprises, including two coal companies (Shenhua Group and China National Coal Group), two oil & gas companies (PetroChina and Sinopec) and one wind and biomass energy company (GD Power Development Company) are considered to shed light on the diversification potential of commodity futures for individual energy companies. These companies are selected based on the size of their outstanding shares.<sup>4</sup> Regarding the Chinese commodity

<sup>2</sup> Besides of the literature noted above, very relevant studies with this paper also include studies such as [Haushalter \(2000\)](#), [Jin and Jorion \(2006\)](#) and [Phan et al. \(2014\)](#), however these studies emphasize the effect of risk hedging on the firm value of energy companies (mainly the oil and gas companies), and their hedging strategies consist of taking a short position of some amounts of derivatives and a long position in the spot market.

<sup>3</sup> We exclude energy commodity futures to the extent that energy companies are known to have revenue-based energy price exposures and thus their stocks are subject to energy price movements.

<sup>4</sup> In the coal/oil & gas industry, Shenhua Group and China National Coal Group (CNCG) / PetroChina and Sinopec are ranked the first and the second in terms of market capitalization, respectively. GD Power Development Company is ranked the first in the new energy industry. More details about China's coal and oil index and new energy index can be directly seen in [Wen et al. \(2014\)](#), and further information about China's coal and oil index, new energy index, and the individual energy stocks are all provided in Great Wisdom market software.

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