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Co-movement of international copper prices, China's economic activity, and stock returns: Structural breaks and volatility dynamics

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ABSTRACT

This study empirically investigates both causal nexus and time-varying correlations among international copper prices, China's real economic activity, and stock returns from January 1991 to December 2015. Using a cross-correlation function approach with structural breaks and dynamic conditional correlation models, we find, first, significant volatility cross-effects between international copper prices and real economic activity in China. Second, China's past stock returns play a pivotal role in forecasting future volatility in international copper prices, but not vice versa. Third, negative dynamic correlations between copper prices and China's stock returns around the 2008 global financial crisis suggest that a copper asset can hedge the risk of stock investment in China. Our results have important implications for investors, portfolio managers, and Chinese policymakers, who should regulate extreme financial speculation in copper to minimize the impact of excess volatility on the real economy.

1. Introduction

Dramatic fluctuations in resource prices in recent years have caused not only developed but also emerging countries to worry about the impacts on their real economic activity and financial markets. Besides crude oil and gold, one resource that cannot be neglected in forecasting economic growth and stock returns is copper. In August 2008, before U.S. stock prices crashed in September, the London Metal Exchange (henceforth, LME) price of three-month copper futures had already begun to fall sharply. After the LME copper price hit bottom and began to recover, from December 2008, U.S. stock prices showed signs of recovery in February 2009, and the economic growth rate turned positive from the third quarter of 2009. This phenomenon has generated increasing interest in the linkage among international copper prices, macroeconomic factors, and financial indicators. Both copper market investors and policymakers would be keenly interested in understanding these relationships. Therefore, considerable bodies of research have investigated the co-movement between copper price and macroeconomic variables (Batten, Ciner, & Lucey, 2010; Chen, 2010; Hammoudeh & Yuan, 2008; Pindyck & Rotemberg, 1990) and the correlation between copper price and stock returns (Creti, Joets, & Mignon, 2013; Choi & Hammoudeh, 2010; Mensi, Beljid, Boubaker, & Managi, 2013; Sadorsky, 2014). Although these studies show that international copper prices partly determine stock returns in some countries, academic research addressing this relationship in China, and its practical implications for portfolios, is still very limited. Meanwhile, little attention has been paid to the interaction between economic activity in China and international copper prices.

China is now the second-largest economy, and also has the second-largest stock market, in the world. With its remarkable economic growth in the past two decades, China accounts for the largest share by far of global copper consumption at the end of

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2016. It is thus reasonable to assume that China's demand significantly affects the international copper market; and in return, rising copper prices would increase input costs for industry and inflationary pressure in the Chinese economy. Therefore, our first important research question is whether a close interconnection exists between copper prices and China's real economic activity. If so, how are volatility and shocks transmitted between the two variables?

In recent years, because of increasing financial instability and the financialization of commodity markets, most investors in China have allocated portions of their investments to metals viewed as safe-haven and refuge assets. Copper, in particular, has become a recognized asset class within investors' portfolios as a means to diversify risks such as stock market fluctuations or inflation (a flight-to-quality phenomenon). However, benefiting from these investment opportunities and designing strategies for portfolio optimization requires good modeling of time-varying correlations between copper prices and China's stock returns. Therefore, our second research question is as follows: Is there a significant co-movement between China's stock returns and international copper prices? If so, what are the patterns of lead-lag information spillover in terms of market volatility between these two variables?

Given Chinese investors' predilection for copper as a refuge asset, it is also reasonable to expect that international copper prices are determined not only by primary demand in China, but also by China's derivatives trading and financial investors' activities. Accordingly, this study simultaneously examines the causality and dynamic relationships among international copper prices, China's real economic activity, and stock returns. Sadorsky (2014) found negative dynamic conditional correlations between emerging market stock prices and some commodity prices, and therefore suggested that a mixed commodity-stock portfolio should provide better diversification than a stock-only portfolio. Peng, Wang, and Rao (2014) indicated that the volatility of copper prices could predict China's stock portfolio, but paid little attention to the causal nexus between the volatility of copper prices and real economic activity in China. Moreover, the dynamic linkage between copper prices and stock returns at different stages of China's economic development has not been investigated empirically. Our study intends to fill this gap in the literature, to which it makes three significant contributions.

To begin with, this study is the first, to the best of our knowledge, to simultaneously examine the causal relationships among international copper prices, China's real economic activity, and stock returns. In particular, we apply Hong's (2001) time-varying causality test to examine the volatility spillover among the three variables from January 1991 to December 2015. Methodologically, our study differs from most in applying not just one, but three different specifications of the generalized autoregressive conditional heteroscedasticity (GARCH) model: GARCH (Bollerslev, 1986); threshold GARCH, or TGARCH (Zakoianv, 1994); and exponential GARCH, or EGARCH (Nelson, 1991). Second, we explicitly consider the impact of structural breaks on the causal interaction, which the literature has so far ignored. Since the estimation period for our study covers a somewhat turbulent time for China's economy, we execute Bai and Perron's (2003) test of unknown structural breaks and introduce dummies into our model to characterize China's economic fluctuations in the presence of structural breaks. Third, our empirical results clearly represent the magnitude of dynamic correlations among copper prices, China's real economic activity, and stock returns. In particular, we are the first to examine the magnitude of dynamic relationships among these variables by using dynamic conditional correlation (henceforth, DCC; see Engle, 2002) and asymmetric DCC models (henceforth, ADCC; see Cappiello, Engle, & Sheppard, 2006).

The remainder of this paper is structured as follows. Section 2 introduces previous research. Section 3 provides a brief overview of the copper market and the Chinese economy. Section 4 explains the data and estimation model used in the paper, and Section 5 reports the empirical results. Section 6 addresses the implications of these findings.

2. Literature review

While many studies have addressed the relationships between resource prices and economic variables, few have modeled the spillover effects between copper price and economic variables. This section synthesizes selected studies related to the present article.

Pindyck and Rotemberg (1990) examined the comovements of spot copper prices with the prices of six other unrelated commodities (crude oil, gold, cotton, wheat, cocoa, and lumber). They found that these commodities had a tendency to move together and that the comovement can be explained by the effects of common macroeconomic variables such as inflation, changes in aggregate demand, the interest rate, and the exchange rate. Franses and Kofman (1991) analyzed the relationship among LME forward prices for copper, lead, aluminum, zinc, and nickel. They found that the presence of a cointegrating relationship between the five variables implies the existence of a long-run relationship between the forward prices of these metals. Agbeyegbe (1992) also found a cointegrating relationship among the LME spot prices of lead, zinc, and copper and a bivariate relationship between copper and lead. Shyy and Butcher (1994) used data from June 1, 1992, through October 14, 1993, to investigate the interaction between copper prices in the LME and the Shanghai Metals Exchange (SME). The results suggest that the SME copper prices are cointegrated with those of the LME and that the LME spot copper price unidirectionally causes the SME spot copper price. Brunetti and Gilbert (1995) applied monthly data from 1973 to 1995 and found that volatility trends are similar in copper, aluminum, lead, nickel, zinc, and tin. Hardouvelis and Kim (1995) argued that there is a positive linkage between the volatility of copper futures contracts and the change in margin requirements.

Bracker and Smith (1999) and Smith and Bracker (2003) suggested that GARCH and EGARCH models explain the volatility of copper futures better than other models do. Liu, Cheng, Wang, Hong, and Li (2008) investigated spillover effects between the copper futures market and the spot market in China. They used GARCH and TGARCH models to execute a linear Granger causality test based on the daily data from July 10, 2000, to June 30, 2006. Their results indicated significant bi-directional volatility spillovers between the copper futures and spot markets, but especially from the futures market to the spot market. Watkins and McAller (2008), using an autoregressive GARCH (AR-GARCH) model, indicated that the volatility of copper varies over a long time horizon. Hammoudeh and Yuan (2008) examined the conditional volatility behavior of three metal prices (gold, silver, and copper) in response to the world oil