Journal of Cleaner Production 168 (2017) 254–262

Contents lists available at ScienceDirect

Journal of Cleaner Production

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

The impact of international price shocks on China's nonferrous metal companies: A case study of copper

Chunyan Hu [a], Xinheng Liu [b], Bin Pan [c, d, ***], Hu Sheng [b], Meirui Zhong [b], Xuehong Zhu [b, **], Fenghua Wen [b, e, *]

[a] School of Public Administration, Central South University, Changsha, Hunan, 410083, China
[b] Business School, Central South University, Changsha, Hunan, 410083, China
[c] Business School, Ningbo University, Ningbo, Zhejiang 315211, China
[d] Business School, Wenzhou University, Wenzhou, Zhejiang, 325399, China
[e] Supply Chain and Logistics Optimization Research Centre, Faculty of Engineering, University of Windsor, Windsor, ON, Canada

ARTICLE INFO

Article history:
Received 6 May 2017
Received in revised form
4 September 2017
Accepted 4 September 2017
Available online 5 September 2017

Handling Editor: Yutao Wang

Key words:
Copper price shock
Chinese stock prices
SVAR
Asymmetric impact

ABSTRACT

Copper is one of the most important nonferrous metals for modern society, which should be utilized in a sustainable way because of its non-renewable nature. This paper addresses the relationship between price shocks from the international copper market and China's listed copper companies. International copper market price shocks are disentangled into supply shocks, aggregate demand shocks, and specific demand shocks using the structural vector autoregression method. Then, the asymmetric impact of those shocks on the stock prices of China's listed copper companies is examined. The results indicate that demand shocks are the dominant factor influencing copper price fluctuations, with their impact on stock prices being significantly higher than those of supply shocks. In the long run, supply shocks and demand shocks both have significant asymmetric impacts on stock prices, while in the short run, specific demand shocks have an asymmetric impact on stock prices.

1. Introduction

Nonferrous metals as a representative of bulk commodities are important raw materials that play an indispensable role in economic development(Shao and Wang, 2016). Utilizing nonferrous metals in a sustainable way contributes to both economic development and cleaner production(Li et al., 2017). Actually, nonferrous metal production is affected by price fluctuations caused by changes in supply and demand, as well as by fluctuations in listed nonferrous metal companies' stock prices. Therefore, it is important to identify the supply and demand shocks that cause price fluctuations in the international nonferrous metal markets and to examine the effects of those shocks on the stock prices of listed nonferrous metal companies.

There have been extensive studies on the causes of international nonferrous metal price fluctuations. Kim and Ando (2012) show that strong demand for bulk commodities in the global economy is the main contributor of nonferrous metal price fluctuations. Many studies have blamed China for price fluctuations the international nonferrous metal markets. Streifel (2006) argues that demand from emerging economies, represented by China, is the main reason for rises in nonferrous metal prices. Cuddington and Jerrett (2008) suggest that international nonferrous metal prices have entered a super cycle since the beginning of the twenty-first century, and stress that urbanization and industrialization in China are the main contributing factors. Zhang and Zhang (2015) find that the economies of emerging countries recovered faster than the European economy after the global financial crisis, thereby boosting bulk commodities prices. However, Roache (2012) points out that the developed economies, headed by the US, are the primary

* Corresponding author. Business School, Central South University, Changsha, Hunan, 410083, China.
** Corresponding author. Business School, Central South University, Changsha, Hunan, 410083, China.
*** Corresponding author. Business School, Ningbo University, Ningbo, Zhejiang, 325399, China.
E-mail addresses: panbin@wzu.edu.cn (B. Pan), zhxh@csu.edu.cn (X. Zhu), mailtowfh@126.com (F. Wen).

http://dx.doi.org/10.1016/j.jclepro.2017.09.035
0959-6526/

contributors to the high prices of bulk commodities. Furthermore, the increase in global monetary liquidity has led to a rise in demand for nonferrous metals, thus monetary policy is also a factor influencing price volatility (Landgraf and Chowdhury, 2015). Zhang and Sun (2016) point out that some commodities price bubbles developed during the period November 2001–July 2008 as a result of deviations from fundamental values. Speculative trading on the demand side has also led to higher prices(Kaufmann and Ullman, 2009). Based on expectations regarding future supply, investors' precautionary demand may also lead to rises in nonferrous metal prices(Sommer and Gilbert, 2006; Wen et al., 2014b). Zhang and Zhang. (2015) point out that because of a range of factors including supply, demand, speculative trading, and geopolitical conflict, commodity prices exhibit complex, nonlinear, multi-wave characteristics.

Nonferrous metal prices are dominated by demand and supply, and influence the financial performance of companies in the mining industry (Dooley and Lenihan, 2005). With the ever-increasing financialization of bulk commodities, the correlation between the nonferrous metals market and the stock market has been further strengthened. Delatte and Lopez (2013), Gong et al. (2017), and Wen et al. (2014c) find that co-movement between commodity futures and stock prices has gradually intensified since 2003. Particularly, copper prices have had significant spillover effects on major international stock markets (Mensi et al., 2014). Zhang and Sun (2016) and Wen et al. (2017) also find time-varying spillover effects between different markets. For example, Australia's stock market was mainly impacted by the external spillover effects from London metal exchange(LME) copper futures during the global financial crisis (Todorova et al., 2015). Studies in China have found an asymmetric dependence structure between the metal price index and the stock price index (Hammoudeh et al., 2014). Peng et al. (2014) suggest that the price volatility of nonferrous metal futures is a good predictor of aggregate stock market returns in China.

Prior studies have demonstrated that demand is the main factor affecting nonferrous metal price fluctuations. However, studies concerning the relationship between nonferrous metal prices and stock market prices are mostly based on the hypothesis that the prices of nonferrous metals are exogenous to the stock market, which probably leads to spurious regression among variables(Kilian, 2009). As stated by Kilian and Park (2009), the prices of bulk industrial resources are not exogenous when the stock market is taken into consideration because variations in economic demand will simultaneously either increase or decrease both stock prices and bulk commodity prices. When two variables are simultaneously affected by the global economy, causality can be ambiguous (Barsky and Kilian, 2004). To solve this problem, Kilian (2009) introduces the structural vector autoregression (SVAR) model to identify exogenous supply and demand shocks in the crude oil market, noting that there is a significant difference between the impacts of demand shocks and supply shocks on the macroeconomy of the US, and confirms that it is more efficient to deal with risks arising from various market shocks by disentangling different shocks and treating them separately. Sim and Zhou (2015) demonstrate that aggregate shock has an asymmetric impact on US stock prices. Therefore, it is necessary to overcome the problem of endogeneity when studying the effects of bulk commodity price shocks on the stock market.

Among the nonferrous metals, copper has extremely high strategic and economic value. Copper prices are valid indicators of changes in the economic cycle, and are known as “Dr. Copper” in the academic community (Lahart, 2006). Volatility in the copper market can have significant effects on the broader economy (Cochran et al., 2012). China has been the world's biggest consumer of copper in recent years (Han et al., 2016). Therefore, this study aims to examine the impacts of supply and demand shocks from the international copper market on China's nonferrous metal companies. SVAR is used to identify the supply shocks, demand shocks, and specific demand shocks in the international copper market, among which specific demand shocks can be viewed as representing precautionary demand by investors facing supply uncertainty in the future. Then, we use a nonlinear auto regressive distributed lag error correction model (ARDL-ECM) to study the asymmetric effects of those shocks on the stock prices of China's listed copper companies over different time scales.

This study apply Kilian (2009) methodology to decompose international copper market shocks into supply and demand shocks, and to analyze the effects of those supply and demand shocks on the real price of copper, which addresses the shortage of studies that treat copper prices as exogenous. Then, this study simultaneously takes asymmetric effects and short- and long-term differences into account when analyzing the effects of supply and demand shocks on the stock prices of China's listed copper companies. The remainder of this paper is organized as follows. Section 2 presents the data in detail, Section 3 describes the methods used in the study, Section 4 discusses the results, and Section 5 concludes and provides policy recommendations.

2. Data

Our dataset consists of monthly data from August 2004 to December 2016 on global copper production, the Kilian economic index, actual copper prices, and the stock prices of 12 listed copper companies in China. The source of global copper production is based on monthly production volume data provided by the International Copper Study Group (ICSG, http://www.icsg.org/). Unlike monthly crude oil production, copper production has a strong seasonal characteristic. Thus, we adopt X-12 to make seasonal adjustments. We use the monthly Kilian economic index to represent the global economy (see http://www-personal.umich.edu/~lkilian/). The index measures global freight volume of diversified bulk commodities, which effectively depicts the global economic situation (Klovland, 2002), and thus is an effective indicator of global demand for copper. Furthermore, the Kilian index is compiled monthly, and thus is advantageous compared with GDP data compiled yearly. The copper price is sourced from average monthly data for imported copper prices provided by China's customs authorities. We calculate the copper price in RMB based on the Yuan/USD exchange rate. Then, price deflation is performed using CPI data, with August 2004 as the base period, to obtain the actual import price. This price reflects the variations in the global copper market and is used as the cost price for importing, processing, and production by China's copper companies. The selection of China's listed copper companies is based on industry classification standards identifying companies whose major business is copper production or copper operations. Twelve companies were selected: Jiangxi Copper, Yunan Copper, Tongling Nonferrous Metals, Sichuan Western Resources, Tibet Mineral Industry, Anhui Xinke New Materials, Sichuan Hongda, Tibet Tianlu, Pengxin International Mining, Shenyang Hejin Holding, Chengtun Mining Group, and Dezhan Healthcare. The real stock price is derived after applying a price deflate or based on China's CPI. All of the data used are available on the Wind database (http://www.wind.com.cn/En/).

The average stock price is calculated for the selected companies to analyze similarities in the stock price trend. From Fig. 1, it can be seen that global copper production continues to rise despite the effects of various significant global events. The Kilian economic