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Metal prices and stock market performance: Is there an empirical link?

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ABSTRACT

Most studies have focused on the role of oil and gold prices in the link between commodity prices and stock prices. This paper investigates the causal linkage between metal prices and share values for 10 European countries over the period of January 2011 to September 2016. On the basis of the bootstrap panel granger causality approach, the results show that the metal price index and stock price index are not causally related. The policy implication of this empirical finding is that the financial markets are informationally efficient in the sample countries' equity markets. Thus, the information contained in the metal price index cannot be used to predict the future values of the equity indexes.

1. Introduction

Surprisingly, little work has been done on the relationships between metal price index movements and stock market performance since previous studies have focused on the relationship between oil/ gold prices and stock prices. An important item that influences production costs, foreign and domestic earnings, and determines aggregate demand and supply is metal prices. An increase in metal prices leads to an increase and a decrease in income and wealth for metal producers and metal consumers, respectively. In other words, the aggregate demand affects corporate output and domestic price levels (through its effects on expected inflation which in turn affects the expected discount rate), which eventually affects corporate earnings and stock market share prices. Especially, asset prices and stock prices in particular will be influenced by the price of metals, through the cash flow of metal producing firms. Asset prices may then affect consumption through: (i) investments via the Tobin-Q effect (wealth channel), and (ii) increase a firm's ability to fund operations (credit channel).

Thus, asset prices may be an important transmission channel of wealth. It is rational to expect that the stock market would absorb information about the consequences of metal price shock and include it in stock prices very quickly. In efficient financial markets, the actors will predict these changes, therefore, the steps will take place almost simultaneously. Both the current and the future impacts of such a shock should be absorbed into prices and returns without waiting for those impacts to actually happen due to the fact that asset prices are the present discounted value of the future net earnings of firms. Such a strong metal price impact on the national economy makes countries primarily targets for examining the links between metal prices and the performance of their stock markets.

Recently, the prices of mineral resources have rapidly increased because of rapid increases in demand in China and throughout the world. While the competition toward the resources between countries occur very fiercely as the resource nationalism to nationalize the resources and even the speculation demand toward the resources have pitched in. The nonferrous metals are the ones used as raw materials to produce the daily necessities such as automobiles and home appliances while the consumption is getting greater in emerging markets. Various countries attempt to obtain the prior occupation of resources because the demand toward the minerals is getting increased even further as people's lives have become enriched while the mineral resources have recorded a significant increase of prices for the last twenty years.

Previous studies have investigated the role oil and gold prices in stock market performance. Rubio (1989) reveals the return on gold as a potential hedging variable, into his tests of the applicability of an intertemporal capital asset pricing model (ICAPM) in the Spanish market. In the ICAPM, investors can build portfolios to hedge against uncertainties. Davidson et al. (2003) also studied the importance of gold in an international asset pricing context. They conclude that, with its long distinguished and prominent role in the financial markets, gold is a potential factor in international extensions to asset pricing models such as Merton (1973) ICAPM.

However, previous studies on the relationship between oil prices, gold prices, and stock prices have produced mixed and contradictory results. Examples are Salant and Henderson (1978); Jones and Kaul (1996); Huang et al. (1996); Sadorsky, (1999, 2014); Papapetrou

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(2001); Hammoudeh and Aleisa (2004); Hammoudeh and Li (2005); El-Sharif et al. (2005); Malik and Hammoudeh (2007); Nandha and Faff (2008); Driesprong et al. (2008); Starr and Tran (2008); Bhar and Nikolova (2009); Bjornland (2009); Al Janabi et al. (2010); Hatemi-J and Irandoust (2015); Jain and Biswal (2016); Raza et al. (2016); and Singhal and Ghosh (2016). These studies have focused mainly on assessing oil/gold prices and their effects on stock prices using linear and non-linear cointegration analysis and different versions of GARCH approach.

The aim of this study is to explore the causal nexus of metal prices and stock prices for 10 European markets (Germany, Denmark, Belgium, Finland, Sweden, Italy, Spain, UK, France, and Netherlands) for the period January 2011 through September 2016. This issue is examined by using the bootstrap panel granger causality approach that accounts for both cross-sectional dependence and heterogeneity across countries. To the best of the author's knowledge, this approach has not been used in the previous literature on the relationship between stock market performance and metal prices.

The reminder of the paper is organised as follows. Section 2 discusses the data and methodology. Section 3 provides the empirical findings. The last section offers conclusions.

2. Data and methodology

The dataset used in this study consists of monthly observations for 10 European countries (Germany, Denmark, Belgium, Finland, Sweden, Italy, Spain, UK, France, and Netherlands) for the period January 2011 through September 2016. The rationale for choosing this time period is the availability of data for the sample countries. The metal price index (*MPI*), which includes copper, aluminum, iron ore, tin, nickel, zinc, lead, and uranium price indices, is obtained from IMF Cross-country Macroeconomic Statistics. The share price index (*SPI*) and nominal interest rate (*IR*), as a control variable, are taken from the OECD Monthly Financial Statistics.

The estimation follows the bootstrap panel Granger causality proposed by Kónya (2006). This approach has two important advantages. First, it is not required to test the unit root and cointegration (i.e. the variables are used in their levels, without any stationarity conditions). Second, additional panel information can also be obtained given the contemporaneous correlations across countries (i.e. the equations denote a Seemingly Unrelated Regressions system- SUR system).

Two steps should be followed before applying the bootstrap panel Granger causality: testing the panel for cross-sectional dependence and testing for cross-country heterogeneity. The first issue implies the transmission of shocks from one variable to others. In other words, all countries in the sample are influenced by globalization and have common economic characteristics. The second issue indicates that a significant economic connection in one country is not necessarily replicated by the others.

A set of three tests is constructed in order to check the cross-sectional dependence assumption: the Breusch and Pagan (1980) cross-sectional dependence (CD_{BP}) test, the Pesaran (2004) cross-sectional dependence (CD_P) test, and the Pesaran et al. (2008) bias-adjusted LM test (LM_{adj}). Regarding the country-specific heterogeneity assumption, the slope homogeneity tests ($\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$) of Pesaran and Yamagata (2008) are used. The Kónya's (2006) approach considers both issues, based on SUR systems estimation and identification of Wald tests with country-specific bootstrap critical values. This procedure allows us to consider all variables in their levels and perform causality output for each country:

$$\begin{aligned}
MPI_{1,t} &= \alpha_{1,1} + \sum_{i=1}^{lm1} \beta_{1,1,i} MPI_{1,t-i} + \sum_{i=1}^{\ln 1} \delta_{1,1,i} SPI_{1,t-i} + \sum_{i=1}^{lk1} \gamma_{1,1,i} IR_{1,t-i} + \varepsilon_{1,1,t},\\
MPI_{2,t} &= \alpha_{1,2} + \sum_{i=1}^{lm1} \beta_{1,2,i} MPI_{2,t-i} + \sum_{i=1}^{\ln 1} \delta_{1,2,i} SPI_{2,t-i} + \sum_{i=1}^{lk1} \gamma_{1,2,i} IR_{2,t-i} + \varepsilon_{1,2,t},\\
&\vdots\\
MPI_{N,t} &= \alpha_{1,N} + \sum_{i=1}^{lm1} \beta_{1,N,i} MPI_{N,t-i} + \sum_{i=1}^{\ln 1} \delta_{1,N,i} SPI_{N,t-i} + \sum_{i=1}^{lk1} \gamma_{1,N,i} IR_{N.t-i} + \varepsilon_{1,N,t},
\end{aligned} \tag{1}$$

and

$$\begin{aligned}
SPI_{1,t} &= \alpha_{2,1} + \sum_{i=1}^{lm2} \beta_{2,1,i} MPI_{1,t-i} + \sum_{i=1}^{\ln 2} \delta_{2,1,i} SPI_{1,t-i} + \sum_{i=1}^{lk2} \gamma_{2,1,i} IR_{1,t-i} + \varepsilon_{2,1,t},\\
SPI_{2,t} &= \alpha_{2,2} + \sum_{i=1}^{lm2} \beta_{2,2,i} MPI_{2,t-i} + \sum_{i=1}^{\ln 2} \delta_{2,2,i} SPI_{2,t-i} + \sum_{i=1}^{lk2} \gamma_{2,1,i} IR_{2,t-i} + \varepsilon_{2,2,t},\\
&\vdots\\
SPI_{N,t} &= \alpha_{2,N} + \sum_{i=1}^{lm2} \beta_{2,N,i} MPI_{N,t-i} + \sum_{i=1}^{\ln 2} \delta_{2,N,i} SPI_{N,t-i} + \sum_{i=1}^{lk2} \gamma_{2,N,i} IR_{N,t-i} + \varepsilon_{2,N,t}.
\end{aligned} \tag{2}$$

In equation systems (1) and (2), *MPI* is metal price index, *SPI* denotes stock price index, *IR* is nominal interest rate as a control variable, *N* is the number of panel members, *t* is the time period (*t=1, ..., T*), and *i* is the lag length selected in the system. The common coefficient is α, the slopes are β, δ, and γ, while ε is the error term.

To test for Granger causality in this system, alternative causal relations for each country are likely to be found: (i) there is one-way Granger causality from X to Y if not all $\delta_{1,i}$ are zero, but all $\beta_{2,i}$ are zero; (ii) there is one-way Granger causality from Y to X if all $\delta_{1,i}$ are zero, but not all $\beta_{2,i}$ are zero; (iii) there is two-way Granger causality between X and Y if neither $\delta_{1,I}$ nor $\beta_{2,i}$ are zero; and (iv) there is no Granger causality between X and Y if all $\delta_{1,i}$ and $\beta_{2,i}$ are zero. It is also allowed the maximal lags to differ across variables, but the same across equations. In this study, the system is estimated by each possible pair

Table 1
Cross-sectional dependence and slope homogeneity tests.

Method	Test statistics	p-value
Cross-sectional dependence test		
CD_{BP}	152.637***	0.0000
CD_P	14.801***	0.0000
LM_{adj}	10.617***	0.0000
Slope homogeneity test		
$\tilde{\Delta}$ test	19.345***	0.0000
$\tilde{\Delta}_{adj}$ test	16.650***	0.0000

Notes:
1. *** Indicate significance for 0.01 level.
2. CD_{BP} test, CD_P test, and LM_{adj} test show the cross-sectional dependence tests of Breusch and Pagan (1980), Pesaran (2004), and Pesaran et al. (2008), respectively.
3. $\tilde{\Delta}$ test and $\tilde{\Delta}_{adj}$ test show the slope homogeneity tests proposed by Pesaran and Yamagata (2008).