DYNAMIC INTERACTION BETWEEN THE MARKET FOR UPSTREAM CO-PRODUCT RAW MATERIALS AND THE DOWNSTREAM NEW ENERGY VEHICLE MARKET

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Overview

Critical minerals such as copper, cobalt, and nickel are widely employed in new energy vehicle, generating considerable interest. The copper is the main metal, whereas the cobalt and nickel are byproduct metals of copper. Under the capacity constraint effect, there is a price relationship between main and byproduct metals. The joint production relationship between byproduct metals and main metals also leads to greater uncertainty in the supply of byproduct metals, which has led to an increased risk of market instability for byproduct metals. The price linkage relationship between main metals and byproduct metals will have varied degrees of influence on high-tech industry development, product operating costs, and product competitiveness. From the perspective of the industrial chain, changes in the downstream market will also have a certain impact on changes in upstream raw material products. To investigate the dynamic interaction between the market for upstream co-product raw materials and the downstream new energy vehicle market is indispensable for industrial growth.

Methods

To investigate the dynamic relationship between copper, cobalt and nickel markets and the impact of new energy markets on the spillover effects of the three markets, this paper divides the empirical approach into two steps: First, the volatility spillover analysis covering the period January 4 in 2006 to May 16 in 2022. We analyze the volatility spillovers between copper, cobalt, and nickel markets using the methodology of Diebold and Yilmaz. Decomposing the price of earnings by the maximum overlap discrete wavelet and examining the direction and extent of metals market spillovers over different time scales by the wavelet multiple correlation and wavelet multiple intercorrelation. Furthermore, we also finished the wavelet coherence analysis to completing the conclusions of the above studies; Second, the impact of new energy vehicle market on the spillover effect of the three markets is analyzed mainly by linear Granger causality test and nonparametric quantile causality method covering the period December 30 in 2014 to May 24 in 2021.

Results

The copper makes the largest contribution to risk in the other two markets and cobalt makes the smallest contribution to risk in the other markets, in addition to cobalt being a net recipient of shocks in the other markets, while copper and nickel are net contributors. The copper and nickel were highly correlated at all time scales, while cobalt was only correlated with copper and nickel at high time scales. The significant wavelet coherence exists between the three markets only at low frequencies and that the significant co-movement over most of the sample period only at low frequencies.

According to the linear Granger causality tests and quantile Granger causality tests, there is a linear relationship between the new energy vehicle market and copper-to-nickel spillover, nickel-to-copper spillover, copper-to-cobalt spillover and nickel-to-cobalt spillover, and a non-linear relationship between the new energy vehicle market and cobalt-to-copper spillover. Consequently, the new energy vehicle market will have an impact on the copper-cobalt-nickel price spillover effect.

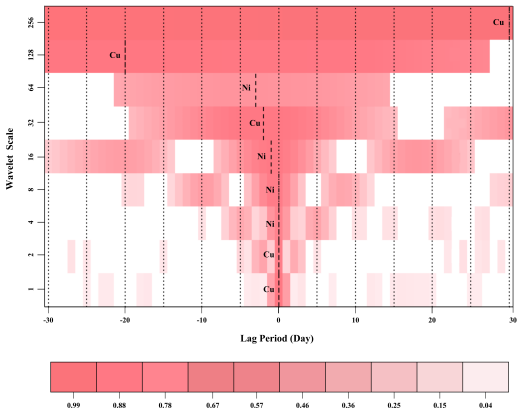

Fig. Wavelet Multiple Cross-Correlation

Note: For each wavelet correlation value in the above figure, the significance is at 95% confidence interval.

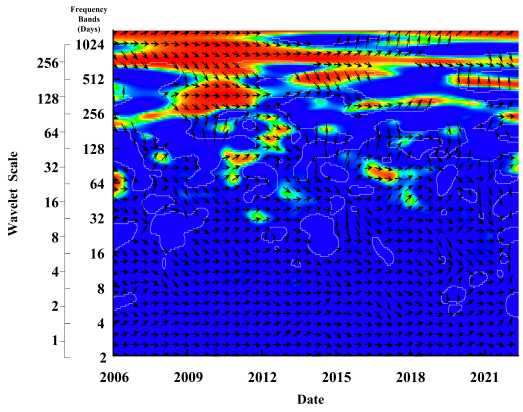

Fig. Wavelet Coherence between copper market and nickel market

Note: The direction of black arrows highlights phase difference between two markets. The direction of arrow towards right highlight that the variables are in-phase (both markets move in the same direction) whereas their direction towards left indicate that the variables are out-of-phase (both markets move in inverse direction). The directions of arrows highlighting leading and lagging relationships are as follows. (→) = variables are in-phase (i.e., cyclical effect on each other); (←) = variables are out-of-phase (anti-cyclical effect). (↗) or (↙)= first market is leading; (↘) or (↖)= first market is lagging. The horizontal axis presents timeline whereas vertical axis highlights frequency in terms of days. Red color indicates the presence of strong coherence between precious metal pair.

Conclusions

It is critical to monitor price variations in by-product metals. Risk spillovers between main and byproduct metal markets must be considered in risk hedge management for investors and portfolio managers, and portfolio investment strategies established based on the connectedness of main-byproduct metal markets could be improved by incorporating information related to the exogenous shock of the clean energy market on the metal markets. Particularly, for price forecasting and investment decisions on the metal market, both primary and byproduct metal prices should be collected.