

COVID-19 Pandemic Impact on Copper Futures Prices

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Abstract. The COVID-19 pandemic has halted the global economy, causing significant changes in the economic policies of various countries, which have had a significant impact on the relationship between supply and demand for various commodities. Under these circumstances, commodity prices have fluctuated significantly. This paper concentrates on the influence of the COVID-19 pandemic on copper prices to forecast the long-term movement of copper futures prices and provide investment conditions for transacting copper futures contracts. Comparing the timing of different monetary policy announcements in the United States with the trend of copper futures prices reveals a negative correlation between the copper futures prices and the Fed's rate. Moreover, copper storage is susceptible to logistical disruptions, and copper's financial properties have outweighed its industrial properties during monetary policy changes, resulting in a volatile downward trend in copper futures prices in the short term. Copper's industrial properties will be the primary contributor to stable monetary policy and economic expansion, resulting in a gradual upward trend in copper futures prices. In conclusion, hedging investors can profit from long copper futures when quantitative easing is announced, as future copper prices are anticipated to rise. Conversely, speculating investors can profit from long copper futures immediately after the contractionary monetary policy has been announced, as copper futures prices at that time are predicted to be at a trough and rebound shortly.

Keywords: COVID-19, Copper futures price, Monetary policy, Demand and Supply, Financial and industrial properties.

1. Introduction

1.1 Background

Copper's price has always been regarded as a significant economic leading indicator, as it is the most widely used non-ferrous metal in modern industry. Copper prices are extraordinarily sensitive to global economic conditions. It is also influenced by a variety of additional variables. Copper is an industrial metal that is affected by market supply and demand as well as inventory surplus. In comparison to other industrial metals, copper's financial characteristics are relatively prominent. Copper possesses several financial properties that are influenced by the global economic climate and monetary policy. Since the London Metal Exchange (LME) is the global pricing centre for copper and the US dollar is the pricing currency unit, the US economy has a significant impact on the price of copper futures.

1.2 Related research

The mechanism for pricing nonferrous metals has become more complicated, exhibiting nonlinearity, dynamic properties, and structure dissimilation. Chen analyzed the effects of financial elements on oscillations in non-ferrous metals' prices by constructing a theoretical framework and conducted a non-linear empirical analysis by applying the Markov-switching vector autoregression model, utilizing the monthly data of the price of international copper futures from 2004/08 to 2016/10.

Wu used the frequent data of the SHFE from July 2014 to September 2018 to construct a prediction model of the volatility of metal futures prices based on symbolic high-frequency time series. The outcomes indicate that the movement of the forecast histogram of copper futures earnings is less pronounced than the movement of the actual histogram, the overall condition of the forecast outcomes is better, and the overall volatility of the predicted one-week copper futures earnings is similar to the actual volatility [2]. Wang utilised a time series model to forecast the Shanghai copper futures price. As a result, the X12-ARIMA-TGARCH model provides the optimal conditions for forecasting the

Shanghai copper futures price. The forecast effect was determined by comparing the actual daily closing price of Shanghai CUL8 futures contracts with the price predicted by the same model [3]. Using a similar model, Lee derived changes in volatility spillover and return between the LME/COMEX and SHFE copper futures markets prior to and following the worldwide financial crisis, the result demonstrated that although the trading volume of the SHFE copper futures market has increased significantly since the crisis, it has not exceeded that of the LME/COMEX in terms of information spillover effect [4].

Zhang examined the effect of the COVID-19 pandemic on the short-term and long-term volatilities of futures contracts on the most important commodities. Research is conducted by extending ARMA (m, n)-GARCH (p, q) models to incorporate COVID-19 impacting factors. According to research, the COVID-19 pandemic has accelerated copper's long-term volatility, and the pandemic's increasing prevalence will boost copper's instantaneous volatility in the short run [5]. In the meantime, Liu discussed the differences between the Shanghai copper futures market prior to and following the pandemic in terms of the price discovery mechanism and volatility spillover effect. Using the cointegration test and causality test, both short- and long-term data have been validated. The result shows that there is a steady dynamic equilibrium correlation between the spot market and Shanghai Copper futures, which constructs a bidirectional assistance trend [6]. Yu conducted additional research utilising wavelet analysis and grey correlation analysis to examine the synchronisation properties of the spot and future price relationships for copper on a scale-by-scale basis. The key findings suggest that the dynamic correlation between copper spots and futures prices varies in amounts, whereas the oscillation of daily, quarterly, and annual copper future-spot price connections appears robust. These correlations of copper spot and futures prices can be utilised in pricing adjustment strategies and cross-market arbitrage [7].

Pedersen investigated the relationship between copper price shocks and macroeconomic factors in Chile, the world's largest copper producer. Empirical analysis has been conducted by setting up a structural VAR model with sign restrictions to identify shocks. Results demonstrate the correlation between a shock's source and its economic impact. Copper prices rise in response to a rise in global demand, which is indicative of Chile's economic growth. However, supply and specific copper demand shocks have a negative impact on growth [8]. Valenta provided an up-to-date, exhaustive, multi-factor risk profile again for the future copper supply of the world by analyzing the top 308 largest undeveloped copper orebodies. It has been discovered that a significant portion of future copper supply involves non-price-sensitive factors, and the rapid release of these ore bodies may have negative effects on human development and economic growth [9].

Juan described the evolution of warehouses and the composition of copper prices, as well as their utility for hedging in the context of a catastrophic event. It has been demonstrated that contango in futures price structures has increased in value during this period and that the rising inventory levels in copper LME warehouses are associated with a sustainable contango structure. In a context where commodities were previously more financialized, fundamental market effects now predominate [10].

1.3 Objective

This study will concentrate on how COVID-19 drives the copper futures price from three factors. The paper's structure is as follows: Beginning with the beginning of the epidemic, the effects of various monetary policies implemented by the United States in response to the then-current economic climate on copper futures prices are examined. Second, the effect of changes in supply and demand and storage volumes on copper futures prices on the global refined copper market during the epidemic. Lastly, the effect of the interaction between copper's metal properties and industrial properties on copper futures prices.

2. Description of current status

Prior research has investigated the variables that affect the volatility of spot prices for non-ferrous metals. Using a sample of high-frequency data from the Shanghai Copper Futures Exchange, predict the volatility of copper futures prices, demonstrate the dynamic correlation between copper futures prices and spot prices, and argue the copper futures market's revenues and returns. Existing studies analysed the effects of major market events on copper prices, discussing differences in volatility spillovers between the SHFE and LME/COMEX copper futures markets before and after the global financial crisis, as well as differences in price discovery mechanisms and volatility spillovers in the Shanghai copper futures market prior to the COVID-19 epidemic. In addition, prior research has demonstrated a mutual influence between economic development and changes in copper prices, with higher copper spot prices and futures price premiums due to rising global demand, which will have a negative long-term impact not only on economic growth but also on human development and sustainable social development.

As the global environment enters the post-epidemic period, however, the negative effects of the economic downturn caused by the COVID-19 pandemic and the easing policies implemented by countries to stimulate the economy at the beginning of the pandemic are gradually emerging, with the high inflationary status of countries around the world serving as a prime example. Existing research has not considered how the U.S.'s gradual implementation of fiscal and monetary policies as the world's representative will affect copper futures and spot prices in an effort to curb this phenomenon. Similarly, fluctuations in supply and demand and storage volumes affecting copper futures prices on the global refined copper market during the epidemic are significant factors influencing copper futures and spot prices, which need to be further studied.

3. Impact factor analysis

3.1 Impact of monetary policy

Copper futures price fluctuations are significantly influenced by the monetary policy adopted by the United States in response to the effects of the epidemic. Since the beginning of the epidemic, the global economy has shut down, and production and processing companies that use copper as a raw material have also ceased operations. In the global market, both demand and supply of refined copper have decreased, leading to an increase in refined copper inventory. Futures prices are more responsive to economic changes as a leading economic indicator than spot prices. As shown in Figure 1, on 3rd February 2020, Copper futures prices reached a trough in the past of the year of 2.6005, due to the anticipated economic market sluggishness.

Since March 2020, the United States has implemented a quantitative easing monetary policy to help the economy withstand the effects of the COVID-19 pandemic. Since then, the Federal Reserve has implemented an unprecedented bond purchase programme, continuing to purchase unlimited quantities of U.S. treasury bonds and mortgage-backed securities in order to support the efficient operation of the market and the transmission of monetary policy. This conduct is comparable to an open-ended quantitative easing policy. Simultaneously, the Federal Reserve lowered the target range for the federal funds rate to between 0% and 0.25%, and the U.S. government printed a significant amount of money to initiate a quantitative easing policy of 700 billion U.S. dollars to expand market liquidity facilities. The rise in the US dollar's money supply has resulted in a consistent increase in the dollar's global currency circulation. Currently, commodity prices worldwide have increased significantly. As the CPI in the United States continues to rise, it is possible to predict the inflationary risk associated with quantitative easing monetary policy. As shown in Figure 1, after reaching the trough of 2.1750 on 23rd March 2020, copper futures prices began to rise which acts as a predictor of future copper prices.

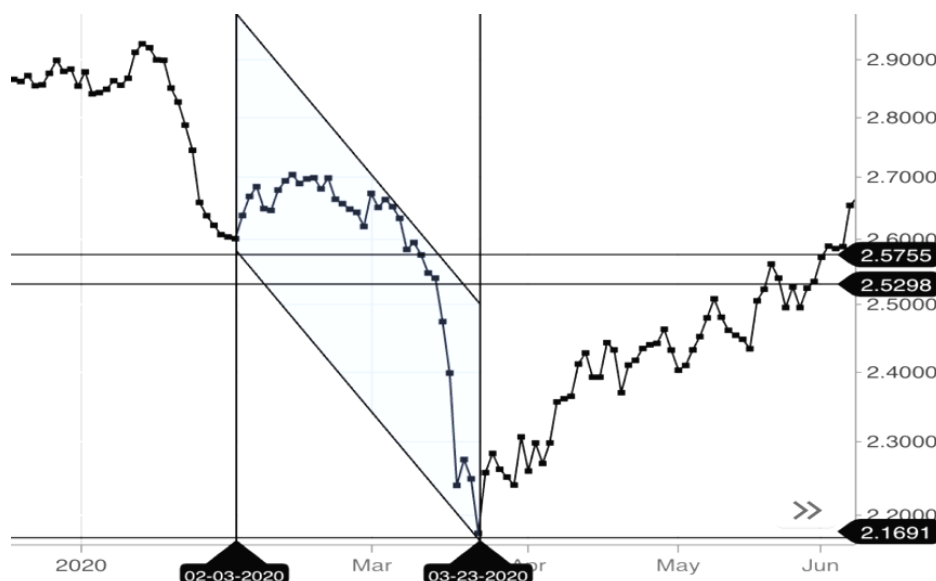


Fig. 1 Movement of copper futures price (2020/02/03 - 2020/03/23)

As a result of the continued implementation of quantitative easing in the United States, the proportion of government assistance has increased. The epidemic in the United States diminished gradually, and social control was loosened to promote economic growth. Concurrently, the epidemic has halted the global industrial supply chain cycle. Consequently, the CPI in the United States has accelerated since March 2021, rising 1.7% year over year in February and continuing to rise. Investors believe that the United States will stop quantitative easing, implement a tighter monetary policy, and raise interest rates to encourage the return of funds and the return of US dollars in a highly inflationary economic climate. Commodity prices will eventually decline in this situation. Beginning in May 2021, the price of rising copper futures decreased (Figure 2 shows that the copper future price reached the peak of 4.705 on 11th May and dropped slightly by 3.2% during the next month with an average value of 4.5776). In addition, the fact validated the futures market's speculation. In November 2021, the Federal Reserve announced that it would begin to reduce its bond purchases and hinted that interest rates might begin to rise.



Fig. 2 Movement of copper futures price between two peaks (2020/05/11-2022/03/04)

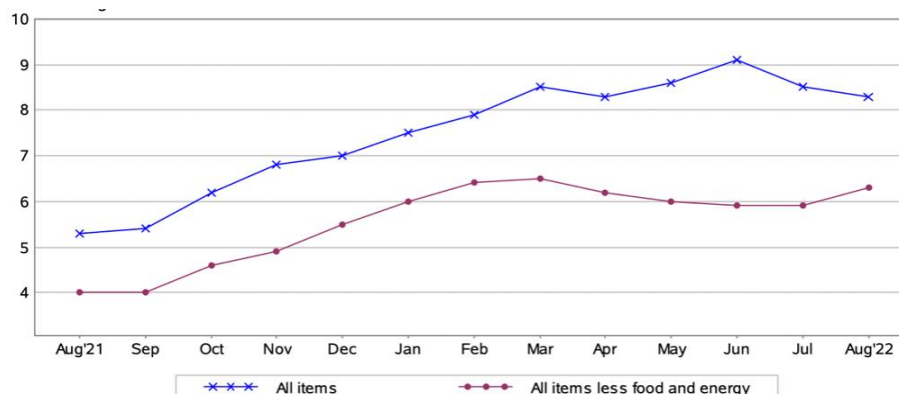


Fig. 3 12-month percentage change in CPI-U (2021/08–2022/08)

As Figure 3 shows above, the CPI in the United States increased by 7.9% annually in February 2022, exceeding expectations. The Federal Reserve announced in mid-March that it would raise interest rates by 25 basis points and end quantitative easing. The CPI increased 8.5% year-over-year in March, the highest annual increase in the past four decades, which corresponded to the highest value of copper futures price during the past two years (4.8655 on 4th March 2022). Despite a decline, it reached 8.3% in April. In May, the Federal Reserve increased interest rates by an additional 50 basis points and announced that it would begin selling previously acquired assets and promoting the reduction of its balance sheet in June. Shown as the peak in Figure 4, the copper futures prices plummeted from their monthly high of 4.5690 at the beginning of June, primarily due to the Federal Reserve's interest rate increase. Beginning in June, the Federal Reserve announced a continuous increase of 75 basis points. Following the change, the interest rate increased from 1.5% to 1.7%, further contributing to the decrease in copper futures prices.

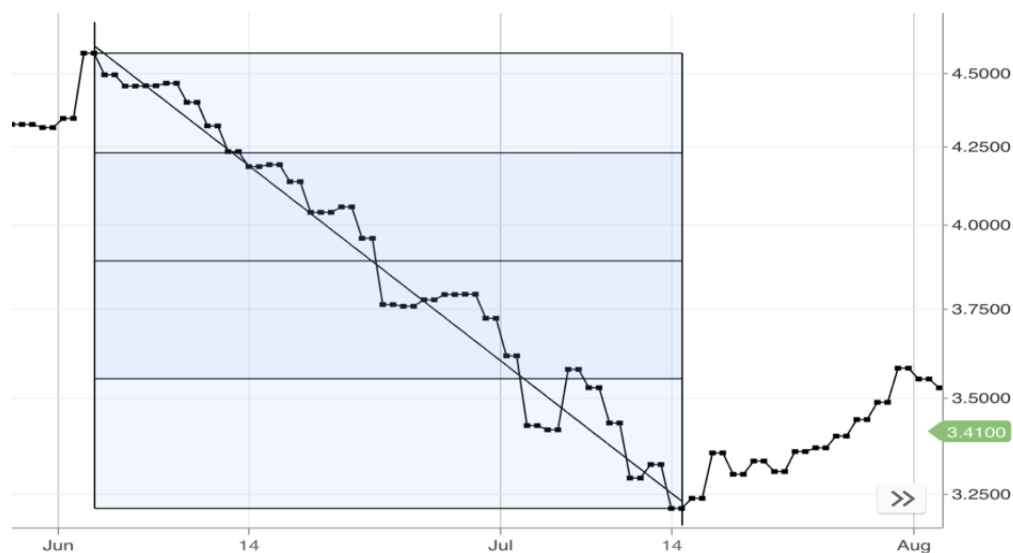


Fig. 4 Regression line of copper future price (2022/06/02–2022/07/14)

Shown as the trough in Figure 4, the price of copper futures dropped to 3.2125 on 14th July before recovering gradually thereafter. This is caused by the fact that after an interest rate adjustment, future prices stop falling and rebound during the maintenance period.

3.2 Demand & supply analysis

According to microeconomic principles, a commodity's price falls when its supply exceeds its demand and vice versa. Likewise, the price will influence supply and demand. When the price rises, supply will increase and demand will decrease and vice versa.

Inventory is an important indicator of the relationship between supply and demand. Copper inventory is separated into reported and unreported inventory. Exchange inventory is referred to as reported inventory or explicit inventory. Copper futures trading is currently dominated by the Shanghai Futures Exchange (SHFE), the COMEX division of the New York Mercantile Exchange (NYMEX) and the London Metal Exchange (LME). All three exchanges publish designated warehouse inventory on a regular basis. Non-reported inventory, also known as "hidden inventory," refers to inventories held worldwide by producers, traders, and consumers. As a consequence, given the fact that these inventories are not regularly disclosed to the public, which is difficult to identify, inventories are typically measured in relation to the inventories in exchanges.

As an indispensable industrial raw material copper's demand is highly correlated to the state of the economy. Copper demand increases as the economy expands, causing copper prices to rise and vice versa. In addition to contributing to inflation, the actual supply of copper remains below expectations. From 2020 to the first quarter of 2022, the growth rate of the refined copper supply will remain between 1% and 3%, which is lower than the expected growth rate of 4-6%. Copper's recent sharp price increase is largely attributable to the market consensus that the global economy will begin to recover in 2021. Copper supply issues exist despite the market's expectation that the European and American economies will enter a recovery cycle and that demand will surge.

The decline in global copper production has tightened the supply and demand relationship. In 2020, the global production of refined copper reached 23,94 million tonnes, a 2% increase over the same period in 2019. The global demand, however, is 25.33 million tonnes, resulting in a supply deficit of 1.39 million tonnes. In contrast to the relatively small supply deficit of 383,000 tonnes in 2019, the global copper production capacity has decreased. Copper prices have increased since 2020 as a result of supply shortages and rising demand.

Since 2021, when the strict restrictions imposed by COVID-19 were lifted and the global economy reopened, copper demand has increased. After continuous destocking in 2020 and 2021, stocks during the off-season of early 2022 have not been significantly depleted. At the end of April 2022, copper inventories on the LME, COMEX, and SHFE totalled 371,000 tonnes, which is low but within the normal range. When the impact of international copper stocks on the Shanghai Futures Exchange is subtracted, the price is at an all-time low. There are currently only 48,400 tonnes of SHFE in stock, and this number continues to decrease. although there will be a small surplus of copper in 2022 and 2023 as a result of robust mine supply growth, inventories are likely to remain extremely low, with any logistical disruptions having the potential to cause local copper shortages.

Nonetheless, with the improvement in the epidemic situation, the previously tense relationship between supply and demand for copper has dissipated, and the copper price has lost momentum for a sustained rise. From a long-term perspective, the relationship between copper's supply and demand will cause the price of copper futures to experience a relatively volatile downward trend in the short term, but there will be a gradual upward trend in the long term, which will return to the price level of copper futures during the epidemic gradually.

3.3 Interaction between copper's metal and industrial properties

Copper futures prices fluctuate according to certain rules based on the interactions between copper's financial properties and industrial properties in different economic environments and monetary policy contexts.

Firstly, the financial and industrial properties of copper influence the price trend of copper futures bilaterally, with the relative dominance of the two properties shifting over time. After the implementation of zero interest rates and quantitative easing during the economic market downturn, market confidence slowly recovered. Despite persistent economic pessimism, copper prices have rebounded sharply, with its financial property dominating a backdrop of abundant liquidity. At the onset of the economic recovery, liquidity remained abundant, copper prices increased as industrial property prices dominated. Copper futures prices decreased during the period of economic consolidation due to the anticipated withdrawal of easy monetary policy and the gradual dominance

of financial assets. Copper futures prices will remain under greater pressure during the period of exiting a contractionary monetary policy, despite the expansion of the economy.

Secondly, although the long-term Treasury bond yield bottom rebounded at the beginning of the recovery, the upward trend of copper futures prices has not changed. Referring to the performance of copper spot and futures prices during the recovery period of the 2008 financial crisis, at the beginning of the recovery, the bottom of the treasury bond yield rose and the upward trend of prices was halted due to the anticipation of monetary policy adjustment and inflation resulting from the economic recovery. Since last year, the focus of development has shifted to reviving the global economy, which was halted by the pandemic; this has also contributed to the increase in copper futures prices.

In addition, copper prices will decline gradually as the economic recovery gains traction. This is due to the fact that economic growth will gradually return to normal once the stable period commences. Despite this, the financial and industrial properties of copper were initially overestimated, resulting in a gradual decline in the price of copper futures.

The significant decline in copper prices is a direct result of the change in monetary policy. In conjunction with the previous analysis, it can be concluded that, as a result of the change in monetary policy, financial property has once again become the primary contributor, exerting greater downward pressure on copper prices. In the long run, when monetary policy and economic growth are relatively stable, copper's industrial properties will outweigh its financial properties, resulting in a gradual upward trend in the price of copper futures.

4. Conclusion

In this study, the impact of the COVID-19 pandemic on the future price of copper is examined from three factors. Our research indicates that, from the perspective of monetary policy, there is a negative relationship between the fed's rate and the price of copper futures; copper futures prices tend to rise if the market implies quantitative easing as a predictor of potential inflation, while it tends to decline if the Fed raises interest rates, which is indicative of a decline in commodity prices. In addition, copper storage is susceptible to logistical disruptions, and copper's financial properties have outweighed its industrial properties during periods of monetary policy change, resulting in a relatively volatile downward trend in copper future prices in the short term. Copper's industrial properties will become the primary contributor under the relatively stable monetary policy and economic growth conditions, resulting in a gradual upward trend in copper futures prices in the distant future.

According to the research, the price of copper futures is sensitive to economic conditions, and the price fluctuates significantly when policy and market changes are announced. When the price of copper futures fluctuates significantly in the short term, hedging investors can adjust their risk tolerance and mentality accordingly. When quantitative easing is announced, the suggested investment strategy is long copper futures, in anticipation of higher commodity prices in the future. Moreover, the period of announcement of contractionary monetary policy is a good time for speculating investors to long copper futures, as an increase in the Fed's rate will cause a sharp drop in the price of copper futures. However, the industrial properties of copper will cause its futures price to rebound, allowing long copper futures contracts to be profitable.

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