

Factor Analysis and Influence of Aluminum Price

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Abstract. Since 2018, the large fluctuations in aluminum prices have had an impact on the economy as well as the related industrial chain. To lessen the impact of aluminum price fluctuations and to reduce the volatility of aluminum prices. This paper aims to investigate the various factors influencing aluminum prices and the degree to which each factor affects aluminum prices. This paper examines the price trend of aluminum over the past decade, the price of aluminum, and the impact of various factors such as the Russian-Ukrainian war and the pandemic on the price of aluminum. This paper states some observations. The supply of alumina and the price of electricity have a significant impact on the price of aluminum, and the supply and demand of aluminum, as well as the global economy, are closely related to the price of aluminum. The government should implement a sound monetary and economic policy and stabilize the energy supply in order to reduce the volatility of aluminum prices and their effect on production.

Keywords: Aluminum price; Price trend; Supply and demand.

1. Introduction

1.1 Background

Since 2018, the global aluminum market has been impacted by the pandemic, the war in Russia and Ukraine, and the global economic recession, which has resulted in significant price fluctuations in the global aluminum market. Since the onset of the outbreak in April 2020, prices have rebounded to all-time lows, followed by a steep decrease in March 2022. Due to economic recovery drivers, prices increased following the outbreak.

Due to the economic impact of fluctuations in global metal prices, it is vital for metal-exporting nations to comprehend the causes, characteristics, and effects of these fluctuations in order to formulate appropriate policy responses. Price fluctuations of varying duration and magnitude can result from shocks caused by a variety of factors. When the more severe and long-term impact of factors, it may be necessary to make economic and policy adjustments to mitigate the effects of price volatility.

1.2 Related research

Numerous research investigating the relationship between aluminum pricing and other elements, such as monetary liquidity, macroeconomic factors, epidemics, aluminum inventory loading queues, etc., have examined a variety of methodologies. Chen et al. empirically examine the relationship between aluminum prices and monetary liquidity by extending the theoretical model of Frankel and Rose to account for the interaction of commodity prices with monetary liquidity and expectation formation. Vector autoregression (VAR) and impulse response function methods are utilized. Long-lasting connections and short-term dynamics [1]. Labys et al. analyzed the prices of aluminum, copper, tin, lead, and zinc in addition to macroeconomic variables such as industrial production, consumer prices, interest rates, and stock prices. Using dynamic factor analysis, it was tried to figure out what effect macroeconomic factors have on the volatility of LME metal prices. Results indicate that common metal price factors may be related to this macroeconomic effect [2]. Gilbert considers the effects of a particular instance of bank involvement in the physical commodities trade and demonstrates that the warehouse load-out queues that emerged, as a result, increased not only aluminum premiums but also the total price paid by aluminum consumers and received by aluminum producers, and highlights the aluminum warehousing issues [3]. Su et al. analyze whether COVID-

COVID-19 affects oil and precious metals prices by comparing data derived from web search trends and actual events. This study used the linear Granger causality test and the nonparametric causality-in-quantity method to examine the relationships between the four most-traded metals and crude oil. While the linear Granger causality test indicated no causal relationship between COVID-19 and oil and precious metal prices (i.e., online search trends and real occurrences), the nonparametric test revealed a nonlinear association between the structures. The findings of nonparametric tests indicate that COVID-19 has substantially affected the price of oil and precious metals [4].

While analyzing the impact of various factors on aluminum prices, numerous studies have employed various techniques to forecast the long- and short-term prices of aluminum and its social supply. Pincheira and Hardy employ the standard statistical measures of forecast accuracy—mean squared prediction error and mean directional accuracy—to demonstrate that the exchange rates of certain commodities exporting nations can predict aluminum contracts' current and future prices. In addition, they investigate how they may collectively utilize the predictive knowledge contained in all of our commodity currencies [5]. Sverdrup et al. employ a comprehensive model to evaluate the long-term forecast for future primary aluminum production and aluminum supply to society. Considering the dynamic feedback of market processes and policies, recycling, protection, and the buildup of aluminum in society will receive particular emphasis. This study's model creates aluminum prices on the global market from the interaction of supply and demand through the market mechanism [6]. Ru and Ren, through the analysis of aluminum price, an ARMA-based method for predicting aluminum price is proposed. The results demonstrate that the model can adequately account for the price fluctuations of aluminum, and the prediction results demonstrate the model's validity and dependability [7]. Wzorek et al. examine aluminum market prices over the 20th and 21st centuries, with a concentration on the previous five years. Identified are variables influencing the price of this metal, as well as those influencing short- and long-term aluminum price estimates on global marketplaces, including the London Metal Exchange [8].

In addition, there is research on the transformation of the aluminum industry, the degree of commercialization of aluminum ingots, and price difficulties, along with policy proposals to prevent the cyclical impact of non-ferrous metal prices. Choksi examines the extent to which major aluminum producers have lost pricing flexibility due to the industry's massive structural transformations over the past few decades. According to statistical analysis, aluminum ingots have been "commoditized," although not to the same extent as the copper industry. During the semi-manufacturing stage, the company can still isolate the price of mill products from the fluctuations that affect ingot prices [9]. Cheng et al. used the V statistic and the empirical modal decomposition method to empirically analyze the cyclical characteristics of a country's non-ferrous metal price fluctuations, using copper and aluminum prices as examples. They proposed relevant countermeasures and suggestions based on the research findings to prevent the periodicity of non-ferrous metal prices—the adverse effects of volatility on the economy and industry [10].

1.3 Objective

A variety of factors contribute to the price volatility of aluminum. The price of aluminum has been affected differently by epidemics, wars, and recessions. In 2020, global economic growth was expected to decline by approximately 3% before rebounding by 6% in 2021. From 2019 to 2021, China's economic growth will decelerate and increase before picking up in 2021. China accounts for approximately 60% of the world's aluminum consumption. Aluminum is used a lot in construction and other industries undergoing cycles. Because of changes in global and Chinese economic growth, global demand for metal has gone up and down. The Russia-Ukraine war, the new crown pneumonia, economic sanctions, political sanctions, and the energy crisis have all simultaneously affected the mining, processing, and transmission businesses in the related industry.

The purpose of the research presented in this paper is to investigate how different factors affect aluminum prices and the magnitude and persistence of these effects. Which factors have the most

significant effect on aluminum prices? What effect do these factors have on the price of aluminum for nations, businesses, and individual investors?

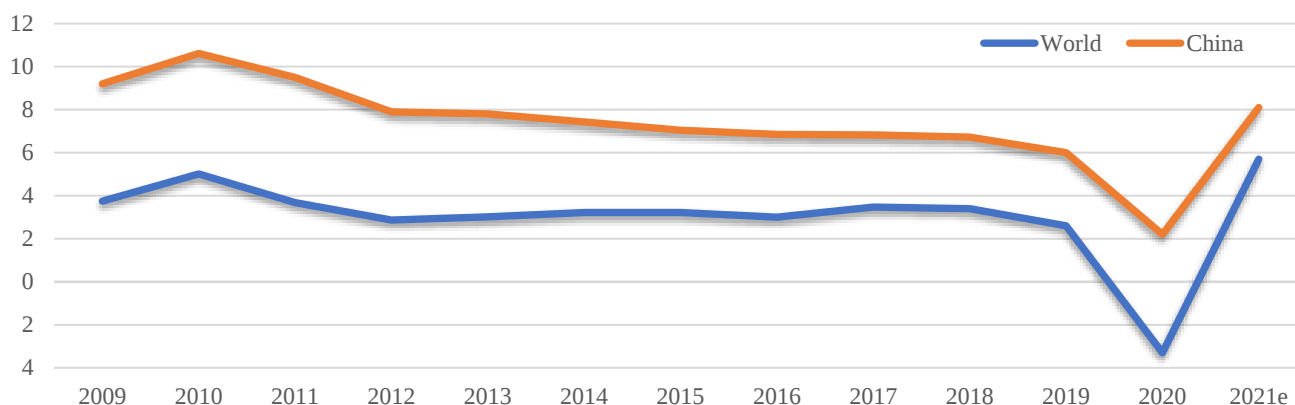


Fig. 1 The Economic growth of World and the Economic growth of China

2. The price trend and price situation of aluminum

2.1 The price of aluminum in ten years

The price of aluminum has exhibited significant volatility over the past three years, and the breakout of the new crown epidemic in 2019 has triggered a global recession due to the blockage of imports and exports and the closure of several facilities. Between January and March of 2020, the global price of aluminum reached record lows. With the subsequent global economic recovery, the price of aluminum rose sharply. By March 2022, aluminum prices adjusted for inflation and hit their second-highest level in a decade. Since then, aluminum costs have decreased by an additional 36%.

Figure 2 depicts the price trend of LME aluminum futures over the past decade (2012-11-22 to 2022-11-14). In the past decade, the price of aluminum futures has reached its lowest point between 2016 and 2020, at approximately 1400 USD/ton. From 2012 to 2016, the futures price of aluminum fluctuated between approximately 2000 USD/ton and approximately 1500 USD/ton. From 2016 to April 2018, the price of aluminum futures fluctuated between approximately 1500 USD/ton and approximately 2200 USD/ton, with a high of 2485 USD/ton. From April 2018 to May 2020, the price of aluminum futures fluctuated between 2200 and 1500 USD/ton. The price of aluminum futures continued to rise from May 2020 to February 2022, and the increase was evident. Futures prices for aluminum went from about \$1,500 per ton to a high of \$3,849 per ton. From February 2022 to November 2022, the price of aluminum futures began to decline, with the shock falling to approximately 2400 USD/ton.

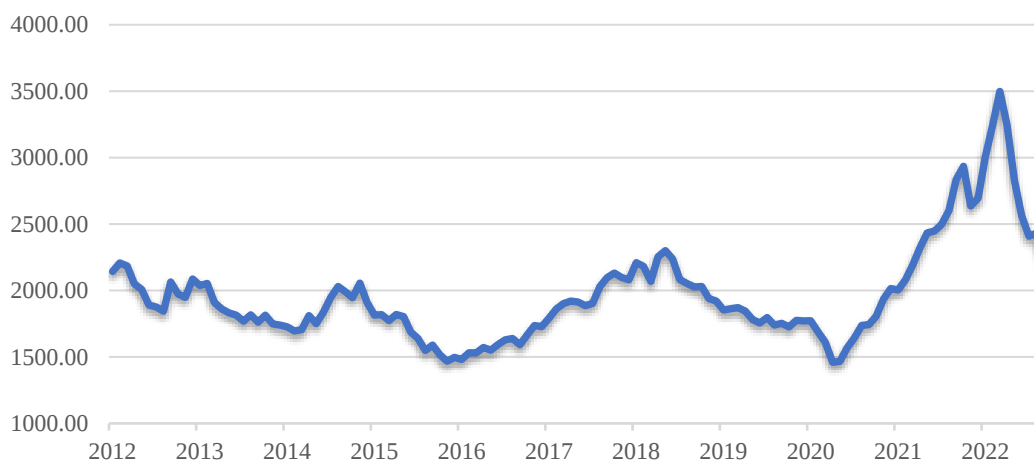


Fig. 2 The price of aluminum (2012 to 2022)

2.2 The Price of Aluminum in 2022

Aluminum futures traded near \$2,400 per tonne, near their highest levels since mid-August, after the world's largest consumer, China, eased coronavirus-related restrictions, sparking rumors of a broader easing and providing a short-term boost to the demand outlook. (Figure 3) On the supply side, the London Metal Exchange (LME) has decided not to prohibit the trading and storage of Russian metal in its warehouses, as the majority of the market still intends to purchase metal from Russia in 2023. Still, the metal is down roughly 40% from its all-time highs earlier this year due to persistent fears that aggressive tightening by major central banks will cause a global recession and reduce demand. Alcoa, the largest U.S. aluminum producer, cautioned investors that rising energy and raw material costs and falling aluminum prices are putting pressure on profit margins. Due to Russia's invasion of Ukraine in March, the price of a tonne of aluminum exceeded \$4,000.



Fig. 3 The price of aluminum in 2022

3. What factors determine or affect the price of aluminum

3.1 The influence of supply and demand

Demand and supply have a direct impact on the market price of a commodity. When market supply and demand are in brief equilibrium, the commodity's market price will fluctuate within a small range; when supply and demand are out of balance, the price will fluctuate substantially.

Aluminum is an adaptable, lightweight, corrosion-resistant, and recyclable metal with several applications in the building, automotive, aerospace, packaging, and electronics industries, among others. The transition from autos to electric vehicles has raised the metal's demand. Aluminum is used in the structural structures and battery packs of electric vehicles to keep them lightweight and enhance battery performance.

Aluminum is utilized in the body frames and battery packs of electric vehicles to keep them light and increase battery efficiency. Aluminum accounts for around 30% of construction materials in emerging nations. Construction expansion rates can be volatile. Interest rates, unemployment, and the condition of the economy as a whole can affect aluminum's demand and price.

Countries are a demand source when accumulating stockpiles and a supply source when liquidating them. Prices may be affected by events occurring in any country. This is especially crucial when a country accounts for a big proportion of production or consumption, indicating that events in that country or countries may have a substantial effect on commodity prices.

The global demand for aluminum is concentrated. Between 2002 and 2006, the World Bureau of Metal Statistics recorded 22 bauxite producers and 67 customers. Australia, China, and Brazil were the top three producers, while China, the United States, Japan, and Germany were the top four buyers.

3.2 Alumina supply and pricing

Alumina accounts for approximately 28%–34% of the production cost of aluminum ingots. Hence, the supply and price of alumina will have a direct impact on the price of aluminum ingots. In 2000, the international spot price of alumina fell from a high of \$450/ton at the beginning of the year to a low of \$165-175/ton by the end of the year, while the international futures price of aluminum ingots fell from \$1,753/ton at the beginning of the year to \$1,480-1,650/ton during the same period.

Figures 4 and 5 depict the price change trends of alumina and aluminum from 2020 to 2021, respectively, and it can be seen that the price trends are incredibly similar. According to the correlation analysis, the price correlation between alumina and aluminum from 2020 to 2021 is as high as 0.72.

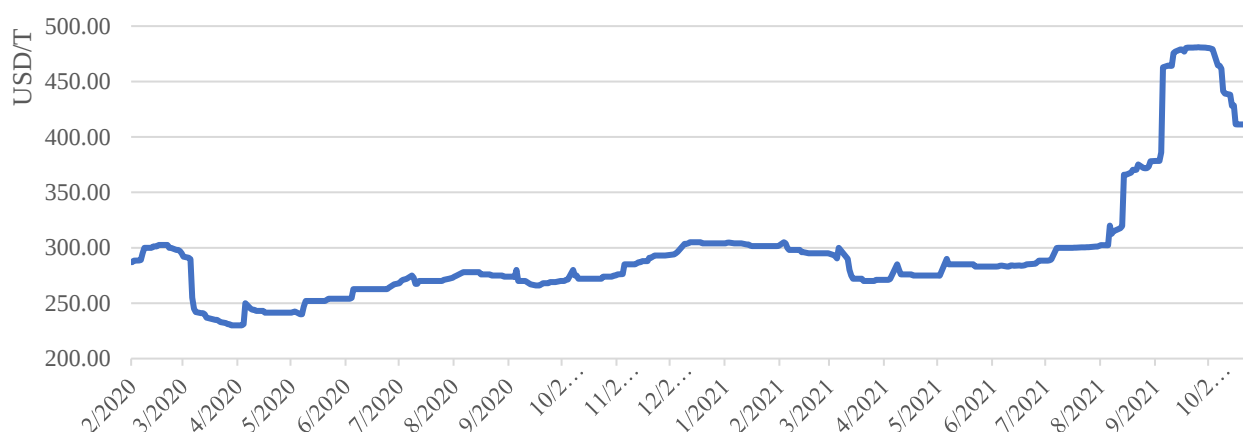


Fig. 4 Alumina Price (2020 to 2021)

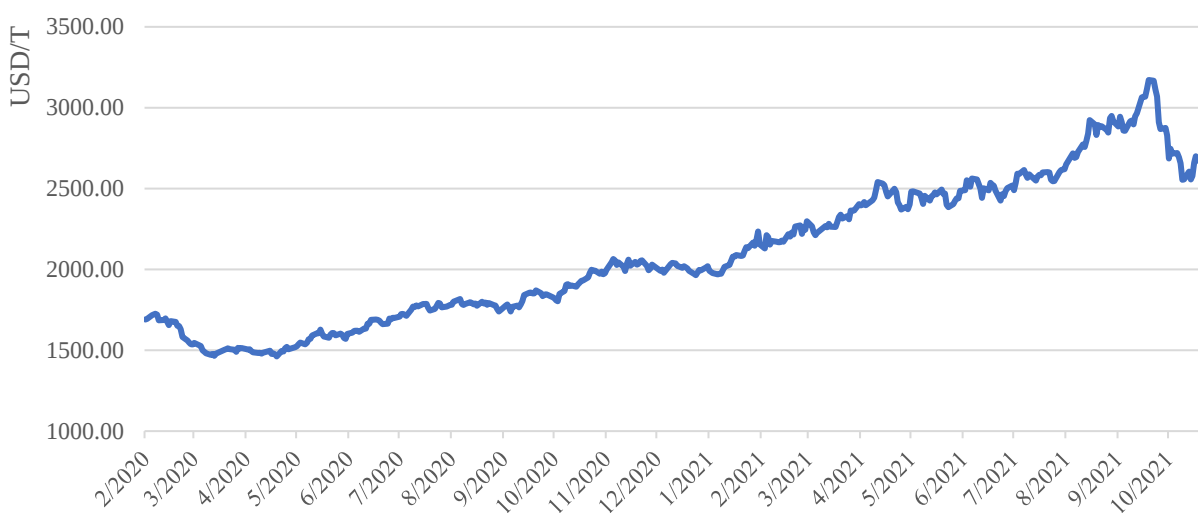


Fig. 5 Aluminum Price (2020 to 2021)

3.3 Energy dilemma

Aluminum is the most energy-intensive basic metal to produce, with energy expenses accounting for 30% to 44% of the final aluminum ingot's overall cost. Due to growing electricity costs in Europe and the United States, companies have struggled to maintain profitable operations.

European aluminum electrolysis plants have reduced output primarily due to the high cost of power. For instance, after the onset of the financial crisis in 2008, the price of electrolytic aluminum fell, causing European electrolytic aluminum manufacturers to reduce production; in 2012, certain European countries initiated countervailing investigations on electricity prices, resulting in an increase in electricity prices, causing European electrolytic aluminum manufacturers to reduce

production once more. As of the year 2020, the energy intensity of European electrolytic aluminum smelting is 15,499 kWh/ton, ranking it at the top of the global cost curve for electrolytic aluminum. By September 2022, the cumulative production reduction capacity in Europe will reach around 1.538 million tons, representing approximately 15% of the region's total electrolytic aluminum capacity. Recall that in 2021, aluminum smelters in the European region reduced production by 928,000 tons due to rising energy costs, and that the annual output of European electrolytic aluminum production in 2021 was approximately 7.5 million tons, with production cuts accounting for 12.4% of total output. As energy prices increase, it is anticipated that additional aluminum smelters will begin production cuts in the fourth quarter of this year. Aluminum production in Europe has fallen to its lowest level since the 1970s due to the energy-intensive industry's struggle to deal with growing energy prices. Some analysts assert that if European electricity prices remain consistently above 90 euros in 2022, production cuts could continue to expand by 600,000 tons, and that by the end of 2022, European production capacity, excluding Russia, will be approximately 1.2 million tons lower than its peak in the second quarter of 2021, with final production falling by approximately 800,000 tons from 2021.

3.4 Global Economy

The worldwide recession has had an effect on aluminum prices. The downward trend in aluminum prices since the beginning of the global recession is strong proof that a global recession leads aluminum prices to decline. Figures 6 depict the aluminum price trend, and gray shades show global recessions. After the severe global recession caused by the epidemic, global economic activity rebounded sharply and then slowed again as policies tightened. China, one of the world's largest metal consumers, temporarily halted production and shut down ores as a result of the pandemic; global demand shifted from services to commodities and then reversed; the war between Russia and Ukraine, the pandemic policy, and recent inflation control policies have all had a negative effect on global economic activity.

From January 2020 to April 2020, aluminum prices plummeted by 18%, the largest drop in the same period in nearly ten years. From April 2020 to March 2022, aluminum prices more than doubled, representing the most significant increase in aluminum prices for the equivalent time over three decades. Since then, a quarter of aluminum's price gains have been retraced in less than five months due to increased fears of a worldwide recession putting downward pressure on commodities prices as a whole.

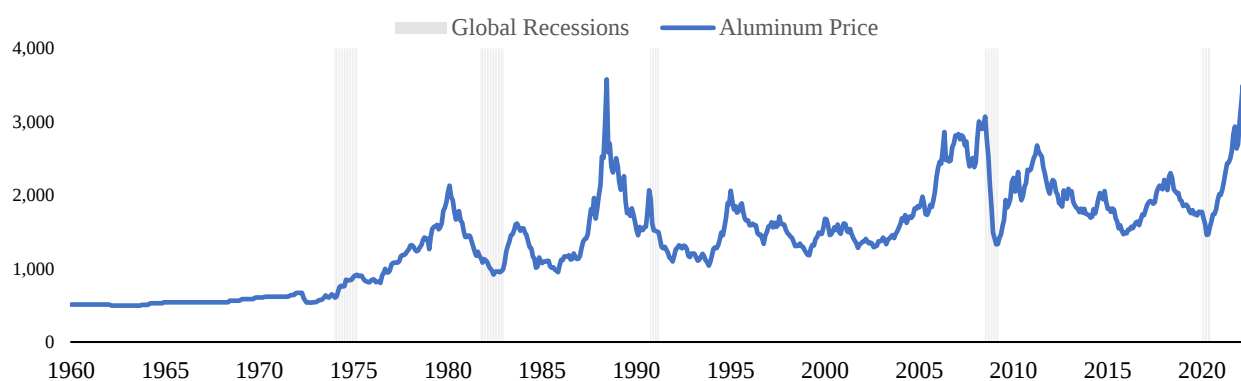


Fig. 6 Aluminum Price (1960 to 2022)

4. Conclusion

This paper examines the significant price variations of aluminum in recent years, the pattern of aluminum prices over the previous decade, and the variables influencing aluminum pricing. The effect of elements such as aluminum demand, alumina, the energy crisis, electricity prices, and the global economy on the price of aluminum is explored. Aluminum prices are determined by the production and supply of alumina and the cost of power. Alumina and electricity usage are the two major

components of aluminum expenses. Aluminum price is influenced by the world economy and aluminum demand. Aluminum's price is influenced by the demand for aluminum from various nations and industries. A global economic recession causes aluminum prices to decline, but a global economic rebound causes aluminum prices to climb. The government should develop a sound fiscal and monetary policy framework to lessen the impact of aluminum and metal prices on the economy and related enterprises and to reduce the volatility of aluminum prices. The government should make adjustments to ensure energy supply and maintain stable energy prices, thereby mitigating the impact on aluminum prices. There are numerous factors that contribute to the fluctuation of aluminum prices, the most significant of which are controlling the cost of the aluminum production process, maintaining a stable demand for aluminum, the stability of the global economy, and the sound economic policies of individual nations.

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