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The Impact of the US-China Trade Conflict on China's Metal Market

Ying Shao[1,a,*]

[1]*College of Letters & Science, University of Wisconsin-Madison, Madison, 53706, United States*
a. shao67@wisc.edu
**corresponding author*

Abstract: The US-China trade war began in March 2018. The United States imposed trade sanctions on China such as increasing tariffs on imported goods, including tariffs of 25% on imported steel and 10% on aluminum. As an important resource for bilateral import and export between China and the United States, metal products are greatly affected by the trade war, which has caused severe fluctuations in the Chinese metal market. This article selects the Chinese metal market prices from September 30, 2011, to December 2019, establishes an ARIMA model to simulate and analyze the data, predicts future trends, and finally finds that the trade war exerts adverse effects on the metal product market in China, driving down the market and making it more difficult for companies to survive. The research suggests that policy makers should pay more attention to relevant companies, adopt a more active stance to resolve the trade war, and restore market stability.

Keywords: United States, China, trade war, metal market, ARIMA model

1. Introduction

The trade war against China launched by the United States reflects its increasing perception of China as a significant competitor. Although the US is still the leader in the world economy, China is not only the second largest economy, but also one of the largest exporters in the world. And it is also the permanent member of the United Nations, which plays a more and more important role in international community. In US-China trade, China has always exported cheap goods to the US, occupying a considerable weight in the US market and maintaining a trade surplus. This not only poses a threat to domestic employment in the United States, but also affects the American manufacturing industry. Combined with the current political situation in the world, the United States inevitably regards China as a challenger to its global leadership. In this situation, Trump imposed trade sanctions on China and increased tariffs on imports of Chinese goods. As for metal products, the US has imposed new tariffs of 25% on imported steel and 10% on aluminum since March 8, 2018. In contrast, China has also adopted anti-sanction measures, such as terminating tax cuts for scrap aluminum from the United States.

The trade of metal products between the two countries is very frequent. In 2017, the US accounted for 14% of China's total aluminum exports. Until October of that year, the US produced only 840,000 tons of aluminum while importing over 5.7 million tons, with 550,000 tons sourced from China. In terms of steel, although China is only the eleventh largest import partner of the United States in the world, accounting for just 2% of total steel imports, since China is the largest steel exporter in the

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world, the US steel industry believes that China's significant steel exports to other countries indirectly contribute to a substantial share of steel imported by the United States. In terms of copper, the United States possesses abundant copper resources and is one of the important source countries for the copper imports of China. In 2017, China imported 2,100 tons of refined copper and 433,000 tons of copper concentrate from the United States, which accounted for 0.06% and 2.5% of the import proportion respectively; while importing scrap copper from the United States was 535,000 tons, accounting for 15% of the import proportion, which is the main source of copper scrap imports in China. This close metal trade is bound to be directly impacted by the US-China trade war, which will have a huge impact and change the price trend of Chinese metal products market.

This research hopes to establish an ARIMA model to predict the market price of metal products, and to show the impact of the trade war on the metal market more intuitively by comparing it with the actual price trend. Based on this, it will provide suggestions to policy makers and investors, and ultimately promotes the introduction of policies that are favorable to the market and encourages investors to invest more rationally.

2. Literature Review

After the reform and opening, China has experienced rapid development, from a backward country to the world second largest economy. As the largest economy and the world's hegemon, the United States not only has close trade relations with China, but also maintains a state of alert against China. Tao Liu and Wing Thye Woo pointed out that the US launched a trade war against China out of concerns about China's long-term trade surplus, its wariness of China stealing advanced technology from the United States through trade, and the most fundamental concern that China will threat the national security and political status of the United States [1]. The reason why the trade war broke out during this period is closely related to the Trump administration. Olaniyi Evans pointed out that the core of Trump's economics is America First, so he does not hesitate to go against the background of economic globalization and threaten the global economy [2]. Dan Steinbock believes that the Trump administration, based on the "imperial presidency", relies on emergency status quo, new campaign funds and "big money", which is not good for both China and the United States [3]. The outbreak of the trade war does not only harm the interests of China, but also harms the United States in the long run. R Hass and A Denmark believe that the trade war policy implemented by the Trump administration cannot really solve the deep-seated problems of the US economy and will only hurt the US [4].

In the field of metal products, the United States has also adopted a sanction policy of imposing tariffs. CTA Fund Website listed the categories of tariffs imposed by the United States on China, pointing out that the metal trade between the two countries is close, and the trade war will burden both countries' metal imports [5]. Sara Skejo believes that the trade war will lead to a reduction in steel and aluminum trade, which will hit the US economy and damage diplomatic relations between the United States and its allies [6]. This impact is indeed global, and H Mao and H Görg believe that trade issues between the two countries in areas such as metals will indirectly bring heavy burdens to many other countries [7]. For China, Liu K believes that although the trade war will have a blow to China's manufacturing industry, due to the 'Made in China 2025' plan, it is difficult for China to compromise in the trade war [8]. Of course, trade war affects China and US differently. V Archana believes that compared with the United States, China will still benefit from industrial products [9]. The fluctuation in the metal market significantly impacts investors as well. J. Chen, Y. Huang, X. Ren, and J. Qu indicated through the TVP-VAR model that there is a robust dynamic spillover between trade policy uncertainty (TPU) during the trade war and the precious metal market. They call upon investors to pay attention to international trade policies when making investments [10].

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Generally speaking, the research on the US-China trade war and its impact on metal products as well as other fields point out the negativity of the trade war. Whether it's for China, the United States, or any other nations globally, the trade war has resulted in disruptions within industries and inflicted damage on all countries.

3. Research Design

3.1. Data Source

The research uses China's financial terminal Wind to collect daily, weekly, and monthly closing price data of metal products from September 30, 2011, to the present, and selects the data up to December 2019 to exclude the interference of the global covid-19 epidemic. And the date, March 8, 2018, when the US-China trade war erupted with the US imposing supplementary tariffs on metal products, was selected as the key research object. By analyzing the stock price before and simulating the stock price change situation after that, it provides data and theoretical support for the study.

3.2. Weak Stationarity Test

Before constructing the model, to ensure the accuracy of its predictions, it is necessary to conduct a unit root test on the model. Initially, it assumes that a unit root exists, indicating non-stationarity in the time series. Subsequently, daily, weekly, and monthly metal product price data are imported into Stata for weak stationarity testing, leading to the final Table 1. It can be observed that after performing first-order and second-order differencing, the p-values for both cases are 0, which is less than 0.1. This leads us to reject the null hypothesis, indicating that the model achieves stability and can be used for prediction.

Table 1: Weak stationarity test.

	t-statistic	p-value
	Daily	
Raw	-1.168	0.9168
1st order difference	-28.693	0.0000
	Weekly	
Raw	-1.194	0.9118
1st order difference	-12.887	0.0000
	Monthly	
Raw	-1.243	0.9013
1st order difference	-7.191	0.0000
2nd order difference	-9.913	0.0000

3.3. ARIMA Model

The ARIMA model is an ARMA model that takes difference into account. Due to the high p-values obtained from the autocorrelation analysis of the original data, which means the non-stationarity of the time series, difference is applied to the data before using the model for forecasting in order to make the time series stationarity series.

$$Return = \phi_0 + \sum_{i=1}^{p} \phi_i \, Return_{t-i} + a_t - \sum_{i=1}^{q} \theta_i a_{t-i} \quad (1)$$

In equation (1), Return is the observed value of the time series at time. ϕ_0 is the constant term.

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AR(p) model is $\sum_{i=1}^{p} \phi_i \, Return_{t-i}$, where p is the order of the autoregressive process. It indicates that the current return is influenced by its own past value $Return_{t-i}$ with corresponding coefficients ϕ_i. And this model is a prediction of future metal product prices based on past metal product stock closing price data.

a_t is the white noise or error term at time t. It's an unobserved random variable.

MA(q) model is $a_t - \sum_{i=1}^{q} \theta_i a_{t-i}$, where q is the order of the moving average process. It indicates that the current return is influenced by past error terms a_{t-i} with corresponding coefficients θ_i. This model aims to predict the future price through the disturbance of the closing price of metal products in the past.

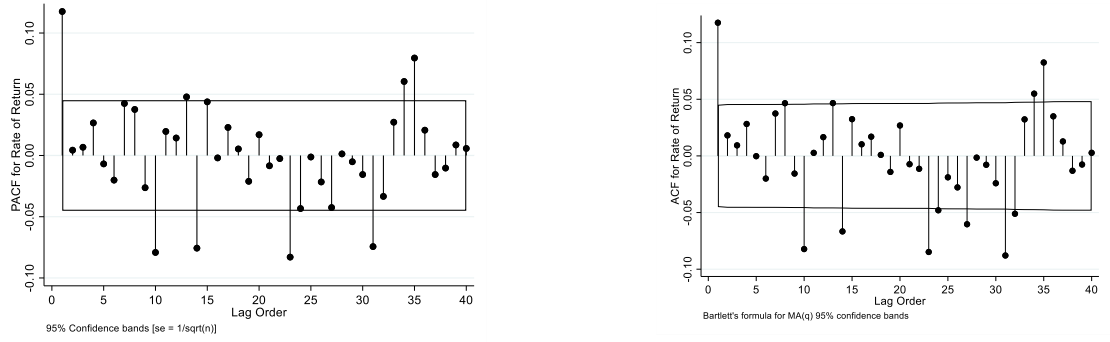
4. Demonstration Results and Analysis

4.1. Order Selection

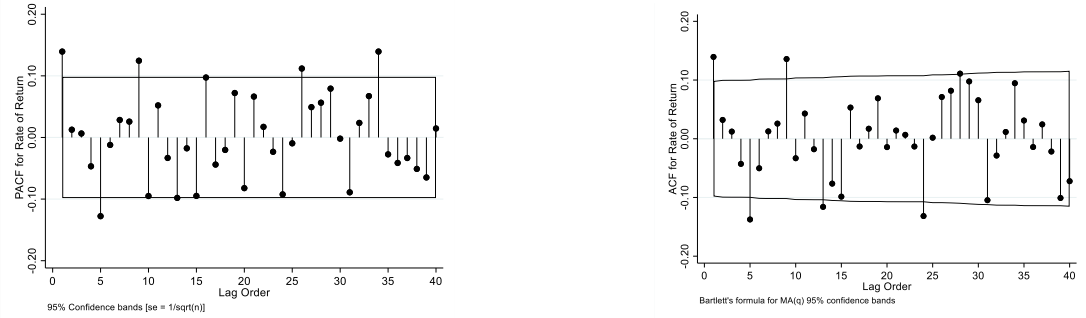
After confirming the differencing order d, based on the PACF and ACF plots in Figure 1 obtained from STATA, the values of p and q can be determined. In this context, values greater than 5 are selected for p and q. Upon observation of the two images of daily data in the first row in Figure1, the first occurrence of exceeding the confidence interval in the PACF plot is at x=10, and the first occurrence in the ACF plot is also at x=10. Since the difference order for daily data is 1, the model is ARIMA (10,1,10). As for the second row in Figure 1, the first occurrence of exceeding the confidence interval in the PACF plot is at x=9, and in the ACF plot, it is also at x=9. With a difference order of 1, the weekly model is ARIMA (9,1,9). Regarding the third row in Figure 1, in the PACF plot, the first occurrence of exceeding the confidence interval is at x=6, while in the ACF plot, it only exceeds the range at x=1. So, with d=2, the monthly model is ARIMA (6,2,1).

PACF ACF

Daily



Weekly



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Monthly

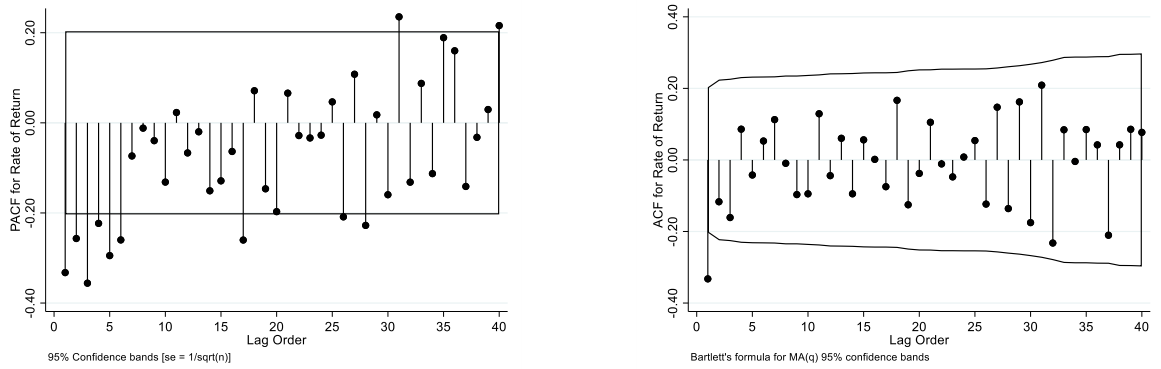

Figure 1: ARMA (p, q) identification.

Note: The Y-axis depicts the dependent variable, PACF, and ACF of the logarithmic returns for daily, weekly, and monthly metal stocks. The X-axis is the time lag order and the range limited by y=±2 standard error indicates the 95% confidence interval for AR(p) and MA(q).

Photo credit: Original

4.2. Residual Test

Before the normal experiment, it is also necessary to use the above-mentioned PACF plot and ACF plot to conduct autocorrelation tests on daily-ARIMA, weekly-ARIMA and monthly-ARIMA to ensure that the model can be used. After the operation of STATA's wntestq, the Table 2 is obtained. It shows that the Portmanteau (Q) statistics of the three are 55.3266, 25.7344 and 33.9280 respectively. And their p values are 0.0541, 0.9608 and 0.7392 in that order, all of which are greater than the significance level of 0.05. Thus, the null hypothesis of uncorrelated residual sequence can be accepted. The model meets expectations and can be used for prediction.

Table 2: Residual test.

Model	Portmanteau (Q) statistic	Prob > chi2
Daily-ARIMA (10,1,10)	55.3266	0.0541
Weekly-ARIMA (9,1,9)	25.7344	0.9608
Monthly-ARIMA (6,2,1)	33.9280	0.7392

4.3. Prediction Results and Interpretation

Through the model prediction, the daily, weekly and monthly closing prices of metal products are simulated, and the following Figure 2, 3 and 4 can be obtained. In these three graphs, the blue curve is the actual value.

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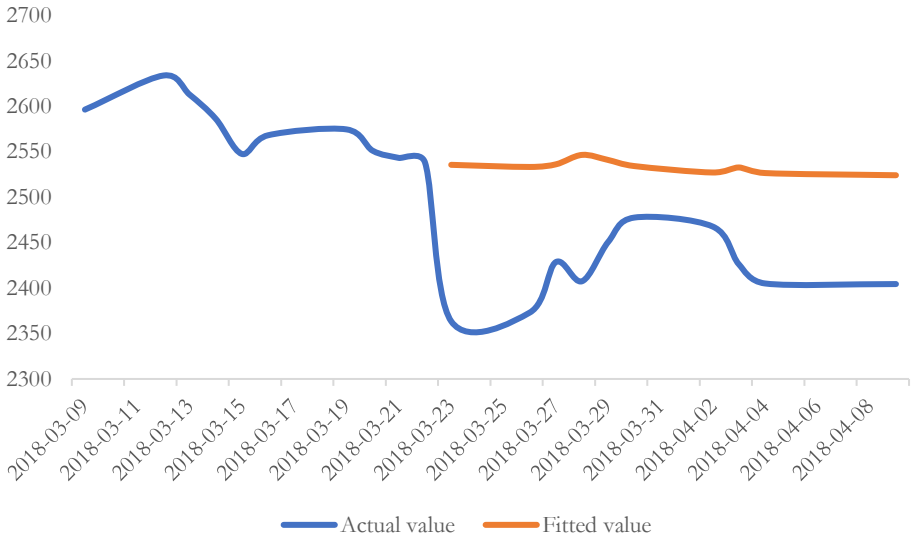

Figure 2: Actual value and fitted value, daily.

Photo credit: Original

The orange curve is the prediction that how the closing price of metal products may change after March 2018 if there doesn't exist US-China trade war basing on past price data and disturbances. According to the prediction results, it shows that the two curves do not overlap. Overall, the orange curve is above the blue curve, indicating that the estimated value of the model is higher than the real value, that is, the outbreak of the trade war has a negative effect on the price of China's metal products. Specifically, in the Figure 2 which predicts the daily data, it shows the direct impact of the outbreak of the US-China trade war on the metal product stock price. After a few days of reaction, it dropped rapidly on March 23. After that, there were some ups and downs, but in total it kept decreasing. However, it should show a smooth curve as the expectation by the model.

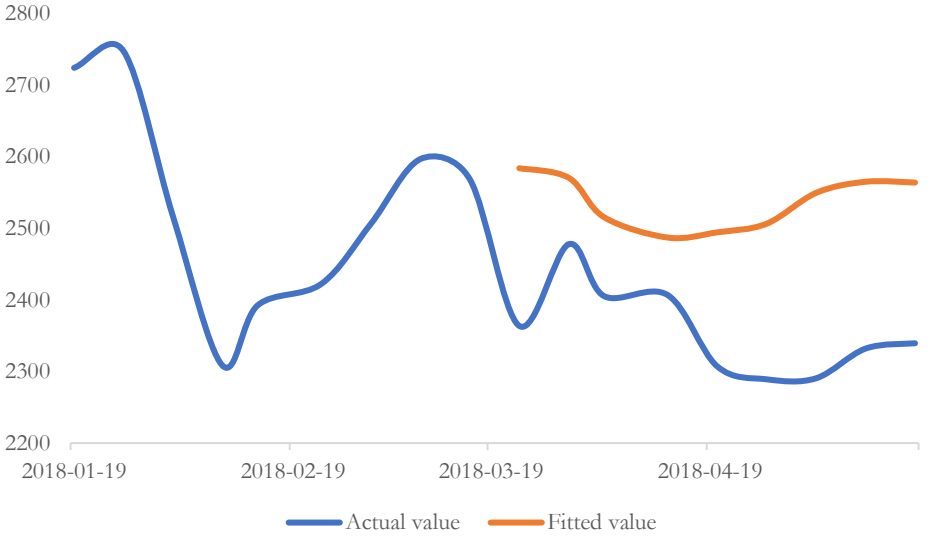

Figure 3: Actual value and fitted value, weekly.

Photo credit: Original

In the Figure 3 for weekly data, the actual curve is bumpier than the predicted curve, and although the overall trend of the two is similar, the actual price is always lower than the predicted price.

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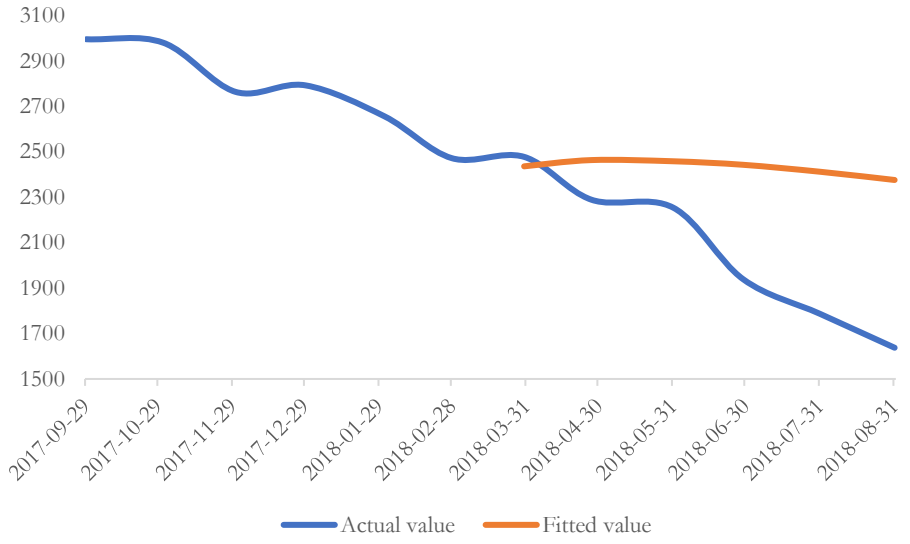

Figure 4: Actual value and fitted value, monthly.

Photo credit: Original

In the Figure 4 on monthly data, taking March 2018 when the trade war broke out as the dividing line, the closing price of metal products showed a completely different trend. According to predication, its price should remain stable, but in fact it has continued to decline all the way, and the gap between the real price and expected price has gradually widened. After the above analysis, it's clearly that the trade war has brought about to a downturn in Chinese metal products market, impacting both the short-term and long-term prospects. The trade war has also led to greater localized instability in metal product prices. If following the model's expectations, its price will develop more steadily.

5. Conclusion

Focusing on the background of the US-China trade war, the article aims to study how the Chinese metal products market is affected after China and the United States impose trade sanctions on each other. This article uses the daily, weekly, and annual closing price data of metal products stocks from 2013 to before the outbreak of the global covid-19 epidemic, establishes the ARIMA model to predict the price trend and compare it with the actual price trend to analyze the influence of the US-China trade war. Finally, it intuitively shows that the trade war hit Chinese metal product market due to the United States' imposition of tariffs on imported metals and other ways of sanctions, resulting in a drop in the price of metal products. And this kind of negative impact exists in both the short term and the long term. According to the model prediction, if the two parties do not take new measures, the gap between the actual price and the expected price will gradually widen, and the hit to the China's metal products market will be persistent. As an important metal exporter of China, the United States is of utmost importance. It is difficult for China to find a market that can completely replace the United States. Therefore, to develop China's metal industry healthily, improving US-China trade relations cannot be ignored. Properly solving the matters related to the trade conflict is bound to be more advantageous for China's metal industry to leverage its inherent price and production advantages, and finally make the industry restore stability and grow positively.

This paper, like the existing literature, has drawn the conclusion that the trade war will lead to deleterious implications for China's metal products market. Different from the existing literature, this article does not only look at the policy level but adopts the method of model prediction. By comparing the specific differences between the real price trends and prediction price trends if the US-China trade

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war has not occurred, it can obtain more accurate and more convincing results. The research results show the US-China trade war impacts China's metal products market significantly. And the continued decline in the price of metal products will seriously damage the interests of practitioners in China's metal processing industry and deteriorate the environment of Chinese metal processing enterprises. Therefore, as a policy maker, it should pay more attention to the ecological environment of the metal product industry. In the case of a poor market environment, providing support and subsidies to relevant enterprises to ensure the basic market of China's metal processing industry and avoiding being hit too much by the trade war. At the same time, in response to the sanctions imposed by trade war opponent, a more positive negotiation approach and counter-sanction measures that are favorable for the recovery of the China market should be adopted, rather than simply retaliating tit for tat, which would result in mutual harm. As far as the investors, this study found that the China metal products market is temporarily in a downward state, and the investment environment is not optimistic. And judging from the large negative impact of the outbreak of this trade war on the price of metal products, the policy changes at any time under this game between the two countries during the trade war may cause large fluctuations in the metal market. Therefore, to invest in the metal products market, it's necessary to maintain a high degree of attention to the trade policies implemented by China and the US and adopt a more flexible and timely investment strategy.

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