

# ***The Comprehensive Effect of the US-China Trade War on the Chinese Chip Industry: A Dynamic Perspective Based on Return***

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**Abstract:** Along with the growing trade conflict between China and the America, many Chinese industries have been affected by it. The impact on the Chinese chip industry is particularly dramatic. Depending on some studies, due to the deteriorating relationship between these two big countries, the United States has implemented many restrictive policies on Chinese chip industry, such as limiting technical support from U.S. companies to Chinese companies and requiring licenses for related companies to cooperate with Chinese companies. This series of initiatives on the Chinese chip industry is a huge impact, but also greatly influence the trend of the Chinese chip stock market. This study uses the ARIMA model to estimates the chip index without U.S.-China trade conflict The model based on weekly data finds that in the ultra-short term, the influence of the trade war on the chip index is relatively small. The model based on monthly data finds that in the short term (4 months) the average effect of this conflict on the chip index is about -3.29%.

**Keywords:** China-US trade war, chip industry, modeling, impact

## **1. Introduction**

Today is an era of rapid technological development, cell phones, computers, artificial intelligence and other products are developing rapidly, and has become an integral part of people's lives. When people interact with these products, electronic products need to process a large amount of data, this process requires a very strong arithmetic support, the core of the arithmetic is completed by the chip. So chip industry is very important in this era. Because chip is a very important part not only in industry, but also in national security, both China and the United States are seeking to establish greater control and autonomy over the industry. Because chips is a very important part not only in industrial field, but also in national security, both China and the America are seeking to establish greater control and autonomy over this industry [1].

From 2018, various industries in China and the America have been affected by this trade war. For China, the industries that are more affected are some of the industries that the United States directly imposed sanctions on [2]. media, computer application and computer and electronic equipment industries are the part of these industries [2]. Since the chip industry is a very important industry in this era, the United States has imposed many restrictions on China's chip industry, and this phenomenon becomes more and more serious. From 2018, both China and the United States have

increased tariffs on goods exported to each other many times [3]. Especially for the summer to autumn of 2020, the Trump administration imposes new restrictions on Chinese governments or companies almost every week [4]. For example, ZET and Huawei, two important Chinese technology companies, have been strictly sanctioned by the U.S. government in the China-U.S. trade war, and Huawei has even been blacklisted and banned from entering the U.S. market. [5]. Some articles argue that these measures will not affect China's technological development because technological development can increase China's total output and the Chinese government will try its best to develop technology [6]. However, the negative effect of the U.S.-China trade war on Chinese chip industry is bound to be huge. And this impact can also be reflected in the Chinese stock market. This research develops an ARIMA model for the Chinese chip industry index to investigate the impact of the U.S.-China trade war on Chinese chip industry. This article is based on an ARIMA model that assumes that the stock index before March 18, 2018, does not contain information related to this trade conflict (this is a weak assumption) and makes an over-the-top multi-step forecast for the chip index after March 18, 2018. By comparing the experimental and control groups (actual and fitted values), the ultrashort- and short-term effects of the U.S.-China trade war on the Chinese chip index are derived. This article is useful to help individual investors and policy makers understand the effects of the US-China trade war on Chinese chip industry.

The remainder of the article are these sections: the second part is the research design, which reports the data sources, the weak smoothing test and the ARIMA model setup; the third part is the empirical results, which compares the differences between the predicted and fitted values and analyzes the possible explanations; and the fourth part is the discussion, makes Some relevant discussions of the study results.

## **2. Variables and Model**

### **2.1. Data Sources**

To explore the influence of the US-China trade war on the Chinese chip industry, the chip industry index is a very representative available data which gives a good indication of the overall changes in this industry. In this study, weekly data and monthly data of the Chinese chip industry are used. It contains weekly (monthly) opening price, closing price, highest price, lowest price and up/down . The data period is from the end of 2012 to May 2023. The large data interval like this can better reflect the influence on the chip industry and facilitates the comparison. The data in this study are transformed by the formula  $\ln(1+\text{closing price})$  (log returns) and the first-order difference and second-order difference of this formula, and the date of the US-China trade war was set as  $t_0$ . Stata is used in this study to analyze the weekly and monthly data respectively, and construct models.

### **2.2. Weak Stationarity Test**

First, the study needs to confirm whether the data used are stationary or not. The data to be confirmed are  $\ln(1+\text{close price})$  (log returns), first-order difference of log returns, and second-order difference of log returns ( $\ln\_dp$ ). In this study, weekly and monthly data are tested for stationarity in Stata. For the weekly data, as in Table 1, the p-value of log returns is 0.4147, which is bigger than 0.05, so the log return is not stationary. However, p-values of both first order and second order are 0, so the first order and second-order differences are stationary. For the monthly data, since the p-value of log returns is 0.4395, which is bigger than 0.05, so the log return is not stationary while the p-values of first order and second order are 0.0002 and 0, which are both less than 0.05, so the first-order and second-order differences are stationary.

Table 1: Weak stationarity test.

	t-statistic	p-value
<b>Weekly</b>		
Raw	-2.335	0.4147
1st order difference	-10.641	0.0000
2nd order difference	-18.389	0.0000
<b>Monthly</b>		
Raw	-2.290	0.4395
1st order difference	-5.059	0.0002
2nd order difference	-7.210	0.0000

### 2.3. ARIMA Model Specification

The overall expression of ARIMA model is shown in equation 1.  $\phi_0 + \sum_{i=1}^p \phi_i x_{t-i}$ , which represents AR(p), and the remaining part of the equation represents MA(q). In this study, AR(p) predicts the future by the Chinese chip industry index from December 2012 to t0, and MA(q) estimates by the error term. This study solves the problem of unstable original series by differential.

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

## 3. Estimation and Results

### 3.1. Model Identification

To determine the order of the ARIMA model, the study needs to draw PACF and PCF figures for the second-order differences of log returns for weekly and monthly data respectively, PACF figure is used to confirm the order of AR and PCF figure is used to confirm the order of MA. As shown in Figure 1, for the weekly data, the order of AR is 5 and the order of MA is 1. For the monthly data, the order of AR is 4 and the order of MA is 1. Since the partial autocorrelation and autocorrelation inscribed by the PACF and ACF of the first-order difference are relatively weak, the study uses second-order differences to build models. The value of d is 2. Thus, we got ARIMA (5,2,1) for weekly data, and ARIMA (4,2,1) for monthly data.

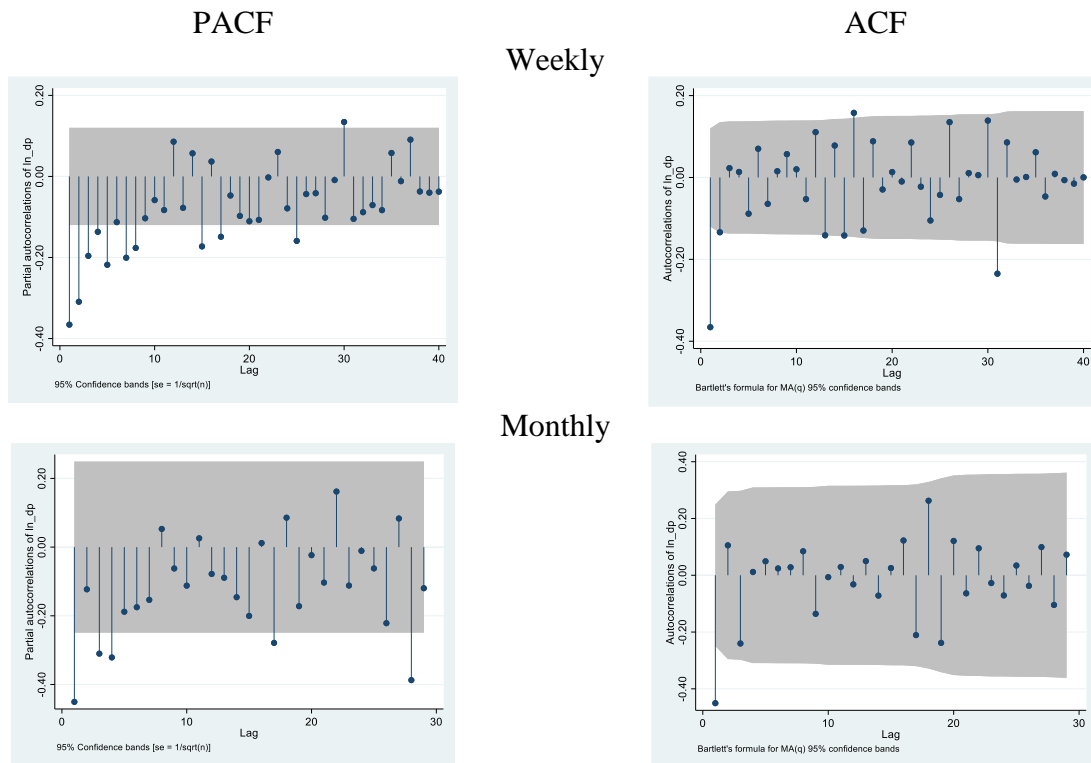


Figure 1: ARMA (p, q) identification (photo credit: Original).

### 3.2. Prediction and Analysis

After determining the order, the ARIMA model of log returns is developed, and the second-order difference of log returns is predicted for weekly and monthly data. The study finally reduced the logarithm to obtain the fitted value.

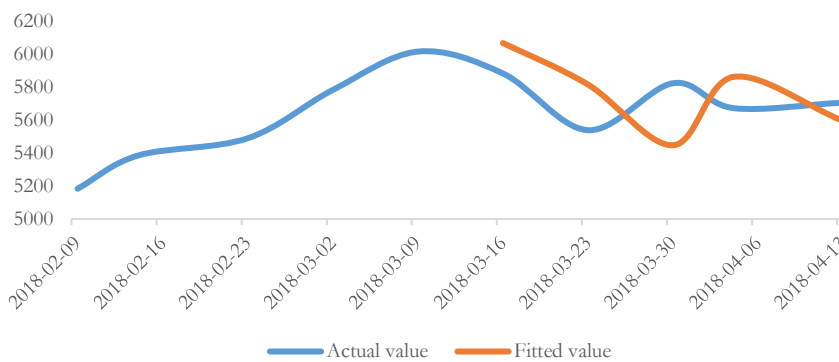


Figure 2: Actual value and fitted value, weekly (Photo credit: Original).

In order to compare the actual value with the fitted value, Figures 2 and 3 are plotted for weekly data and monthly data, respectively. The difference between actual value and fitted value is calculated as -184.374, -277.493, 377.247, -190.893, and 112.053 for weekly data. Dividing the mean of the difference by the mean of the fitted value yields an average benefit of -0.57%. For the monthly data (Figure 3), the difference between actual value and fitted value is 97.393, -438.018, 55.885, -439.294

respectively. Dividing the mean of the difference by the mean of the fitted value yields an average benefit of -3.29%.

From the weekly data (Figure 2), the influence of the conflict between America and China about trade on the Chinese chip industry is relatively small. Therefore, the negative effect on the Chinese chip industry is not large for ultra short term, but the negative impact is still large in the short term. That is, the impact will gradually manifest itself over time. This also illustrates from the side, Chinese chip industry is still relatively serious dependence on the other countries, and its independent research and development capability still need to be improved. This conclusion can also be illustrated by the data, as of 2020, Chinese chip production capacity has been 15%, but 60% of it comes from foreign companies, only 40% from China [7]. Because the U.S. in the chip industry on Chinese most important restrictions on technology sharing and the export of important materials. As shown in Figure 3, the curves of fitted value and actual value are often intersected, but there is almost no such phenomenon in the short-term data. This is because of the overreaction of stockholders. Overreaction refers to the phenomenon that because of the Inadequate information or restricted cognitive ability of investors, they may have some psychological bias in the investment process, which leads to that they overreact to some unexpected events [8]. Stockholders panicked when the trade conflict between America and the China had just started and thus sold off a lot of stocks, causing the index to fall sharply. The reason for overreaction is often that investors are overconfident or overly sensitive and give too much reaction to some new events happening in the market, and it always leads to problems [9]. This is the main reason for the staggered short-term image. Overreaction is a very common phenomenon in financial markets and has been well studied and documented in the stock market [10]. However, the overreaction does not affect the overall trend, and the overall trend is still negative.



Figure 3: Actual value and fitted value, monthly (Photo credit: Original).

#### 4. Discussion

Compared to other studies in the same field, this article also uses the similar approach to model past data to predict future data and then compare it with real data to draw conclusions. This experimental approach is very common in the same type of articles. However, the difference of them is that most other similar articles always focus on the influence of the US-China trade war on the overall economic situation or Chinese overall stock market, while this paper focuses on a single industry, the Chinese chip industry. This is more focused and specific. In addition, this study uses both weekly and monthly data sets to build the long-run and short-run models respectively, which allows the authors to analyze in both directions, making the results more comprehensive. From this paper, it can be seen that policy makers should pay more attention to dealing with the phenomenon of overreaction. They should make

some relevant policies to organize or mitigate the emergence of this phenomenon. In addition, the Chinese government should continue to improve Chinese independent research and development capabilities in chip and should provide more support to relevant companies. So, it will reduce their over-reliance on other countries. For investors, they do not need to overreact to such events in the short term, because the impact is often not so great. But investors can also moderate their investments in the chip industry in this kind of environment.

## 5. Conclusion

Because of the US-China trade war, many industries in China have been affected by it. The chip industry is an important and sensitive industry, so it must also have received the impact of this big event. The research's aim is to verify the impact this war on the Chinese chip industry by way of building an ARIMA model to predict the future value and compare it with the actual value. After the modeling and comparison, the study draws some conclusions successfully. This study finds that the impact caused by the US-China trade war on the chip industry in the ultra short term is not very significant. Even the predicted value is sometimes lower than the actual value due to overreaction of investors. However, as time goes by, the impact on the chip industry becomes bigger and bigger, finally causes a relatively large negative impact. Up to now, the trade conflict between China and the America is still continues, and the limitations imposed by the U.S. on the Chinese chip industry not only have not decreased but also continue to increase. The modeling of future data can be continued later to verify whether the general pattern obtained from this study still holds.

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