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The Impact of Trade Friction on Pharmaceutical Industry -- A Case Study of Sino-US Trade Frictions

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Abstract

Using HP filtering and ARMA models to investigate the impact of Sino-US trade frictions on the Chinese pharmaceutical industry, the study reveals the following findings: Trade frictions have led to a continuous decrease decline in the main business revenue of Chinese pharmaceutical enterprises, with profits and total assets significantly lower than the predicted values, leading to a higher number of companies experiencing financial losses. Among the various sectors within the industry, the biopharmaceutical manufacturing sector is the most heavily affected by the comprehensive impact of trade frictions. Conversely, the pharmaceutical specialized equipment manufacturing sector and the medical instrument and apparatus manufacturing sector are relatively less affected by the trade frictions. China should further enhance the independent research and development capabilities of pharmaceutical enterprises, optimize the trade structure, and reduce its dependence on the United States in foreign trade.

Keywords

Trade friction; Pharmaceutical industry; HP filtering; ARMA model.

1. INTRODUCTION

On March 23, 2018, the United States announced a large-scale imposition of tariffs on goods imported from China, along with restrictions on Chinese companies' investments and acquisitions in the US. Subsequently, a list of Chinese exports worth approximately $50 billion, encompassing over a hundred pharmaceutical-related products from China, including medicinal chemicals, medical instruments, biopharmaceuticals, and equipment, was released. Starting from July 6, the US officially implemented a 25% tariff increase on goods worth $34 billion from the trade list, prompting China to respond with equivalent measures on the same day. On July 10, the US announced another list targeting $200 billion worth of Chinese imports, initially imposing a 10% tariff, which was subsequently increased to 25% on August 3. China also implemented countermeasures in accordance with the law [1-2]. As a result, the Sino-US trade frictions escalated. Therefore, it is important to examine whether the Chinese pharmaceutical industry was substantially affected during this period and what impact the trade policies had on related enterprises. This study aims to utilize financial data from Chinese pharmaceutical companies, employing HP filtering and ARMA modeling techniques, to separate the effects of trade frictions on the pharmaceutical industry and provide suggestions and development recommendations for Chinese pharmaceutical enterprises to respond to these challenges.

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2. DATA AND RESEARCH PRINCIPLES

2.1. Data Selection and Source

This study utilizes financial indicators data from over 8,000 pharmaceutical enterprises in China. The following key financial indicators, which primarily measure the economic conditions of the enterprises, were selected: main business revenue, profit, total assets, and the ratio of the number of loss-making enterprises to the total number of enterprises in the pharmaceutical industry. The sample period covers monthly data from January 2002 to August 2018. Linear interpolation was used to fill in the missing data for a small number of months. The data sources include the CEIC Database and pharmaceutical statistics websites.

2.2. Research Principles

Based on the principles of the HP filtering method, this study decomposes time series data into trend components and fluctuation components. The trend component reflects the normal growth (or decline) trend of the series when it is not affected by exogenous shocks, while the fluctuation component represents the impact of current exogenous shocks. With this principle, it is possible to estimate the impact of the trade frictions on pharmaceutical enterprises by calculating the difference (fluctuation value) between the actual values of financial indicators during the trade frictions period and their corresponding trend values.

However, there are three points worth noting: Firstly, financial indicator data of pharmaceutical enterprises may exhibit seasonal fluctuations, which can be caused by factors such as climate conditions, production cycles, holidays, and sales patterns. Therefore, seasonal adjustment is necessary to eliminate the influence of seasonal factors. Secondly, considering that the trade frictions may affect long-term growth trends, if the data from the trade frictions period is used to estimate the trend values, the fluctuation values may not fully reflect the impact of the trade frictions. To ensure more reliable estimation results, this study uses historical data before the trade frictions to calculate the historical trend values of the series and employs ARMA models to estimate the expected trend values without the trade frictions. Thirdly, the difference between actual values and expected trend values is not solely caused by trade policies but is the result of the combined impact of various exogenous factors during the period. However, the trade frictions have the most significant influence among these exogenous factors. Therefore, the difference between actual values and expected trend values can largely reflect the impact of the trade frictions.

3. RESEARCH METHODS

3.1. X-12 Seasonal Adjustment

The X-12 method developed by the U.S. Bureau of the Census is a widely used seasonal adjustment method. Its core technique is based on moving averages and has evolved from this concept. The process of data handling using X-12 seasonal adjustment for the main business revenue indicator of pharmaceutical enterprises is described, and the seasonal adjustment results are shown in Figure 1. From the results, it can be observed that the main business revenue of pharmaceutical enterprises is relatively low in January and February each year, while reaching its peak in December.

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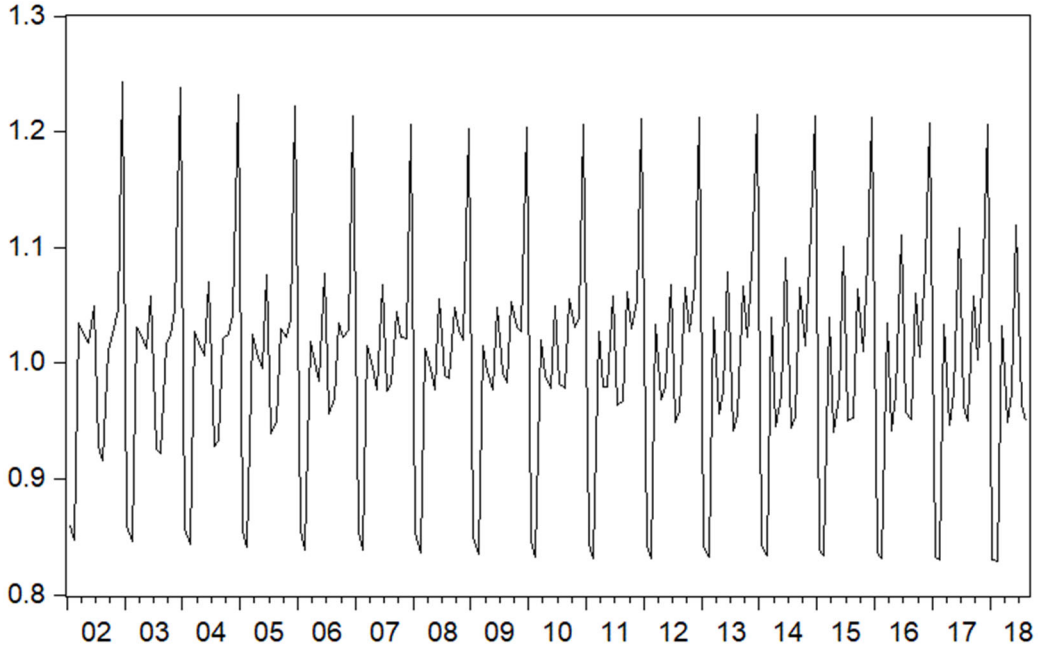

Figure 1. Seasonal Factors of Main Business Income

3.2. HP Filtering

HP filtering is a non-linear regression technique proposed by Hodrick and Prescott [3] for analyzing economic trends. It is based on the spectral analysis of time series, which treats the time series as a combination of different frequency components and separates the low-frequency component (trend) and high-frequency component (fluctuation) by designing a filter.

Assuming the original sequence y_t can be decomposed into the main trend component x_t and the fluctuation component s_t:

$$y_t = x_t + c_t, t = 1,2,\dots T \tag{1}$$

To minimize the loss function:

$$\sum_{t=1}^{T}(y_t - x_t)^2 + \lambda \sum_{t=1}^{T}[(x_{t+1} - x_t) - (x_t - x_{t-1})]^2 \tag{2}$$

The first term represents the residual, indicating the tracking degree of the trend component to the original sequence, while the second term represents the quadratic difference, characterizing the smoothness of the trend component. The coefficient λ controls the weights of the two terms. A larger value of λ makes the separated trend line smoother. When λ approaches infinity, HP filtering approximates a linear regression function. According to general experience, λ=100 for annual data, λ=1600 for quarterly data, and λ=14400 for monthly data [4]. The HP filtering result of the main business income in the pharmaceutical industry is shown in Figure 2.

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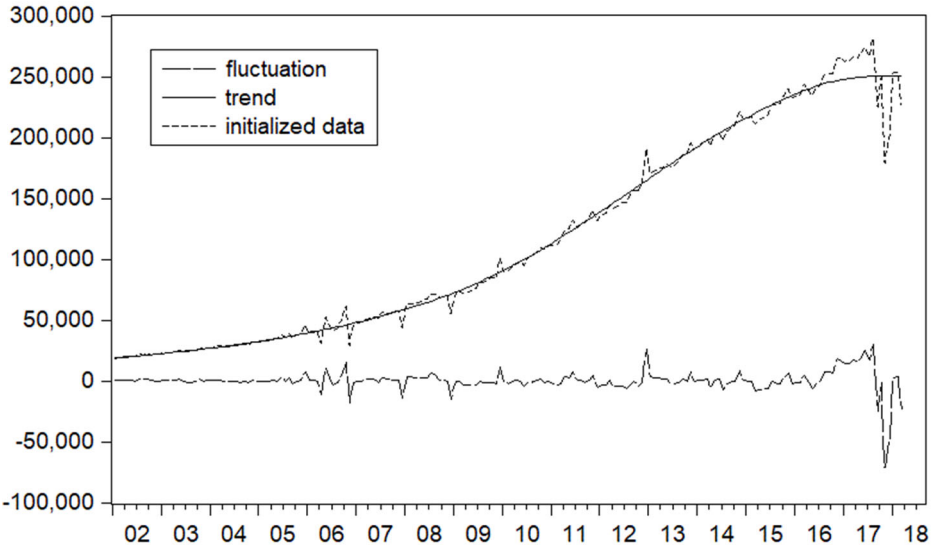

Figure 2. HP Filtering Results of Main Business Income

3.3. ARMA Model

The autoregressive moving average model (ARMA model) is suitable for short-term forecasting of stationary time series. It assumes that the time series is a linear function of the current and past random error terms and past values. An ARMA(p, q) model can be represented as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \cdots + \alpha_p Y_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + \ldots + \beta_q \varepsilon_{t-q} \quad (3)$$

where the order p and q are determined by the AIC and SC criteria.

4. RESULTS ANALYSIS

4.1. Impact of the Trade Friction on the Pharmaceutical Industry

Firstly, this study examines the overall impact of the trade friction on the pharmaceutical industry, as shown in Table 1. The actual values represent the seasonally adjusted values of the original sequence, while the predicted values are the results obtained by forecasting the historical trend values using the ARMA model. The change ratio of financial indicators is calculated as the difference between the actual value and the predicted value divided by the actual value, reflecting the fluctuations in financial indicators caused by the trade friction.

Based on the simulation results, it can be observed that the pharmaceutical industry in China performed poorly during the period of the trade friction. The main business income, profits, and total assets of pharmaceutical enterprises were all lower than the predicted values, and the proportion of loss-making enterprises increased. Starting from the outbreak of the trade friction in March, the main business income of Chinese pharmaceutical enterprises exhibited a downward trend, decreasing from 234.81 billion yuan in April to 200.06 billion yuan in August. This indicates the negative impact of the trade friction on the sales of pharmaceutical products in China. According to estimation results, the negative impact of the trade friction on the main business income of pharmaceutical enterprises in August reached 25.34%. In terms of profits, although there was a slight decrease in the first two months of the trade friction, the profits of enterprises significantly declined in July and August. This can be attributed to the implementation of tariff measures starting from July, which increased the export costs of certain pharmaceutical-related products and weakened the profit margins of pharmaceutical export enterprises. The total assets of the entire pharmaceutical industry decreased by

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approximately 2% due to the impact of the trade friction, and the proportion of loss-making enterprises increased by nearly 3%.

Table 1. Impact of the Trade Friction on Key Financial Indicators of the Pharmaceutical Industry

(Unit: billion yuan)

Month		Main Business Income	Profit	Total Assets	Loss-making Enterprise Ratio
April	Actual Value	234.81	29.03	3327.12	17.58%
	Predicted Value	250.66	31.57	3399.54	14.94%
	Change Ratio	-6.75%	-8.78%	-2.18%	2.65%
May	Actual Value	228.41	27.56	3369.67	17.60%
	Predicted Value	250.68	31.78	3427.23	14.99%
	Change Ratio	-9.75%	-15.34%	-1.71%	2.62%
June	Actual Value	215.04	32.54	3400.43	17.79%
	Predicted Value	250.71	31.99	3454.90	15.03%
	Change Ratio	-16.59%	1.68%	-1.60%	2.76%
July	Actual Value	207.14	28.14	3420.69	17.87%
	Predicted Value	250.73	32.20	3482.55	15.08%
	Change Ratio	-21.05%	-14.45%	-1.81%	2.79%
August	Actual Value	200.06	27.59	3441.03	18.00%
	Predicted Value	250.75	32.41	3510.17	15.13%
	Change Ratio	-25.34%	-17.46%	-2.01%	2.87%

4.2. Impact of the Trade Friction on Different Categories of Enterprises

Further analysis was conducted to examine the impact of the trade friction on different types of pharmaceutical enterprises. This study classified pharmaceutical-related enterprises into eight categories: manufacturing of chemical raw materials for pharmaceuticals, manufacturing of chemical pharmaceutical preparations, manufacturing of biological pharmaceuticals, manufacturing of sanitary materials and medical supplies, production of traditional Chinese medicines, processing of Chinese herbal medicines, manufacturing of medical instruments and equipment, and manufacturing of pharmaceutical specialized equipment. The manufacturing of veterinary drugs was not considered due to data limitations.

Table 2 presents the average change ratios of key financial indicators for different types of pharmaceutical enterprises from April to August. According to the simulation results, the most affected sector by the trade friction is the manufacturing of biological pharmaceuticals, with a decrease of 27.6% in main business income and 17% in profits. The industry's total assets decreased by 4.12%, and the proportion of loss-making enterprises increased by 3.29%. The manufacturing of Chinese herbal medicines was most impacted in terms of main business income, while the production of traditional Chinese medicines experienced the largest decline in profits. On the other hand, the manufacturing of pharmaceutical specialized equipment and medical instruments and equipment were least affected by the trade friction. This can be attributed to the fact that China's medical equipment exports to the United States mainly focus on low- to mid-end medical devices, which are essential for the daily lives and health of the American population. According to WIND statistical data, the total export value of medical devices included in the list is approximately 1.2 billion US dollars, indicating a relatively small overall scale.

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Table 2. Change Ratios of Financial Indicators in Different Sectors of the Pharmaceutical Industry

(Unit: Percentage)

Category	Main Business Income	Profit	Total Assets	Loss-making Enterprise Ratio
Manufacturing of Biological Pharmaceuticals	-27.60	-17.00	-4.12	3.29
Manufacturing of Chemical Raw Materials for Pharmaceuticals	-14.29	-2.30	3.81	5.34
Manufacturing of Chemical Pharmaceutical Preparations	-8.72	-15.65	-3.68	2.82
Production of Traditional Chinese Medicines	-14.92	-18.65	-4.33	1.96
Processing of Chinese Herbal Medicines	-31.92	-8.25	-3.69	2.10
Manufacturing of Sanitary Materials and Medical Supplies	-18.68	-9.31	0.56	1.80
Manufacturing of Pharmaceutical Specialized Equipment	4.01	4.48	-1.07	0.59
Manufacturing of Medical Instruments and Equipment	-11.00	5.46	1.17	1.89

Continuing the analysis, it is evident that the trade friction has had varying impacts on different categories of pharmaceutical enterprises. The manufacturing of biological pharmaceuticals experienced the most significant negative effects, with notable decreases in main business income, profits, and total assets, as well as an increased proportion of loss-making enterprises. On the other hand, the manufacturing of pharmaceutical specialized equipment and medical instruments and equipment were relatively less affected, showing slight increases or minor decreases in key financial indicators.

Overall, the results indicate that the trade friction has adversely affected the pharmaceutical industry in China. The main business income, profits, and total assets of pharmaceutical enterprises have been impacted, leading to a higher proportion of loss-making enterprises. The degree of impact varies among different sectors, with the manufacturing of biological pharmaceuticals being the most severely affected. These findings provide valuable insights into the consequences of the trade friction and can guide further analysis and decision-making in the pharmaceutical industry.

5. CONCLUSION AND RECOMMENDATIONS

Using the HP filtering technique, this study separates the trend and volatility components of financial indicators in the pharmaceutical industry. Additionally, the ARMA model is employed to predict the trend values of the series during the period of Sino-US trade friction. By comparing the predicted values with the actual values, the study investigates the impact of the trade friction on China's pharmaceutical industry. The research findings indicate that the pharmaceutical industry in China experienced an overall decline. The main operating revenue of medical enterprises continuously decreased, and both profits and total assets were significantly lower than the predicted values, with more companies reporting losses. Through a comparative study of pharmaceutical enterprises, it was observed that the biopharmaceutical

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manufacturing industry was most heavily affected by the trade friction, while the pharmaceutical specialized equipment manufacturing industry and the medical instrument and apparatus manufacturing industry were relatively less affected. Based on the conclusions of this study, the following measures and recommendations are proposed for Chinese pharmaceutical enterprises to cope with the trade friction:

Firstly, deepen the reform of the medical and health system and optimize the development environment of the industry [5]. This includes enhancing the protection of intellectual property rights to promote innovation, improving the efficiency of drug approval to align with international standards, and enforcing strict industry regulations.

Secondly, enhance the independent research and development capabilities of Chinese pharmaceutical enterprises and strengthen the quality and innovation of their products and devices. Independent innovation capability is the core competitiveness of pharmaceutical enterprises, and increasing innovation capacity is essential for success in the intense international competition. The Chinese government should increase financial support for the healthcare sector [6] to encourage medical enterprises to increase research and development investments, promote industrial upgrading, and enhance the international competitiveness of products.

Thirdly, expand opening up to the outside world, optimize trade structure, and reduce dependence on the United States in foreign trade [7]. Currently, China's pharmaceutical products have a high dependence on the US market. China must increase its openness to the outside world and vigorously develop economic and trade relations with other countries. It should also expand export business with countries along the "Belt and Road" initiative, thereby mitigating the impact of the trade friction on China's pharmaceutical industry.

REFERENCES

[1] J.Y. Chen: The Background, Causes, Essence, and Chinese Strategies of Sino-US Trade War, Journal of Wuhan University (Philosophy & Social Sciences), (2018) No. 5, p. 72-81.

[2] L.J. Huang: Reasons, Impacts, and Trends Analysis of the Escalation of Sino-US Trade War, New Finance, (2018) No. 9, p. 20-24.

[3] R. Hodrick, E.C. Prescott: Postwar U.S. Business Cycles: An Empirical Investigation, Journal of Money, Credit, and Banking, vol. 29 (1997) No. 1, p. 1–16.

[4] T.M. Gao: Econometric Analysis and Modeling Methods, Beijing: Tsinghua University Press, 2011.

[5] F.M. Zhu: Review of Logic of Medical and Health System Reform in China from 1985 to 2015, Chinese Health Economics, (2016) No. 1, p. 5-9.

[6] Q.M. Tang, Y. Ma: Analysis of the Time-Varying Relationship between Government Health Expenditure and Total Health Expenditure, Chinese Health Economics, (2014) No. 12, p. 53-54.

[7] P.P. Yu, Y.P. Zhao: Essence, Impact, and Strategies Analysis of Sino-US Trade War, Modern Management Science, (2018) No. 11, p. 87-89.