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To Analyze the Impact of COVID-19 on Listed Pharmaceutical Companies in China Based on ANOVA

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Abstract: As an important part of China's national economy, pharmaceutical enterprises have also been greatly impacted. The pharmaceutical industry has always been a sunrise industry. However, with the outbreak of COVID-19, listed pharmaceutical companies will have an impact. According to the development of the epidemic situation and market environment in 2020, the main epidemic period can be divided into three stages. This paper uses the analysis of variance to calculate the return on equity, net profit on total assets, and operating net profit of listed pharmaceutical companies in the past four years to confirm whether the emergence of COVID-19 has had a significant impact on listed pharmaceutical companies. According to the research conclusions, the corresponding theoretical basis was provided for the listed pharmaceutical companies, so that they listed pharmaceutical companies could better serve the people during the epidemic. It was found that the outbreak of the epidemic did not have a great impact on listed pharmaceutical enterprises.

Keywords: three-factor model, five-factor model, anomaly study, asset pricing, yield

1. Introduction

At the beginning of 2020, the COVID-19 outbreak brought challenges to China's economy, and almost every enterprise was affected differently. As an important part of China's national economy [1-3], pharmaceutical enterprises have also been greatly impacted. Pharmaceutical operations have been significantly affected by varying degrees of start-up delays, production suspensions, transportation obstacles, logistics controls, and restrictions on the movement of personnel. In particular, some of the strength is not strong enterprises, in the short term will even face the risk of a capital chain break, and the overall business expectations are bleak. However, it is worth noting that TCM has been widely used during the COVID-19 pandemic [4-5].

In a series of literature, it was found that under the outbreak of the epidemic, China's pharmaceutical industry will be hindered in the short term, and will recover growth in the long term. Because COVID-19 and SARS-like coronavirus share more than 85% identity [6], the review of the development of the SARS epidemic and the performance of the pharmaceutical industry is of great reference significance for the development of this epidemic. Based on the experience of TCM treatment in fighting SARS, TCM has been involved in the treatment of patients in the early stage of the COVID-19 outbreak. In a series of notices issued by China's National Health Commission, drugs such as Lianhua Qingwen capsule and Hembijing injection will be included in the list, especially the production of related drug manufacturers will be significantly increased. Meng believes the pandemic

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has boosted sales of traditional Chinese medicines, which have nothing to do with preventing COVID-19. However, it has also brought about an increase in the demand for antiviral and beneficial traditional Chinese medicine, thereby raising awareness of TCM [1]. Duan used event analysis to analyze whether the pandemic had a significant impact on the stock prices of China's pharmaceutical industry. He found that the sudden onset of the pandemic raised investor expectations for the pharmaceutical industry and that the COVID-19 pandemic had a significant positive impact on pharmaceutical industry earnings [2]. In general, there is little research literature on the impact of the pandemic on Chinese pharmaceutical companies.

This paper selected the operating net profit margin that is shown in Table 3, net profit on total assets that is shown in Table 2, and the return on equity of 30 listed pharmaceutical companies from 2018 to 2021 that is shown in Table 1, concluded that the epidemic had an impact on the operating performance of listed pharmaceutical companies, and further studied whether the impact was significant. In this paper, the analysis of variance is used to analyze whether the COVID-19 epidemic has a significant impact on the business performance of listed pharmaceutical companies. Finally, it was found that the outbreak of the epidemic did not have a great impact on listed pharmaceutical enterprises.

The rest of this paper is organized as follows: Section 2 describes the impact on pharmaceutical companies during the pandemic. The third section introduces the classical analysis of variance and the function of analysis of variance. The fourth section carries on the empirical analysis and obtains the result through the analysis of the enterprise. The last section gives the conclusion and the suggestion

2. Literature Review

According to the development of the epidemic situation and market environment in 2020, the main epidemic period can be divided into three stages: the first stage is from January 20 to February 5, the national epidemic is in the rapid growth stage, and the overall industry index is rising; the second stage is from February 6 to April 28, the spread of the local epidemic, the market response is intense, and the third stage is in May and later, the national epidemic prevention, and control. From May to July, the epidemic was sporadic, and the public was eagerly waiting for pharmaceutical companies to develop and promote vaccines as soon as possible. The performance of the pharmaceutical sector was very bright, and the industry index rose significantly. After reaching a historical high in August, the pharmaceutical biological index fell, the correction is obvious. In the third stage, enterprises gradually resume work and production, and as consumption rebounded, the Shanghai Composite index continued to rebound. The stock price of the firm can be seen in Fig 1.

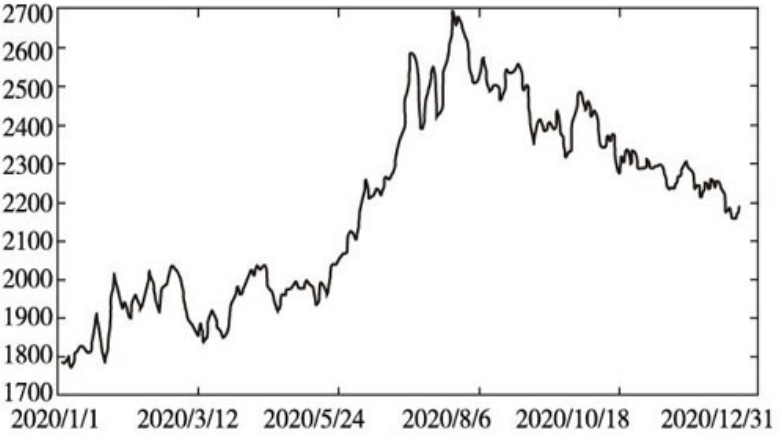

Figure 1: The stock price of the firm.

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Statistics of the total profit of China's pharmaceutical manufacturing industry from 2019 to 2021 can be seen in Fig 2.

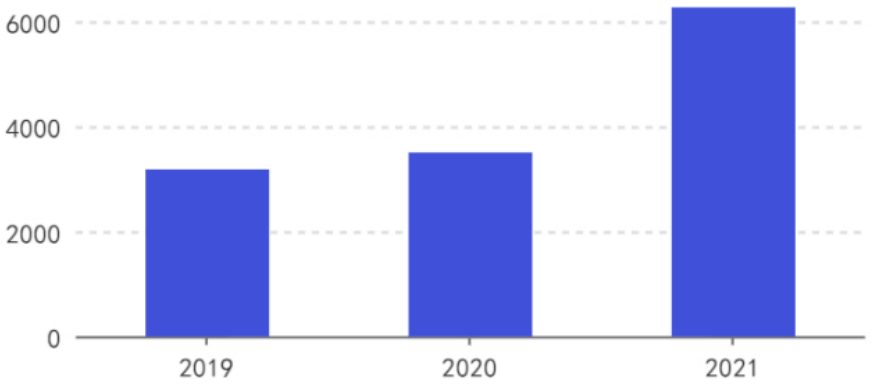

Figure 2: The total profit of China's pharmaceutical manufacturing industry.

With the increase in operating income, profitability continues to improve. In 2021 [7-9], the total profit of China's pharmaceutical manufacturing industry increased significantly, and in 2021, China's pharmaceutical manufacturing industry reached 627.14 billion yuan. This increased by 276.47 billion yuan from 2020, up 78.84% year on year. The outbreak of the epidemic has given Chinese pharmaceutical companies a new opportunity for development. The increase in operating income can be seen in Fig 3.

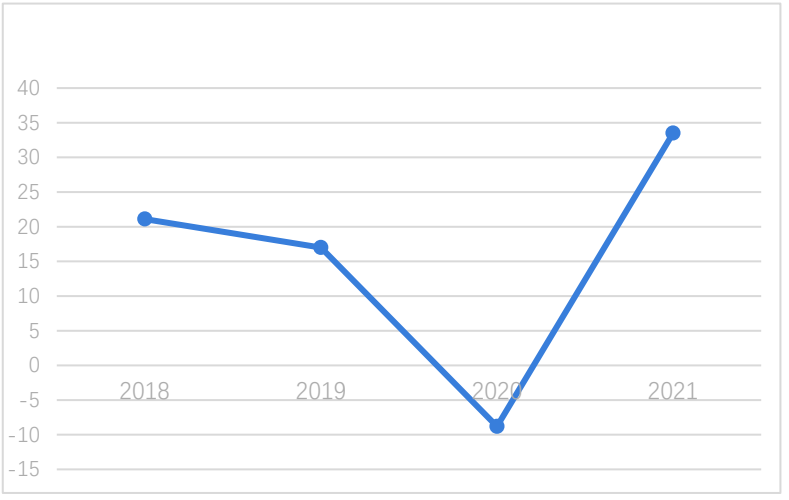

Figure 3: The increase in operating income.

3. Samples, Variables, and Models

Analysis of variance, also known as "ANOVA" or "F-test", was invented by R.A.Fisher to test the significance of differences between the means of two or more samples. Due to the influence of various factors, the data obtained from the study show fluctuations. The causes of fluctuations can be divided into two categories, one is uncontrollable random factors, and the other controllable factors exerted in the research to shape the results. ANOVA is mainly used to test the significance of the difference between the means of two or more samples. ANOVA is mainly used to test the significance of the

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difference between the means of two or more samples. This paper analyzes the impact of COVID-19 on Chinese pharmaceutical enterprises through ANOVA. The analysis of variance was used to test and compare the growth rate of operating revenue, net profit, and total assets of 30 listed pharmaceutical companies from 2018 to 2021.

4. Empirical Results and Analysis

The formula for calculating the F-value of the test statistic is:

$$F=MA/fAMe/fe \quad (1)$$

When the test statistic F value falls into the rejection domain W, the null hypothesis H0 does not hold, and the rejection domain W is:

$$W=\{F1-\alpha（fA，fe）\} \quad (2)$$

For the test of operating income growth rate, there are four levels of control variables, respectively in 2018, 2019, 2020 and 2021, each level has 30 test results, respectively, for the operating income, net profit growth rate, and total asset growth rate of 30 different pharmaceutical companies [10].

By querying the F distribution table, it can be seen that under the given significance level a = 0.05

$$Fc =F0.05 (3,120) = 2.68. \quad (3)$$

The yield rate of the inspection is shown in the table:

Table 1: Return on equity of pharmaceutical enterprises from 2018 to 2021.

Unit: %

	2018	2019	2020	2021
Intel group	10.59	12.4	9.88	9.13
Shuyu Civilian Pharmacy	6.71	1.56	8.66	11.96
Rincon	9.53	11.77	3.56	1.75
Qingdao Baheal Medical	26.5	17.82	18.09	22.87
Chinese medicine	18.83	10.93	13.58	6.39
Shanghai No.1 Pharmacy	6.89	7.63	9.3	6.45
SICHUAN HEZONG MEDICINE	16.09	14.58	10.75	0.85
China-TCM	9.84	10.11	10.48	10.78
Shenzhen Neptunus Bioengineering	7.81	3.41	-4.72	1.57
LuYan Pharma	11.72	13.99	12.93	11.82
Renmintongtai Pharmaceutical Corporation	16.93	15.6	7.57	13.26
China National Accord Medicines Corporation	11.41	10.31	10.49	9.29
Shanghai Kai Kai lndustrial Company	6.94	4.39	2.64	4.14
Guangxi Liuzhou Pharmaceutical	14.33	16.85	15.34	10.69
Cachet Pharmaceutical	13.93	13.38	9	9.42
Nanjing Medical Company	7.29	9.02	8.89	11.2
Zhejiang Zhenyuan Share	5.08	13.36	5.21	4.3
Yunnan Jianzhijia Health-Chain	32.95	32	31.79	16.67

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Table 1: (continued).

Tiansheng Pharmaceutical Group	0.27	-7.42	-18.57	-2.94
Shanghai Pharmaceuticals	10.34	10.12	10.34	10.76
Yifeng Pharmary	12.42	12.72	15.31	13.03
Thalys Medical Technology Group Corporation	7.51	7.31	3.79	-3.09
Bicon	4.39	2.59	-10.89	-7.76
Jointown	7.75	9.54	15.9	11.37
SINOPHARM	16.23	16.31	12.67	14.57
Yixintang	13.47	14	15.81	15.04
LBX Pharmacy Chain Joint Stock Company	14.87	15.58	15.87	15.72
WINSAN	7.38	-28.04	4.4	5.89
Retail	18.47	20.39	22.74	14.61
Wholesale	15.45	10.68	28.79	18.48

Table 2: Net profit margin on total assets of pharmaceutical enterprises from 2018 to 2021.

Unit: %

	2018	2019	2020	2021
Intel group	2.48	3.42	3.11	3.37
Shuyu Civilian Pharmacy	2.83	7.96	4.77	5.04
Rincon	4.1	1.39	1.94	1.31
Qingdao Baheal Medical	10.21	6.97	7.46	9.7
Chinese medicine	7.77	4.55	4.4	2.22
Shanghai No.1 Pharmacy	4.26	4.62	5.25	3.62
SICHUAN HEZONG MEDICINE	10.64	9.05	6.62	0.66
China-TCM	4.25	4.14	3.38	2.8
Shenzhen Neptunus Bioengineering	2.03	1.25	-0.1	0.67
LuYan Pharma	3.3	3.78	3.31	3.28
Renmintongtai Pharmaceutical Corporation	5.57	5.37	2.51	4.34
China National Accord Medicines Corporation	5.26	4.7	4.68	3.71
Shanghai Kai Kai lndustrial Company	3.41	2.11	1.24	1.55
Guangxi Liuzhou Pharmaceutical	6.56	7.04	5.84	5.18
Cachet Pharmaceutical	5.69	5.52	4.35	4.14
Nanjing Medical Company	1.91	2.08	2.07	2.48
Zhejiang Zhenyuan Share	3.44	9.09	3.51	2.83
Yunnan Jianzhijia Health-Chain	8.35	9.03	9.13	6.89
Tiansheng Pharmaceutical Group	0.32	-4.85	-12.26	-2.14
Shanghai Pharmaceuticals	4.03	3.66	3.92	3.01
Yifeng Pharmary	6.98	7.15	6.85	6.12
Thalys Medical Technology Group Corporation	5.61	5.1	2.37	-0.94
Bicon	2.1	1.17	-4.92	-3.48
Jointown	2.33	2.59	4.45	3.13
SINOPHARM	7.64	8.23	6.15	7.36
Yixintang	7.17	7.88	9.13	7.75

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Table 2: (continued).

LBX Pharmacy Chain Joint Stock Company	6.64	6.68	7.21	5.57
WINSAN	3.37	-18.82	2.99	4.69
Retail	8.51	9.16	10.31	5.42
Wholesale	12.25	7.78	20.32	13.52

Table 3: Operating net profit margin of pharmaceutical enterprises from 2018 to 2021.

Unit: %

	2018	2019	2020	2021
Intel group	1.09	1.37	1.37	1.48
Shuyu Civilian Pharmacy	2.15	4.73	3.13	3.72
Rincon	3.74	-1.23	2.3	1.81
Qingdao Baheal Medical	7.01	4.35	4.72	5.92
Chinese medicine	5.87	3.56	3.53	1.97
Shanghai No.1 Pharmacy	4.01	4.27	4.32	3.53
SICHUAN HEZONG MEDICINE	2.79	2.72	1.88	0.2
China-TCM	2.91	2.79	2.54	2.06
Shenzhen Neptunus Bioengineering	1.9	1.24	-0.1	0.63
LuYan Pharma	1.6	1.72	1.72	1.74
Renmintongtai Pharmaceutical Corporation	3.65	3.2	1.81	2.97
China National Accord Medicines Corporation	3.13	2.8	2.89	2.23
Shanghai Kai Kai lndustrial Company	4	2.49	1.69	2.45
Guangxi Liuzhou Pharmaceutical	4.85	5.15	4.99	3.74
Cachet Pharmaceutical	3.18	2.97	2.54	2.35
Nanjing Medical Company	1.1	1.16	1.18	1.35
Zhejiang Zhenyuan Share	2.51	6.6	2.7	2.23
Yunnan Jianzhijia Health-Chain	4.8	4.71	5.58	5.72
Tiansheng Pharmaceutical Group	0.72	-13.1	-41.04	-9.82
Shanghai Pharmaceuticals	2.8	2.59	2.92	2.91
Yifeng Pharmary	6.39	5.93	6.39	6.46
Thalys Medical Technology Group Corporation	8.84	7.78	3.86	-1.48
Bicon	5.04	2.83	-15.46	-8.61
Jointown	1.59	1.79	3.05	2.13
SINOPHARM	4.11	4.21	3.74	4.15
Yixintang	5.66	5.76	6.24	6.29
LBX Pharmacy Chain Joint Stock Company	5.32	5.27	5.47	5.01
WINSAN	8.28	-62.07	21.89	29.38
Retail	5.93	6.25	7.43	4.8
Wholesale	15.62	10.81	21.68	18.36

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Table 4: Variance analysis of return on equity of pharmaceutical enterprises.

Differences between the source	Sum of squared deviations	Degrees of freedom	The mean square	F
Between groups	152.8796	3	50.9599	0.8447
Within the group	6998.0663	116	60.3281	
The sum	7150.9459			

Table 5: Variance analysis of net profit margin of total assets of pharmaceutical enterprises.

Differences between the source	Sum of squared deviations	Degrees of freedom	The mean square	F
Between groups	36.0257	3	12.0086	0.6333
Within the group	2199.7156	116	18.9631	
The sum	2235.7413			

Table 6: Variance analysis of operating net profit margin of pharmaceutical enterprises.

Differences between the source	Sum of squared deviations	Degrees of freedom	The mean square	F
Between groups	178.1224	3	59.3741	0.7487
Within the group	9199.3112	116	79.3044	
The sum	9377.4335			

See Table 4, return on equity F= 0.8447< 2.68 It does not fall into the rejection domain W, that is, the null hypothesis is true, and the COVID-19 pandemic has no significant impact on the return on equity of listed pharmaceutical companies. See Table 5, the net profit margin on total assets F= 0.6333< 2.68 It does not fall into the rejection domain W, that is, the null hypothesis is true, and the COVID-19 pandemic has no significant impact on the net profit margin of total assets of listed pharmaceutical companies. See Table 6, operating net profit margin F=0.7487< 2.68 It does not fall into the rejection domain W, that is, the null hypothesis is true, and the COVID-19 pandemic has no significant impact on the operating net profit margin of listed pharmaceutical companies.

5. Conclusion

The COVID-19 pandemic is both an opportunity and a challenge for pharmaceutical companies. This paper analyzes in detail about the impact of COVID-19 on the business performance of many listed pharmaceutical companies in China. And it confirms that COVID-19 has not had much impact on the yield of pharmaceutical enterprises by using ANOVA analysis. Thanks to the good control of the epidemic, the market sentiment and profitability of the pharmaceutical industry have steadily improved. It is expected that the recovery of the pharmaceutical industry will accelerate as the impact of the epidemic fades in the future. At the same time, the spread of the epidemic overseas has led to a rapid increase in the international demand for Chinese medical products, especially the rapid growth of drugs related to the prevention and control of pneumonia and epidemic prevention materials. The export situation of the pharmaceutical industry has improved. For the next two years or more, economic activity will continue to be affected by the pandemic. Therefore, the future medical industry will recover steadily in the medium and long term. Most companies should actively prepare and

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change their strategy to lay a solid foundation for stable development while coping with possible risks in the future. This paper makes the following suggestions: first, listed pharmaceutical companies should pay close attention to the pharmaceutical-related policies in our country and make timely adjustments to get the maximum support from the government and policies; second, the epidemic situation and virus changes should accelerate the research of corresponding medical drugs, for instance, accelerating the research and development of COVID-19 vaccine in the segmented industries related to COVID-19; In particular, the development, layout and overall industrial upgrading of high-tech drugs need a reasonable layout. Third, the national government can coordinate the supply and demand balance in the case of emergency supplies.

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