The Impact of COVID-19 on Industry Valuation Models

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Abstract. Under the influence of the COVID-19 epidemic in the past three years, all walks of life have been impacted and changed to varying degrees. Changes in public psychology, supply and demand structure and other factors have caused economic fluctuations. In the face of different challenges, risk assessment and development trends have been adjusted accordingly. On this basis, this study investigates the impact of COVID-19 on industry valuation models. To be specific, the comprehensive and empirical analysis were used for analysis based on the industry data of the three periods, before, during and after COVID-19. According to the analysis, this study found that optimizing and adjusting the firm valuation model. In addition, proposing changes to management in the face of a pandemic would result in varying degrees of improvement for each firm and even the industry as a whole. Overall, these results shed light on guiding further exploration of the valuation of the industry during the crisis, especially under the large-scale public health events.

Keywords: COVID-19, P/E, Valuation Model.

1. Introduction

Since December 28, 2019, the novel coronavirus (COVID-19) has been raging in China, and then the epidemic has continued to spread one after another. In the past three years of 2020, 2021 and 2022, it has faced the severe situation of the spread of the epidemic and the complex and changeable international environment, as well as variants of poisonous strains. The country has taken a series of measures to meet the challenges of the epidemic and the weak global economy against globalization, and the lifestyle, work content and economic environment brought by the epidemic have brought great changes. The per capital income level has been reduced, and the investment environment has been affected. In the psychological change of mass consumption, the change of supply and demand structure, the impact of import and export international trade by the epidemic and other factors have changed the industrial valuation model. Therefore, it is known that expectations have also been adjusted accordingly. The estimation and development trend are in sharp contrast to the three stages before, middle and after the epidemic, which also contains opportunities, e.g., industrial restructuring, supply and demand structure transformation. We focus on selecting some industries that are more affected by COVID-19 in the pre-middle and late stages of the novel coronavirus, and use models for empirical analysis. We optimize and adjust the valuation model of enterprises and put forward adjustment suggestions for crisis management in the face of a pandemic.

Yu and Zhang elaborated the impact of COVID-19 on the financial market and the dual impact on biological and pharmaceutical enterprises, and analyzed the impact of COVID-19 on the business, discount rate and other evaluation elements in the traditional valuation model, and put forward the new challenges of COVID-19 on enterprise valuation. Tong and Zhang referred to relevant cases and selected corresponding comparable companies to use the price-earnings ratio valuation model, and explained the advantages of using this model for valuation, such as easy valuation and the need for mature securities markets. Yang thought that under the background of "double carbon", EVA was used to analyze the valuation model of photovoltaic power generation enterprises. Lu and Xiang who analyzed and studied the important role of organizational resilience in the face of crisis. They analyzed Huawei's methods to improve organizational resilience in practice, and analyzed that

mindfulness can better cope with the crisis environment for leaders. Wang studied the formulation and selection of competitive strategy by using SWOT analysis matrix and quantitative strategic planning matrix (QSPM), and found that while securities companies compete in external industries and enjoy the constant release of capital dividends, they also face difficulties such as policy changes in the general environment. For the above problems, the author suggests that exploring a competitive strategy suitable for the development of its own business is the primary task to ensure long-term development. Xu compared the 8-year data from 2014 to 2021, and found that the coefficient of the dummy variable of the price-earnings ratio restriction policy was significantly positive, resulting in a large short-term premium for IPO. Wang believed that the market is the core of the investment bank. Only by doing a good job in risk management and improving the management framework, can the huge operational risk losses be reduced. Taking the A-share listed companies in 2010-2016 as the research sample, this paper analyzes the relationship between the IPO financing performance of enterprises and the long-term debt performance of enterprises and the reputation of investment banks. Lu evaluated the investment value of Changjiang Securities using the relative valuation method (PE model) and the absolute valuation method (dividend discount model), and drew the short-term and long-term recommendations for Changjiang Securities [1-7].

Based on the changes in the A-share market during the COVID-19 period, this paper selects the P/E ratio as the main valuation index, takes the relevant data during the COVID-19 period as the research basis, and estimates the P/E ratio between different markets and industries in China's A-share market through the analysis of different dimensions. The rest of the paper is mainly divided into four parts, including research data and research methods, comprehensive analysis, empirical analysis, and conclusion.

2. Data & Method

This paper extracts quarterly P/E data for 2019-2022 from the Wind database, the Flush iFind database, the Oriental Fortune Choice financial terminal and other databases for the SSE 50 Index, CSI 500 Index, CSI 300 Index, the Main Board, the GEM Board, the Science and Technology Board, the Three Boards and 19 different industries in China. This paper uses the literature research method as well as the qualitative analysis method. Firstly, information was obtained by surveying the literature to get a comprehensive and proper understanding of the issue to be studied. Then by collecting information extensively to analyze the policy reasons, industry reasons, etc. For the changes in the P/E ratios of different indices, markets, and industries during COVID-19. Besides, we construct a P/E valuation model, where correlation analysis and regression analysis are used in this paper. Using the pharmaceutical industry as a representative, valuation model is developed and the explanatory power of variables such as return on net assets, and the P/E ratio during COVID-19 is investigated through correlation analysis and regression analysis. The values of quarterly price-to-sales ratio, current ratio, earnings per share, return on net assets, and asset turnover ratio are extracted from the annual and quarterly reports of ten sample companies, including Shenzhen Mindray Bio-Medical Electronics Co., WuXi AppTec Co., and Jiangsu Hengrui Pharmaceuticals Co, for a total of 11 quarters from the first quarter of 2020 to the third quarter of 2022. This paper also extracts GDP data for each quarter of 2019-2022 from the official website of the National Bureau of Statistics of China.

3. Comprehensive Analysis

3.1. Analysis of P/E Ratios of Different Indices

A share is also known as RMB ordinary shares, outstanding shares, public shares, and ordinary shares, referring to those registered in Chinese mainland, subscribed, and traded in RMB. A share are not physical stocks, with paperless electronic bookkeeping, the implementation of "T+1" delivery system, there is a limit on the rise and fall (10%), and the participating investors are Chinese mainland

institutions or individuals [1]. This paper selects the quarterly P/E ratio data of the SSE 50 Index, CSI 500 Index and CSI 300 Index from 2019 to 2022 for analysis. In order to illustrate in more detail the same relationship between the implementation rate level of various industries and the index P/E ratio, this paper will conduct a preliminary quantitative analysis of the correlation between them through Excel [2], and calculate the analysis and comparison between the fluctuation range and standard deviation between the P/E ratio of different market indices and the P/E ratio of various industries before and after the outbreak of the new crown epidemic, from January 31, 2019 to December 31, 2022. As shown in Fig. 1, the average of SSE50 P/E ratio was 10.76, while the one of CSI500 was 23.93 with the range of 13.83. However, Hushen300 was 13.05.

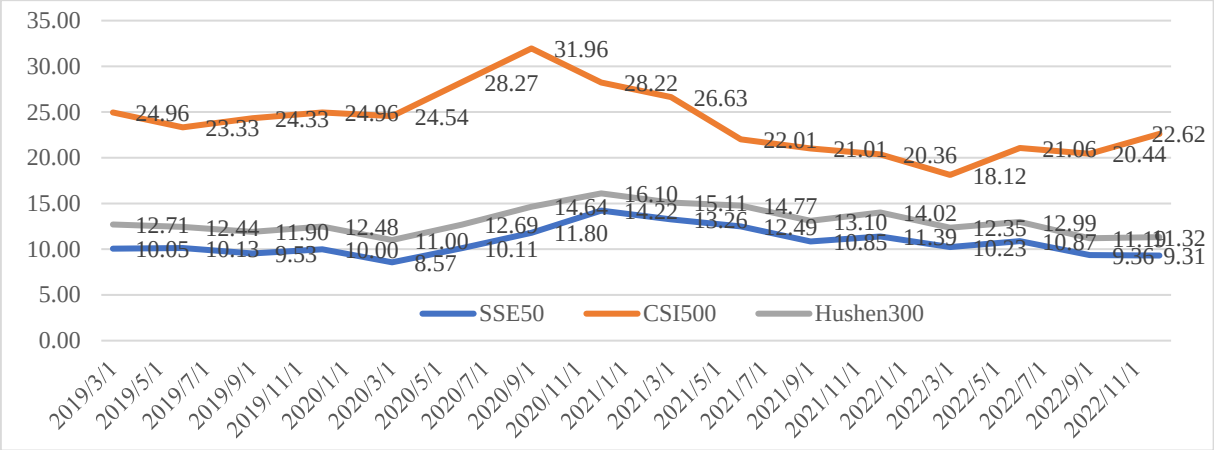


Figure 1. P/E ratio trend of different index

First, for banks, there is a certain lag in financial risks, and some loan risks will be delayed exposed. Since the outbreak of the COVID-19, the pressure on the rise of non-performing assets has been greater in the future. Therefore, theoretically, the overall impairment loss of banks would rise in the first half of 2020. On the one hand, the reason is that the amount of corporate funds is relatively tight, under the conditions of the epidemic. Due to the slowdown in social and economic development, the repayment ability of banks has declined. Because of the conduction effect, bank assets are impacted, which has an impact on other industries in turn, such as manufacturing, and even the flow of capital chains [3-5]. Second, in response to the impact of the epidemic on all walks of life, the national regulatory authorities had issued relief measures like deferred principal and interest repayment [6].

3.2. Analysis of P/E Ratios in Different Markets

This essay selects quarterly P/E ratio data from the Main Board, SME Board, New Third Board and Second-board Market from 2019 to 2022 for analysis. As illustrated in Fig. 2, the price-to-earnings ratio of ChiNext stocks is higher than that of the main board, the small and medium-sized board and the third board, and its dominant position has not changed before and after the outbreak of the epidemic. From January 31, 2019 to December 31, 2022, the average price-to-earnings ratio of the ChiNext market was as high as 55.42, reaching a three-year peak of 67.34 on June 30, 2020, and falling to a minimum of 38.91 on December 31, 2022. First, the elements of career. Taking the estate industry as an example, on the one hand, the epidemic affected the investment confidence of enterprises, resulting in a slowdown in investment of real estate enterprises, in addition, the pressure of prevention and control measures in many places hindered the start of construction sites, which in turn affected real estate investment; On the other hand, under the conditions of the epidemic, the normal social activities of the residential sector had led to a slowdown in residents' house-purchasing activities, then affecting the estate sales. Second, the elements of fluency. As the local epidemic continued to spread, consumption indicators had further weakened. In addition, due to logistics obstructions, some indicators of industrial production began to affect. The prevention and control policies of major First- and Second-tier cities had not been relaxed, further suppressing the consumption and residents' travel. In terms of inner-city transportation, the number of subway

passengers in 7 key cities decreased by 52.8% year-on-year, and the congestion index of 100 cities expanded to 7.0%. Inter-provincial travel declined further, with domestic flights down about 20% month-on-month. In addition, many places closed cinemas and other public entertainment places, and the national film box office fell by 51% with automobile sales also decelerating, with retail sales of passenger cars falling by 23.4%.

Moreover, the elements of policies also have some effects [7]. The stay-at-home order had contributed to the depression of the physical economy. The spread of the new crown pneumonia epidemic around the world has greatly affected the development of the physical economy. Stay-at-home order was a new term coined since the COVID-19, and it had played a key role in stopping the spread of the novel virus. The former development of the epidemic situation in China could be seen that epidemic prevention measures such as work stoppage, isolation and investigation, and city closure had effectively prevented the further spread of the epidemic. Since the new crown epidemic, China first proposed the home isolation order policy, suggesting that people don't go out and gather. Hence, the epidemic has been effectively controlled. Then, many countries in the world have begun to imitate it. However, if the stay-at-home policy was not used properly, it could have a negative impact on the physical economy. Taking the physical economy of the United States as an example, the "do not go out, do not gather" advocated by home isolation has led to people not being able to work normally, factories unable to continue manufacturing, and physical stores unable to operate normally. An analysis from a think tank shows that these enterprises that are forced to close will eventually produce a vicious circle, enterprises will be short of funds because they cannot operate normally. Then the shortage of funds will lead to the untimely procurement of raw materials, machinery and equipment, inventory cannot be guaranteed, and even began to lay off many employees, resulting in many people unemployed, living capital shortage, purchasing power decline, then the entire economy and society cannot operate normally.

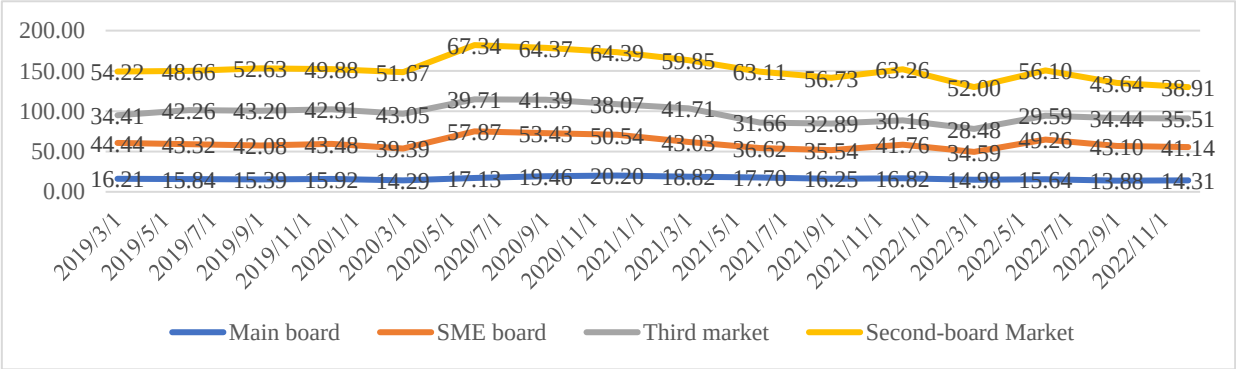


Figure 2. P/E index trends in different market

3.3. Analysis of P/E Ratios by Industry

According to the CSRC's classification of industries, this paper analyzes the extreme values, averages, fluctuation areas and standard deviations of the P/E ratios of different industries from 2019 to 2022. As shown in Table 1, during the three-year period, the max number of standard deviations is 161.70 in accommodation and catering, and 104.08 in residential services repair and others. However, it is hardly impacted in wholesale and retail and transportation and storage which are just 5.24 and 10.71. Seen from Table 1, from 2019 to 2022, we experienced the pre-pandemic and the pandemic period, and different industries also experienced turbulent changes in it. The industries with the largest fluctuations in the region are accommodation and catering, followed by residential services, repairs and other and education industries. Due to the need for epidemic prevention policies in various places, the suspension of work and production, online work, and epidemic lockdown. Thus, labor cannot enter relevant fields, production is affected, the construction industry is greatly affected by this factor, the fluctuation area is also eye-catching. Residential services and repairs are related to other industries such as bathing, beauty salons and other content that require interaction, and many consumers will spontaneously reduce consumption in related industries to reduce the risk of

contracting the virus. On the other hand, owing to the lockdown of consumers, many catering businesses have suspended business. Besides, the suspension of dine-in to reduce the impact of the epidemic has reduced the demand for accommodation catering and residential service repair and other industries. The severity of the epidemic in different regions and different time periods has affected people's willingness to consume and consumption ability. Affected by consumer psychology, adults with more spending power are more willing to let their children participate in activities with relatively little risk. During the period of severe epidemic, educational institutions are also affected to a certain extent because it is difficult for objects to gather on time to participate in offline classes. The shutdown of production has also affected the consumption capacity and consumption expectations of residents, due to the unpredictable shutdown of production and shutdown consumers' spending power has mostly declined, on the other hand, due to the impact of the epidemic on many small and medium-sized enterprises declared bankruptcy, many consumers lost their jobs or consumption expectations conservative. These are also reflected in the financial industry. In addition, ascribed to the pursuit of profits by capital, the upgrading and transformation of industries and the influence of policies and other aspects of the environment, the health and social industry is also fluctuating sharply, ushering in huge development space [8]. On the contrary, the fewer volatile industries are concentrated in the wholesale and retail, delivery and warehousing industry, due to the development of the Internet, the advantages of online shopping and the characteristics of daily necessities, the wholesale and retail industry has a smaller volatility range.

Table 1. Correlation coefficients and changes

Type of industry	max	min	average	Change region	Std
Agriculture, Forestry and Fishery	114.48	59.37	83.1	55.11	14.58
Mining	87.57	40.47	59.06	47.1	13.75
Manufacturing	74.79	38.04	59.76	36.75	11.94
Electricity, Water and Gas	75.94	33.7	51.23	42.24	11.13
Construction	51.25	-70.86	16.34	122.1	41.96
Wholesale and retail	65.39	41.44	54.24	23.95	5.24
Transportation and storage	56.53	23.05	38.28	33.47	10.1
Accommodation and Catering	568.64	43.41	256.89	525.23	161.7
Information Technology	112.12	46.25	71.37	65.87	17.88
Finance	117.37	10.51	38.6	106.86	25.77
Real Estate	65.05	21.25	34.91	43.8	10.11
Rental Business	70.61	35.02	50.96	35.59	11.04
Scientific Research Technology	82.17	42.77	59.23	39.4	14.16
Water and Environment	56.7	22.49	34.64	34.2	10
Residential Services Repair and Others	315.95	-17.32	67.56	333.27	104.08
Education	281.17	24.22	85.5	256.95	73.79
Health and Social	169.72	-11.08	58.17	180.8	49.72
Culture and Sports	53.86	10.73	35.81	43.13	13.1
Comprehensive Enterprises	138.43	20.56	85.32	117.87	40.14

4. Empirical Analysis

4.1. Linkage Between P/E Ratios of Different Industries & Index P/E Ratios

The CSI 300 Index consists of 300 companies with good market representation, large market capitalization, high liquidity and active trading in Shanghai and Shenzhen, basically covering the leading companies in various industries. At the same time, the total market capitalization of the index's constituents, accounting for about 60% of the overall market capitalization of the Shanghai and Shenzhen markets, can well represent the overall situation of the A-share market. Therefore, the CSI 300 Index is regarded as the wind vane of the A-share market. To illustrate the changes in the

correlation between various industries and the CSI 300 index before and after COVID-19, the monthly P/E ratios of various industries for the four-year period 2019-2022 are selected, and their correlation coefficients with the CSI 300 index are calculated using stata 16, and the corresponding correlation analysis is performed. According to the data in Table 2, the correlation coefficients between the P/E ratio of each industry and the P/E ratio of the CSI 300 Index are divided into intervals, as shown in Table 3.

Table 2. Correlation coefficients and changes in industry and CSI 300 P/E ratios

Type of industry	Correlation 2019	Correlation 2020-2022	Change
Residential Services Repair and Others	0.6373	-0.5749	-1.2122
Rental Business	0.7333	-0.4485	-1.1818
Culture and Sports	0.7767	-0.3576	-1.1343
Comprehensive Enterprises	0.7852	-0.2977	-1.0829
Electricity, Water and Gas	0.3514	-0.4939	-0.8453
Accommodation and Catering	0.5049	-0.2337	-0.7386
Information Technology	0.6320	-0.0803	-0.7123
Wholesale and retail	0.5630	-0.1479	-0.7109
Transportation and storage	0.8441	0.1694	-0.6747
Water and Environment	0.8799	0.2281	-0.6518
Finance	0.9019	0.3338	-0.5681
Construction	0.8387	0.5394	-0.2993
Manufacturing	0.7873	0.5094	-0.2779
Scientific Research Technology	0.7935	0.6164	-0.1771
Real Estate	0.5032	0.3475	-0.1557
Mining	0.3799	0.2865	-0.0934
Health and Social	0.6826	0.6119	-0.0707
Agriculture, Forestry and Fishery	0.6825	0.6976	0.0151
Education	0.0188	0.4277	0.4089

Table 3. Correlation coefficient range between industry and CSI 300 P/E ratio

Correlation coefficient intervals	2019	2020-2022
>0.9	Finance	/
0.6-0.9	Residential Services Repair and Others, Rental Business, Culture and Sports, Comprehensive Enterprises, Information Technology, Transportation and storage, Water and Environment, Construction, Manufacturing, Scientific Research Technology Health and Social, Agriculture, Forestry and Fishery	/
0.3-0.6	Electricity, Water and Gas, Accommodation and Catering, Wholesale and retail, Real Estate, Mining	Finance, Construction, Manufacturing, Real Estate, Education
0-0.3	Education	Transportation and storage, Water and Environment, Mining
<0	/	Residential Services Repair and Others, Rental Business, Culture and Sports, Comprehensive Enterprises, Electricity, Water and Gas, Accommodation and Catering, Information Technology, Wholesale and retail

As can be seen from Table 3, the correlation between the P/E ratios of most industries and the P/E ratio of CSI 300 decreased during COVID-19. In 2019, the correlation coefficients between the P/E

ratios of all industries and the P/E ratio of CSI 300 were positive, among which the correlation coefficient between the P/E ratio of the finance and the P/E ratio of CSI 300 index reached 0.9019, showing a strong correlation. During 2020-2022, the correlation between the P/E ratio and the P/E ratio of the CSI 300 Index decreased in all industries except agriculture, forestry, fishery, and education, with industries such as residential services repair and others, rental business showing a negative correlation. The industries with the largest range of changes were residential services repair and others. In summary, the industry P/E ratios and the CSI 300 P/E ratios weakened during COVID-19, so the applicability and reference of the CSI 300 index for the A-share market decreased compared to 2019, which indicated that the differentiation in the industry in the A-share market intensified during COVID-19. In the negative correlation interval shown in Table 3, industry P/E ratios showed a negative correlation with the P/E ratio of the CSI 300 index, which meant that the P/E ratios of industries such as residential services repair and others decreased when the overall P/E ratio of the A-share market represented by the CSI 300 index increased. Since the CSI 300 index contains mostly leading companies with large market capitalization in each industry. Therefore, in the above-mentioned industries, large-cap and small-cap companies have shown significant differences under the influence of COVID-19, with large-cap companies fluctuating less drastically than small-cap companies, and the two even showing fluctuations in opposite directions.

4.2. Valuation Model

In the empirical analysis section, the P/E(price-to-earnings) ratio is used as the explanatory variable, and among the explanatory variables, the price-to-sales ratio, return on net assets and earnings per share are selected to measure profitability, the current ratio is selected to measure liquidity and solvency, the asset turnover ratio is selected to measure operating capacity, and the logarithm of quarterly GDP is used to measure the impact of COVID-19 on the overall national economy. The criteria for sample stock selection are given as follows. Since the time interval studied in this paper is three consecutive years of industry P/E data, companies with IPO and listed for less than three years after 2020 are excluded. The sample stocks are the leading enterprises in each industry, with relatively large scale, relatively good economic efficiency and strong driving ability in the industry. Excluding listed companies that have been suspended after 2020. Excluding listed companies that have undergone major asset restructuring or mergers during the sample period to avoid the interference of their great volatility to the empirical model. The expression is

$$PE = \alpha + \beta_1 PB + \beta_2 ROE + \beta_3 EPS + \beta_4 LA + \beta_5 lnGDP + \beta_6 ATR + \varepsilon \quad (1)$$

Here, PB indicates the quarterly price-to-sales ratio of individual stocks in the industry. ROE indicates quarterly return on net assets for individual stocks in the industry. EPS indicates earnings per share for individual stocks. LA denotes the current ratio of individual industry stocks. lnGDP denotes the logarithm of quarterly GDP. ATR denotes the quarterly asset turnover ratio of an industry stock.

4.3. Empirical Analysis of the Representative Industry P/E Valuation Model

In this paper, the pharmaceutical industry is selected as a representative industry for the empirical analysis of the P/E valuation model.[9] According to the above sample stock selection criteria, this paper selects ten listed companies in the pharmaceutical industry that meet all the conditions as sample stocks, and the selected sample stocks are shown in Table 4. As given in Table. 5, it can be seen that the P/E ratio of companies in the pharmaceutical industry shows a positive correlation with the price-to-sales ratio, current ratio and asset turnover ratio, and a negative correlation with the logarithm of the return on net assets, earnings per share and GDP. The industry's P/E ratio is negatively correlated with the logarithm of GDP, indicating that while COVID-19 exerted downward pressure on the overall national economy, the bio-pharmaceutical industry's P/E ratio increased. The reason for this is that due to the characteristics of the pharmaceutical industry itself, pharmaceutical

companies, especially those engaged in epidemic prevention drugs and supplies, are sought after by the capital market as essential and urgently needed materials to fight against epidemics, and have ushered in a new development opportunity during COVID-19 [10]. The industry's own valuation effect is reflected here. In order to further verify the explanatory power of each variable on the P/E ratio, regression analysis is conducted in this paper using the above data. The data of each variable was brought into the model for OLS regression analysis, and the results of the analysis are shown in Table. 6.

Table 4. Pharmaceutical Industry Sample Stocks

Mindray	Wuxi AppTec	AIER	HENGRUI	PZH
Zhifei	FOSUN PHARMA	PHARMARON	Tigermed	YUNNAN BAIYAO

Table 5. Results of Correlation Analysis

	PB	ROE	EPS	LA	lnGDP	ATR
PE	0.6474	-0.0408	-0.4159	0.0996	-0.1153	0.0553

Table 6. Results of Regression Analysis

PE	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
PB	2.788	.263	10.61	0.000	2.267	3.309	***
ROE	-.938	.358	-2.62	0.010	-1.647	-.229	**
EPS	-6.588	1.617	-4.08	0.000	-9.794	-3.382	***
LA	1.89	.773	1.80	0.075	-.144	2.922	*
ATR	28.034	15.31	1.83	0.070	-2.33	58.397	*
lnGDP	34.413	34.166	1.01	0.316	-33.347	102.174	
Constant	-391.472	427.857	-0.91	0.362	-1240.026	457.082	

Mean dependent var	66.293	SD dependent var	33.741
R-squared	0.634	Number of obs	110
F-test	29.685	Prob > F	0.000
Akaike crit. (AIC)	988.835	Bayesian crit. (BIC)	1007.739

**** p<.01, ** p<.05, * p<.1*

The results of the above tests show that R-squared of the model achieves 0.6, and the F-statistic also passes the test, indicating that the overall effect of the model is good and the fit is good. These results show that the P/E ratio of the industry increases with GDP. supply chain shocks, work stoppages, disruptions in logistics and transportation, and personnel transportation restrictions of varying degrees during COVID-19 have had a significant impact on the pharmaceutical industry, particularly the pharmaceutical manufacturing industry. The market valuation effect is reflected here.

5. Conclusion

In summary, COVID-19 has intensified the phenomenon of individual stock differentiation within the industry. The P/E ratios of some industries showed a negative correlation with the overall P/E ratio of the A-share market, indicating that large-cap and small-cap companies showed obvious differences under the influence of COVID-19, with small-cap companies showing more drastic fluctuations, even showing fluctuations in the opposite direction of large-cap companies. The double valuation effect of COVID-19 are reflected on some industries, with both opportunities and challenges. The pharmaceutical industry showed obvious market valuation effects as well as its own valuation effects during COVID-19. On the one hand, companies faced unprecedented challenges such as work stoppages and production shutdowns due to production disruptions, traffic control and other epidemic prevention measures. Moreover, pharmaceuticals, as necessary and urgent materials to fight against epidemics, are facing a huge market demand and have ushered in a new development opportunity. In the context of COVID-19, this paper analyzes the changes in valuation patterns of

different industries in different markets and the different results and possibilities of the industry affected in this. These results can serve as a reference for companies to make timely adjustments in the event of a subsequent pandemic and to better manage the crisis if a similar situation occurs afterwards.

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