The Effectiveness of Ratio Analysis During COVID-19 Based on Bigdata and Information Estimation

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Abstract—At the end of 2019, the world started experiencing a unusual pandemic which is called COVID-19. The financial market suffered substantially. This paper utilized the mechanism of ratio analysis to explore how different dimensions of the performance of the most valuable companies being affected under such conditions. Specially, ratio analysis includes P/E, EV/sales, and EV/EBITDA ratio for firms' scale, revenue growth, EBITDA change, and earnings per share change for growth, and GP/A for profitability. According to the analysis, firms tend to be overvalued during the COVID. In addition, the revenue growth, change of earnings before interest, taxes, depreciation, and change of amortization, earnings per common share all slows down during the COVID-19. Firms' profitability shows a downward trend which means its' assets didn't have enough ability to generate high sales or the gross margin decreased due to the high expenses of production over the years that had COVID. The significance of this research lies on the fact that most of recent researches didn't use the ratio analysis to interpret the market conditions under COVID-19. These results shed light on guiding further exploration of investment in terms of ratio analysis.

Keywords-Ratio Analysis; COVID-19; stock market; bigdata; information estimation.

1 INTRODUCTION

The outbreak of novel coronavirus pandemic, known as COVID-19 has caused more than 5.15 billion people infected with more than 6.24 million deaths around the world as recorded on May 5,2022(*CSSE at JHU*) [1, 2]. It started from late December 2019 in Wuhan, China, and widely spread throughout the world during 2020. Since the World War II, COVID-19 has been reported as immediate flashpoint contributed to the biggest financial depression, which incurred more than$12 trillion loss (*Wellcom*) [3]. The investment on corporations has mainly shifted to R&D and concentrated on medicines, vaccines, tests and treatments. There are always clues for such a big recession. At the national level, the manufacturing activities have been affected negatively due to the short supply of major production inputs, and therefore leading to the shortage of supply of essential articles of daily use. At the firm level, many corporations have been undermined and even forced to shut down because of huge expenditure for labor and operations. Specifically, small firms experienced greater shocks from the pandemic than large firms [4]. Different sectors would likewise receive different shocks. Furthermore, the COVID pandemic made a tremendous impact on equity or financial market. On March 18 2020, S&P 500 has shown a 28 percent drop of dividend growth, and 2.6 percent drop of GDP growth [5]. Since the outbreak of COVID19, market panic has spread. As a result, substantial fluctuations occurred on the global financial market. The U.S. stock market has experienced four circuit breakers in just two weeks. On March

9, the S&P 500 index triggered the first-level circuit breaker mechanism due to a slump of the U.S. stock market [6]. Subsequently, three circuit breakers occurred following by worldwide circuit breakers incidents. According to incomplete statistics, stocks markets of countries including Tailand, Philippines, South Korea, Pakistan, Indonesia, Brazil, Canada, Mexico, Colombia, and Sri Lanka also triggered circuit breakers [6].

During these years, researchers have shown an increased interest in the effect of COVID-19 on stock market, and has utilized various tools and models to confirm their conjectures. One of the most significant discussions about the effect of COVID-19 on the volatility of stock markets was shown in a research paper written by Charjuthamard et al. [7]. According to their studies, the results suggested that the volatility and jumps of the stock markets were intensified as the COVID-19 confirmed cases increasing while the financial returns were negatively impacted [7]. Likewise, it is suggested that the spillover effect of the pandemic was possible by looking at the positive coefficient of COVID co-jumps models, meaning that the impact on stock market is worldwide [8]. The results from another study that was consistent with the former one, which illustrated that the volatility of the stock market increased with the decrease of mean returns collected and analyzed through ESM and PVAR models [9]. Moreover, Yu et al's reasearch measured the spillover effect of volatility and studied global stock market risk contagion using network connectedness method [9]. Empirical results on their studies have shown an increase risk spillover effects and rising connectedness of markets globally. Almost all of these related papers mentioned the reasons behind were that the stock market participants or investors' perceptions of market risk are distorted, and their mechanisms to evaluate the quality of the stocks are largely affected.

Firm's performances have always been the central interest to the researchers. However, many studies so far have been silent about examining the effectiveness of mechanisms of ratio analysis companies due to the high uncertainty of the financial markets under COVID-19. Thomas and Basariya introduced the concepts of ratio analysis based on operating performance, profitability and liquidity [10]. Ratios are helpful when dealing with comparisons between similar firms [10]. Moreover, another empirical study combined the standard profitability and growth measurement into its extended ratio analysis. The results indicated that ratios of current financial statements forecast the future performance of the companies, but does not incorporate the uncertainty in the market.

The ratio analysis is emerged and widely used by investors and stock market participated because it is readily understandable and acts as the indicators for information revealing of the market. The COVID-19, as known, caused a downward shift of the stock markets as a whole. The question nonetheless lies on what should one know about the prediction of performance of companies based on ratio analysis under COVID-19, and the way incorporate the knowledge for the ratio analysis to wisely make stock selections. The aim of this research is to analyze the effectiveness of basic ratio analysis for picking the stock, including the measurements of valuation, profitability and growth, during the COVID-19.

The framework begins with a subject interest, and continues with a review of subjects and background research following by method selection. Furthermore, it focuses on the stock picking by computing the relevant ratios from sample data collected, and finishes with empirical results and conclusions. The rest part of the paper is organized as follows. The Section II will introduce the sample data and methods or ratios used. The section III comes with the results and discussion

of the stock selected and the effectiveness of ratio analysis. The Section IV will state the conclusions for this study.

2 DATA&METHODOLOGY

2.1 Data

To find the effectiveness of ratio analysis on stock selection during the COVID-19, I use the data which composed of thousands of firms' indices from the Compustat-Capital IQ database. To be more specific, in order to compare the overall performance of the firms, the data collected should include the years before and during the COVID-19. Moreover, 5246 firms in 2016, 5243 firms in 2017, 5229 firms in 2018, 5205 firms in 2019, and 5290 in 2020. However, because some firms were out of the market in years between, we use surviving firms in 2020 as the final target firms. The initial indices contained the following information: total assets(at), book value of common equity (ceq), cash (che), cost of good sold (cogs), common share outstanding (csho), current liabilities (dlc), long term debt (dltt), dividends per common share (dvc), earnings before interest and taxes (ebit), earnings before interest, taxes, depreciation, and amortization (ebitda), earnings per share doesn't include any extraordinary items (epsfx), total liabilities (lt), net income (ni), revenue (revt), total value of stockholders equity (seq), current status (costat), and price of a common share/stock at the end of the fiscal year (prcc$_f$). More importantly, one has to exclude the firms from the data that didn't have records of dltt and dlc, since the services of these firms were mostly funds or mutual funds, which does not apply to the purpose of this research.

2.2 Methodology

The whole procedure was done by computing three major measures, including firms scale, growth and profitability. The P/E ratio, EV/sales ratio, and EV/ebitda are adopted to measures the firms' scale each year from 2016 to 2020. The corresponding equations are as follows:

$$\frac{P}{E} = \frac{prcc_f}{epsfx} \tag{1}$$

$$Mcap = prcc_f \times csho \tag{2}$$

$$EV = Mcap + Debt - Cash \tag{3}$$

$$\frac{EV}{sales} = \frac{EV}{revt} \tag{4}$$

$$\frac{EV}{ebitda} = \frac{EV}{ebitda} \tag{5}$$

Mcap is explained as the market value equity or market capitalization. EV denoted as the value of the business or enterprise value. The firms with negative EV and epsfx are discarded either because they have too much cash or they are not valuable stocks to pick. In order to be precise and comprehensive, the technique of winsorization is applied on this calculation. Winsorization allows to eliminate the unusual value (huge outliers) and then combines the three ratios together to measure the firms scale on a boarder level.

Subsequently, the idea of growth is implemented through calculating the growth in revenue, change in operating profits before depreciation and amortization, change in earnings per share. First, one sorts the companies and find the revenue, operating profits each year, and use the functions as follow:

$$\text{revtgr}_t = \frac{\text{revt}_t - \text{revt}_{t-1}}{\text{revt}_t} \tag{6}$$

The growth rate of revenue of each two years, denoted as Revtgr. revt_t is the revenue of target year, and t-1 denoted the year before the target year. Similar mechanisms are applied to the change in operating profits and earnings per share. Instead of computing the growth, we simply compute the change between each two years.

For Profitability measurement, the GP/A. is calculated, which can be separated by the assets turnover and gross margins to be extended as details. The equations for a particular year are as follows:

$$\text{GP} = \text{revt} - \text{cogs} \tag{7}$$

$$\frac{\text{GP}}{\text{A}} = \frac{\text{GP}}{\text{at}} \tag{8}$$

where GP is the gross profit, and A is the total assets as at.

Each dimension of the firms implies different aspects of the firm's performance. The year as the independent variables should help to compare the average perfromancce of the firms before (2016-2018), and after (2019) the COVID-19.

3 RESULTS AND DISCUSSION

According to Table 1, information provided presents the median and different percentiles of P/E ratio, EV/sales ratio, and EV/ebitda ratio. The table contains various data with years as independent variable which allows for the comparison between ratios of each year, and within the ratios themselves. By using the percentiles computed, each ratio is winsorized based on 10th to 90th percentile, and calculated the average and standard deviations, which excluded the outliers to make the average more credible. The P/E ratios for companies is striking in 2020 which reached 31.47 on average winsorized. Same for EV/sales ratio and EV/ebitda ratio, they were all at the peak in 2020 which the results were respectively 3.43 and 14.13. The result was substantial as it indicates that ratios on average was high in 2020, which was bad for investors. Moreover, a higher P/E ratio, EV/sales ratio or EV/ebitda ratio potentially suggests that more companies were overvalued or there was a small chuck of companies that were overvalued to a great extent in 2020, or COVID year. However, it may imply that the stock participants were expecting the future high growth of the companies. In addition, Figure 1 illustrated how the P/E, EV/sales, and EV/ebitda ratio changed over the past 5 years. Seen from the graph, each ratio had increased to varying degrees. Take P/E ratio as an example, it declined between 2017 and 2018, however, during the COVID(2018-2020), it increased dramatically to a peak in 2020. The result is consistent to what was expected.

Table 1 Data related to P/E ratio, EV/sales ratio, and EV/ebitda ratio of valuable companies in years before COVID vs. valuable companies after COVID

| Statistics	Year														
	Year Before COVID									Year During COVID					
	2016			2017			2018			2019			2020		
Ratio	P/E	EV/sales	EV/ebitda	P/E	EV/sales	EV/ebitda	P/E	EV/sales	EV/ebitda	P/E	EV/sales	EV/ebitda	P/E	EV/sales	EV/ebitda
Median	21.51	2.28	10.64	21.73	2.53	11.22	16.59	2.21	9.40	17.76	2.39	10.40	21.88	2.44	11.64
Percentile 25th	15.66	1.10	7.76	14.86	1.21	8.12	11.09	1.04	6.42	11.52	1.13	6.71	12.58	1.21	7.09
Percentile 75th	31.52	4.41	14.23	34.49	4.76	14.82	27.43	4.09	13.49	30.78	4.48	15.38	41.14	4.91	18.65
Percentile 10th	10.61	0.58	5.19	9.21	0.63	5.40	7.14	0.53	3.98	5.80	0.55	3.52	8.26	0.64	4.27
Percentile 90th	64.84	6.95	19.23	65.48	7.48	21.33	53.43	6.53	20.76	60.82	7.64	24.77	86.78	9.23	33.01
Average, winsorized	27.21	2.93	11.25	27.65	3.17	12.05	21.87	2.74	10.64	24.96	3.09	12.22	31.47	3.43	14.13
St dev, winsorized	16.51	2.12	4.40	17.34	2.26	4.86	14.40	1.96	5.16	16.65	2.26	6.33	24.91	2.78	8.97
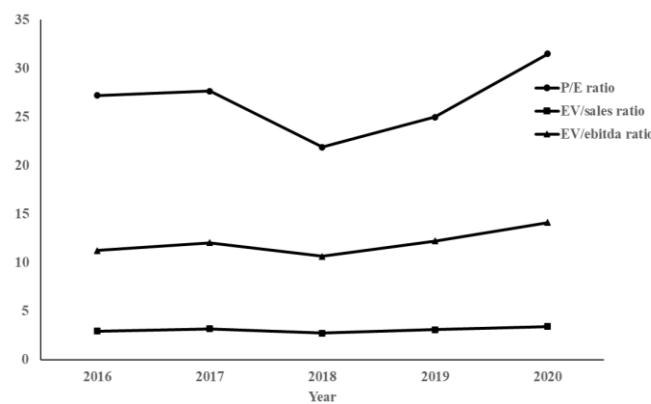
Figure 1. The trends of P/E ratio, EV/sales ratio, and EV/ebitda ratio from 2016 to 2020.

To compare the growth aspects, Figure 2 depicts how the revenue growth of each two years changed before the COVID (2016-2018) and during the COVID (2018-2020). Although the revenue was continuously growing over the 5 years, the figure presents the idea that the revenue growth was decreasing. In other words, the revenue growth is slowing down consistently from 2016 to 2020, especially during the COVID from 2018 to 2020, which is consistent with the result from the studies of Refs. [7] and [8]. According to the results, the revenue growth dropped from 10.73% just before the COVID to nearly 3% in 2020. Since the data collected for each firm

was mostly from the end of the year, and the shutdown was not implemented until the March of 2020, the decline wasn't obvious for 2019.
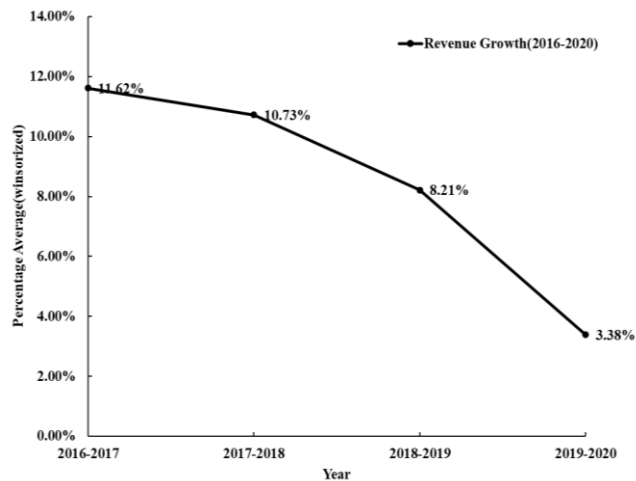

Figure 2. The trend of revenue growth from 2016 to 2020.

Similar result is obtained for ebitda change winsorized, where the change is positive during the 5 years and the change is slowing down dramatically during the COVID pandemic as presented in Figure 3. Similar to the revenue growth, ebitda change measures the earnings. Unlike the revenue, ebitda means earnings before interest, taxes, depreciation and amortization between each two years, which gives a clearly picture of how profitable the business is. Specifically, the ebitda change was decreasing from 38.20 to 17.06.
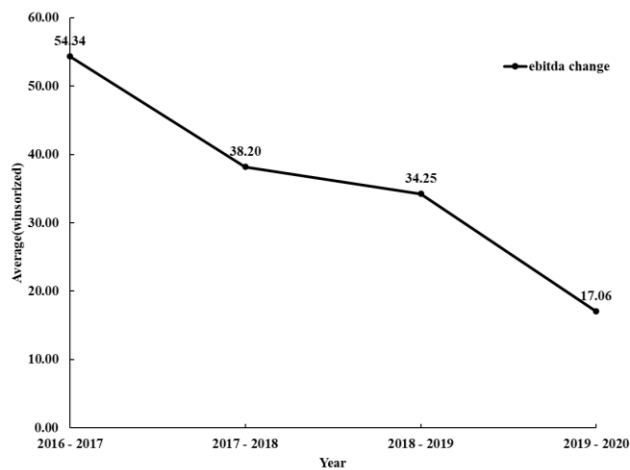

Figure 3. The trend of ebitda change from 2016 to 2020.

Based on Figure 4, the average winsorized change of earnings per share, or change of net profit per common share a company has outstanding, was decreasing to 0.17 at the beginning of

COVID in 2019, but increasing to 0.21 in 2020. The possible interpretation for such an increase might be that the relative non-profitable firms were forced to leave the market due to the high expenses, while the remaining firms were the firms that had ability to pay out the money to its shareholders. Although, it is not consistent with the results of revenue growth and ebitda change, the overall change of earnings per share is decreasing compared to a growth of change of 0.04 before COVID or from 2016 to 2018.
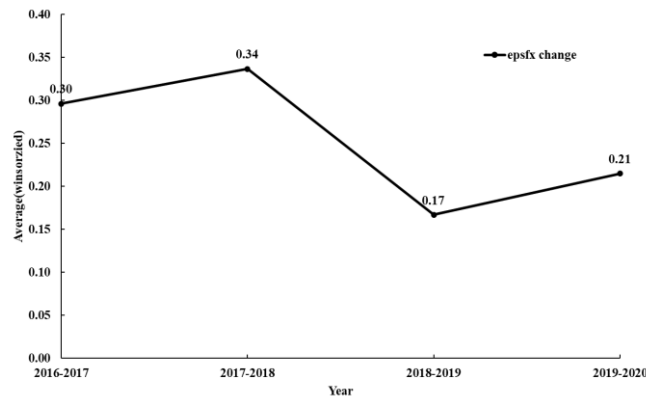

Figure 4. The trend of epsfx change from 2016 to 2020.

To compare the profitability of companies before COVID-19 and during COVID-19, GP/A was essential as it composes both the dimensions of assets turnover and gross margin as a single ratio. Apparently, Figure 5 illustrates a state of rapid decline after discovering the existence of COVID-19. Specifically, GP/A declines from 28.07% in 2018 before the COVID, to 25.91% and 24.24%, respectively in 2019 and 2020 after the COVID. The explanation of the decrease of GP/A can be separated into two parts. The first one is that the assets efficiency is decreasing. Therefore, the firms' assets were unable to generate as much sales as before COVID-19. Second, the companies were getting less and less per product sold because of high cost of production.
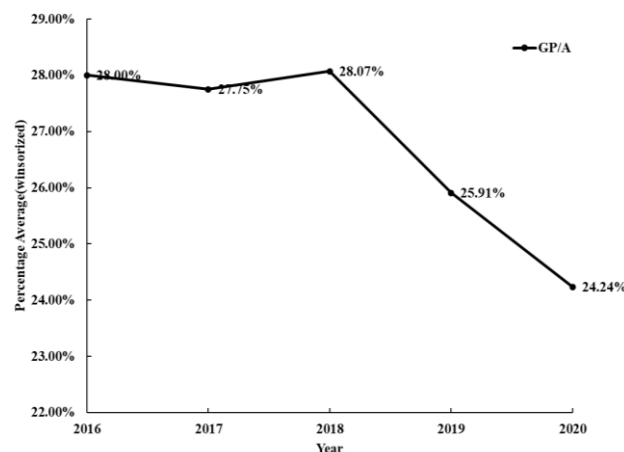

Figure 5. The change of GP/A from 2016 to 2020

The above analysis compared different aspects of the companies based on ratio analysis, particularly firms' scale, growth and profitability, from the years before COVID-19 and years during COVID-19. The results had certain scientific basis, but it contains several limitations. First of all, ratio analysis is useless at individual level. In order to interpret the scale, growth or profitability of a single company, one needs to set up the benchmark to its historical data. However, if the companies are newly-emerged, there is no comparison allowing us to do the interpretation. In addition, the time-lagged effect for the data collected distorts the exact trends and results. Since most of the data was collected at the end of the year, while some others were collected at a point during the year. The time wasn't consistent for all the companies, and therefore biased the results. Besides, different companies have different accounting mechanisms. More importantly, the financial markets contain thousands of companies which touches different divisions. To be more specific, different companies have different services or produce different products, and even some companies have various production line or offer compounding services. This study only measures the overall performance of the financial markets, but not for certain divisions or industries. Moreover, the analysis only concludes the result for most valuable companies because some firms that had missing data or non-valuable measurements are excluded. Last but not least, one cannot eliminate the possibilities that some companies might use some techniques in order to have a "good-looking" balance sheet, or "treat" indirectly on their financial data in order to attract the customers and investors. Therefore, this study has limitations to some extent.

4 CONCLUSIONS&PERSPECTIVES

In summary, this paper investigates the effectiveness of stock selection under the COVID-19 based on ratio analysis. The dimensions used were firms' scale, growth and profitability. Different ratios were computed for different dimensions. The results were consistent with the purposes and some literature reviews that the overall performance of the markets, particularly for valuable companies, shows a downward shift as a whole. More over-valued firms appeared in the markets during COVID. Furthermore, whether the growth or profitability were declining substantially during the COVID-19. Although the study has some limitations such as time-lagged effect which distorted the results, the feasibility of ratio analysis was proved through its consistency. However, the limitations provide ideas for future studies such that the results will be more credible. In the future, performing the ratio analysis based on the divisions of companies will then give a more accurate result. Overall, these results offer a guideline for investors and researchers who are looking for related study of financial markets based on ratio analysis under COVID-19.

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