The Impact of COVID-19 Pandemic on E-commerce

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ABSTRACT

This work explains and evaluates the impact of Covid19 pandemic on e-commerce industry using event analysis approach. This work mainly categorizes the impact into three aspects: study and working, shopping, and socialization. In each aspect, one representative firm is selected to analyze the impact. Generally, Covid19 had a positive impact on e-commerce industry, but to a different degree for different firms, indicating that Covid19 impacts different subdivision of e-commerce distinctively. Consequently, this work reminds people the specific situation for e-commerce industry after the pandemic and may possibly help the government devise targeted subsidy strategies for each area of e-commerce industry.

Keywords: *E-commerce, event analysis, COVID-19*

1. INTRODUCTION

The sudden outbreak of pandemic had a substantial impact on people's lives. People moved to on-line teaching and on-line studying during the pandemic for the fear of infection. Similarly, people moved to on-line shopping because of the requirement of social distancing. According to Commerce Department figures, the online sales reaches $791.70 billion in 2020, YOY+32.4% in the US. Furthermore, people changed to reach out their friends online so there was a surge of users for social media. Our team mainly categorize the influence into three aspects: study and working, shopping, and socialization. We are curious about the extent of influence on those three aspects and this study provides an assessment of it by using event analysis of the three representative firms in the three industries.

1.1 Event

The event our research choose is COVID-19. It is the disease caused by SARS-CoV-2, the coronavirus that emerged in December 2019. The global e-commerce sales jumped to 26.7 trillion dollars in 2019, YOY+4%. In our research, we choose four smaller events, which are four event windows in our methodology. The four events are:

● **29, February 2020, the United Sates reported a death.** On this day, the authorities announced that a patient near Seattle had died from the coronavirus, which is considered as the first coronavirus death in the United States at the time.

● **20, June 2020, Southern US. states saw sharp rise in cases.** On this day, Florida and South Carolina broke their single-day records for the new cases.

● **18, August 2020, universities that reopened soon began moving classes online.** On this day, the University of Notre Dame made the announcement that it would move to online courses for at least two weeks to curb the growing coronavirus outbreak.

● **2, December 2020, the U.K approved Pfizer's coronavirus vaccine.**

1.2 Macro fundamentals

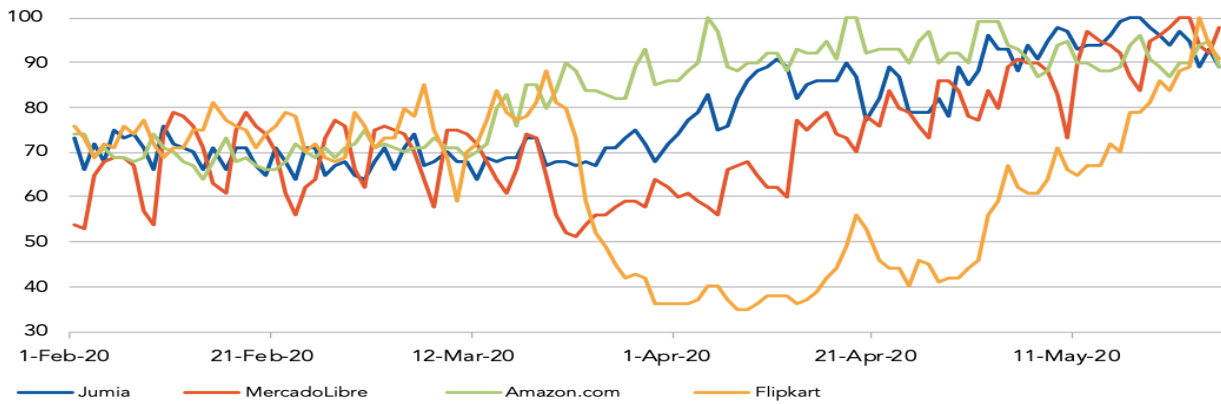### 1.2.1 Increase in the popularity of e-commerce platforms during the pandemic

Figure 1: Google trends for some of the largest e-commerce platforms between March and May 2020 Source: Google trends

Numbers on the Y axis are not absolute values but represent a search interest (worldwide) relative to the highest point on the chart. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular.

According to figure 1, there is a general upward trend for large e-commerce companies at the start of March 2020. Amazon, for example, reached the peak popularity in April 2020 and May 2020. During April and May, the index is consistently above 90. This indicates the increase in popularity for e-commerce platforms during the pandemic.
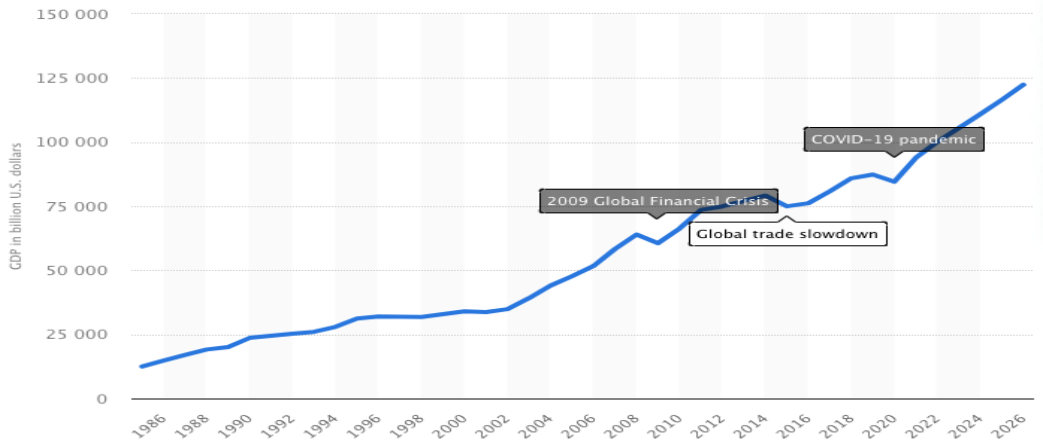
1.2.2 Decline in GDP

Figure 2: global gross domestic product (GDP) at current prices from 1985 to 2026 Source: Statista 2021 [1]

Figure 2 is an overview of the GDP at current price levels from 1985 to 2026. The third apparent drop of GDP in figure 2 is the outbreak of COVID-19. From 2019 to 2020, the global GDP decreased from approximately 87300 billion to 84500 billion, -3.2% YOY.
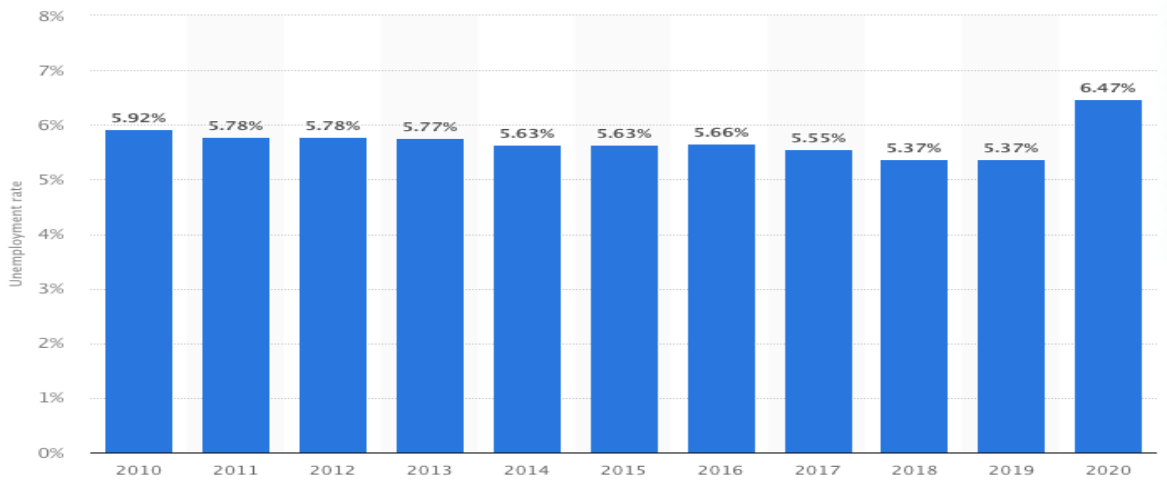
1.2.3 Increase in Unemployment

Figure 3: global unemployment rate from 2010 to 2020 Source: Statista 2021 [1]

As indicated by figure 3, the global unemployment rate jumped to 6.47% in 2020, which topped 6% this decade.

1.3 Company performance

In this part, several indicators such as the user stock prices, number of users, average revenue per user are used to show how the companies perform. Those indicators are significant and closely connected to the revenue of the e-commerce platform because of the equation in figure 4.
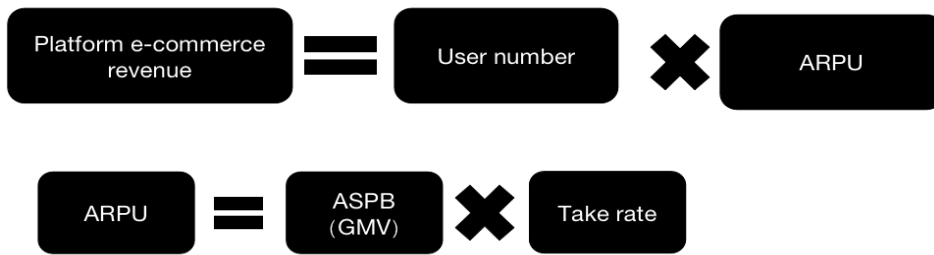

Figure 4 The equation for the e-commerce revenue
ARPU: Average Revenue Per User
ASPB: Annual Active User Purchase Amount

1.3.1 ZOOM

Zoom Video Communications, Inc. Provides a video-first communications platform in the Americas, the Asia Pacific, Europe, the Middle East, and Africa. The company offers Zoom Meetings that offers HD video, voice, chat, and content sharing through mobile devices.

(1) stock prices

Figure 5 Stock prices of Zoom from May 2020 to November 2020
Source: Tiger Trade [2]

From figure 5, as for the stock prices, from May 2020 to November 2020, it gradually increases and in November, it reached the top which is 588.84 during this year.

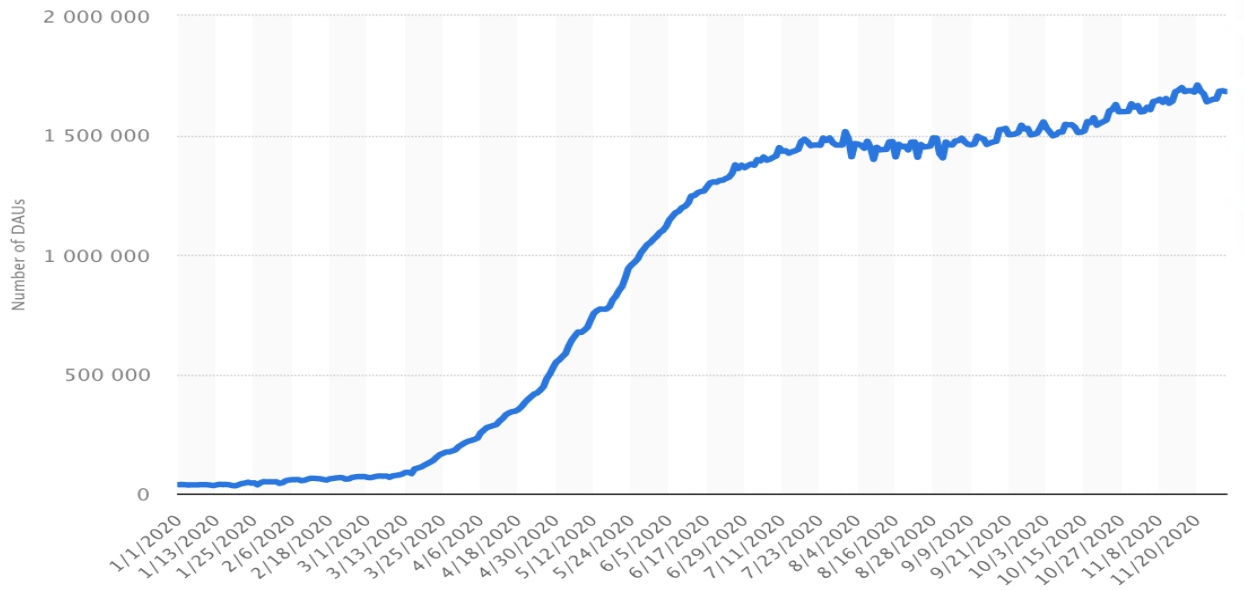**(2) Number of daily active users**

Figure 6: Daily active users (DAU) of the Zoom Source: Statista 2021 [1]

In figure 6, the number of daily active users sharply increases from March 2020 to August 2020. The reason of this dramatic change may be that the students and some employees cannot go to the school or workplace. Hence, people study or work online using zoom meeting.

1.3.2 Amazon

Amazon.com, Inc. engages in the retail sale of consumer products and subscriptions in North America and internationally. It offers products and services both offline and online.

(1) Stock prices

Figure 7 Stock prices of Amazon from May 2020 to November 2020 Source: Tiger Trade [2]

According to figure 7, there is also a steady increase in stock prices of Amazon from March 2020 to February 2020 and there is a large amount of change in stock prices. During this period, the stock price increased from 1,626.03 per share to 3,552.25 per share.
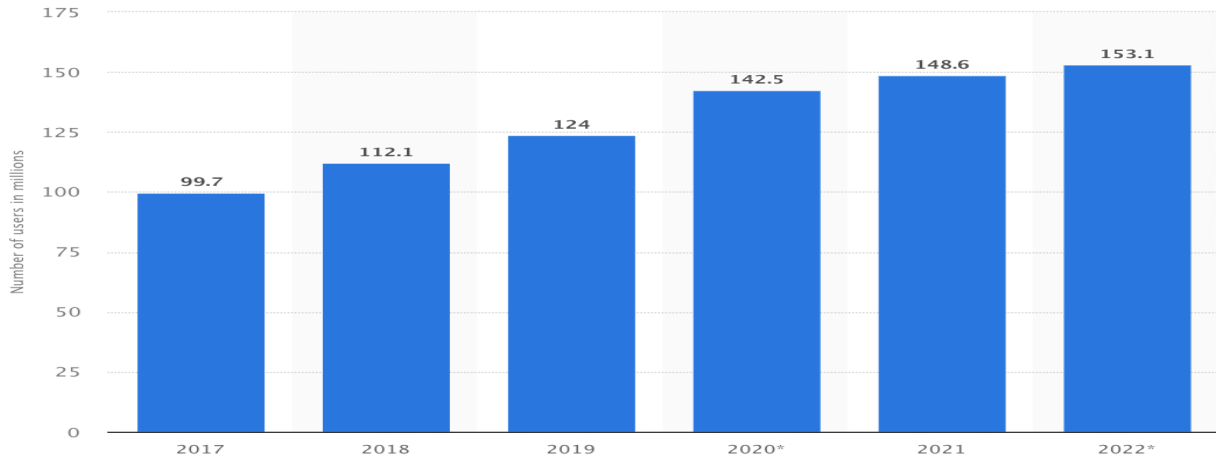
(2) number of users

Figure 8: Number of Amazon Prime users in the United States from 2017 to 2022 Source: Statista 2021 [1]

In figure 8, from 2019 to 2020, the user number of Amazon increased from 124 million to 142.5 million, which is a large jump compared to the previous years.

Figure 9 Estimated Worldwide Amazon GMV Source: Marketplace Pulse [3]

From figure 9, GMV is the gross merchandise value and from 2019 to 2020, there is a large increase in GMV from $335 billion to $490 billion.

1.3.3 Facebook

Facebook, Inc. Develops products that enable people to connect and share with friends and family through mobile devices, personal computers, virtual reality headsets, and in-home devices worldwide. Facebook is a product of this company that enables people to connect, share, discover, and communicate with each other on mobile devices or personal computers.

(1) Stock prices

Figure 10 Stock prices of Facebook from April 2020 to October 2020 Source: Tiger Trade [2]

In figure 10, from April 2020 to September 2020, stock prices of Facebook generally increase from 137.10 per share to 304.67 per share.
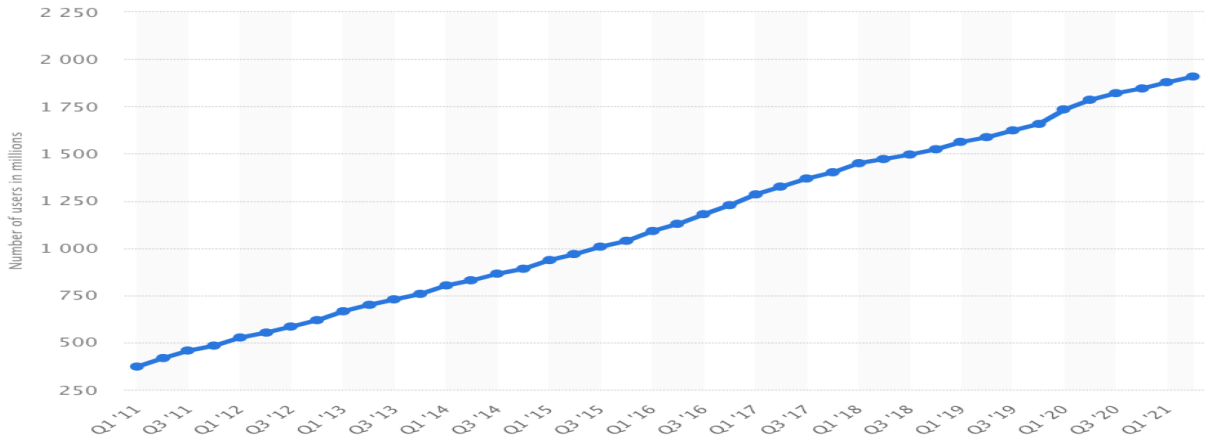
(2) Number of users

Figure 11: Number of daily active Facebook users worldwide as of 2nd quarter 2021 (in million) Source: Statista 2021 [1]

According to figure 11, from the third quarter of 2019 to the first quarter of 2020, there is slightly larger rate of rise in number of users of Facebook.
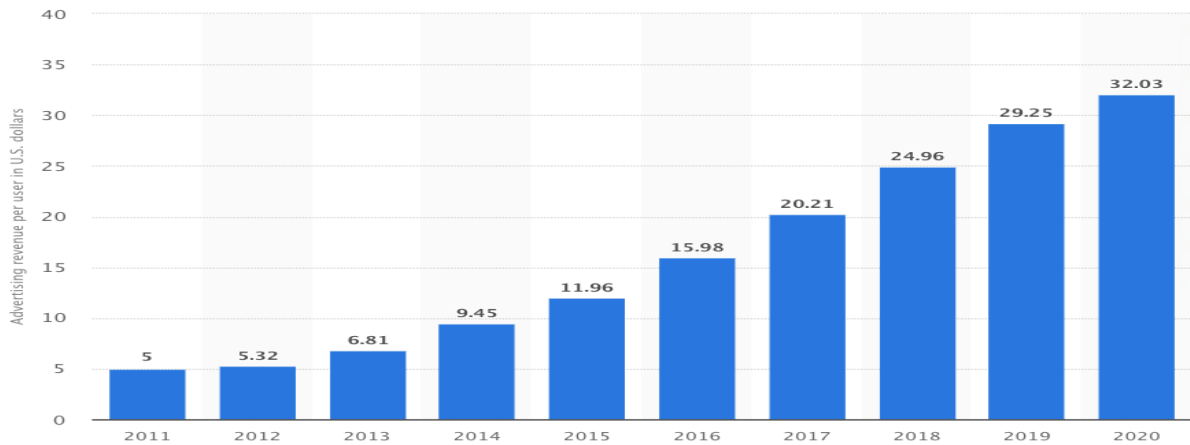
(3) ARPU

Figure 12: Facebook's average revenue per user (ARPU) from 2012 to 2020Source: Statista 2021 [1]

As shown in figure 12, for the ARPU, although the rate of increase in ARPU did not increase, there is still a rise in 2020.

From the previous data, we conclude that these three companies performed better in 2020. However, whether pandemic is the main reason of the improvement of the performance remains uncertain. Therefore, we start research to investigate whether the there is an impact of pandemic on e-commerce.

2. Literature review

In this section, we try to present some previous literature for this research. These research deal with the impact of COVID-19 on e-commerce.

Anam Bhatti aimed to find e-commerce trends during

COVID-19 Pandemic. The research shows that COVID-19 has significant impact on e-commerce of the world and in some cases negative impact, while overall e-commerce is growing rapidly because of virus. The researcher listed and compared data about changes of e-commerce during Coronavirus and described a phenomenon that many products significantly impacted by virus [4].

Arfan Shahzad aimed to investigate the COVID-19 impact on e-commerce usage in the Malaysian healthcare industry through the Technological, Organizational, and Environmental (TOE) model and found that organization readiness, e-commerce knowledge, and supply chain integration have a significant positive impact, while IT infrastructure and external pressure have an insignificant effect on e-commerce usage. The research is a quantitative online survey-based with questionnaires distributed among 100 samples from a healthcare

provider, namely doctors, hospital management, medical assistant nurses, and medical supplier, particularly in Peninsular Malaysia, and the data were analyzed by using SPSS 25 and PLS-SEM 3.0 to examine the relationship between variables and to test the hypotheses [5].

Mansour Abd Elrhim and Abdullah Elsayed aimed to investigate the effect of COVID-19 spread on the e-commerce market using the case of the 5 largest e-commerce companies in the world. The five companies are chosen based on the revenues and market value. This gives our research the idea of choosing representative companies. It uses values both the 'new corona virus cases' and the 'new corona virus deaths' daily and the daily returns of the shares of e-commerce companies in their event analysis [6].

World Bank aimed to assess the impact of COVID-19 on e-commerce and the provision of digital financial services for micro, small and medium enterprises, and low-income consumers. It describes the impact on e-commerce globally and analysis the data about e-commerce by regions. Each region, they choose several representative companies to analysis [7].

Comparing with literature, it is important to point that:

1. We utilize stock prices and calculate the cumulative abnormal return compared with S&P500 to perform our calculation.

2. We categorize the e-commerce companies based on people's daily need. People need to study or work every day, so we choose Zoom meeting. People also need to communicate with others or have fun online, so we choose Facebook. Furthermore, we also need to go shopping so we choose Amazon.

3. Methodology

The whole analysis is based on the event study process developed by Fama et al. (1969). A market model is set up for stock valuation with the assumption that stock price reflects all the public available information in an unbiased, quick, and accurate way.

● Step 1

Estimate window which is used to determine the relationship between individual stocks and the market are selected as well as the event window which is used to measure the difference between actual returns of individual stocks after the event and predicted returns to determine the impact of events.

● Step 2

$\hat{\alpha}$ and $\hat{\beta}$ are obtained by running "single index model" at the period of estimate window.

$$R_t = \alpha + \beta R_{mt} + \epsilon_t$$

R_t is a function that measures all the available information of the market

R_{mt} is the market return on large portfolio of stocks.

ϵ_t is the unanticipated errors and $\epsilon \sim (0, \sigma^2)$

● Step 3

Then we have a significant test that $\hat{\beta}$ is standardized to find whether it could be 0. If it can't, which means individual stocks have correlation with stock market, we can continue researching.

● Step 4

To get the cumulative abnormal return, abnormal returns are measured by the following equation: $AR_t = R_t - (\hat{\alpha} + \hat{\beta} R_{mt} + \epsilon_t)$

CAR is the summation of A_{Rt} that $CAR(T) = \sum_{t=0}^{T} AR_t \sim N(0, T\sigma_\epsilon^2)$

● Step 5

The standard deviation is measured from the formula below with data in estimate window: $\hat{\sigma_\epsilon}^2 = \sum_{t \in D} \frac{(R_t - \widehat{R_t})^2}{D-1}$

● Step 6

The confidence interval for null hypothesis that the event has no impact on individual stock is: $(-1.96 \times \sqrt{T\sigma_\epsilon}, 1.96 \times \sqrt{T\sigma_\epsilon})$

If the value of the CAR exceeds this range, then we can reject this assumption with 95% confidence (1.96 threshold).

4. Event analysis

4.1 Data and Analysis

4.1.1 Estimate window

The estimate window of the whole event starts from 2019.1.1 to 2019.12.31. Table 1 shows the summary statistics of the percentage change of daily return for three firms and the percentage change of S&P 500 daily. The first column shows the total days of estimation; the second column indicates the mean of return for firms and the market index; the following columns are the max and minimum percentage of return separately. It can be inferred from the table that Zoom has the highest mean percentage of return. Zoom's maximum percentage change of daily return reaches as high as 72.22%, and Zoom's minimum percentage change of daily return reaches as low as -11.01%, which are the most striking ones among the three firms. Accordingly, Zoom has the largest fluctuation of the change of the daily percentage return in the three firms.

Table 1 Summary statistics of percentage change of daily return

Name	N(days)	Mean (%)	Max (%)	Min (%)
Zoom	251	0.529	72.22	-11.01
Amazon	251	0.093	5.01	-5.38
Facebook	251	0.201	10.82	-7.51
S&P 500	251	0.104	3.43	-2.98

Table 2 shows the parameter estimates from the market model of the three firms. As we can interpret from the data, there is significantly positive relationship between those three firms' returns and the S&P 500 return. All the significance F is smaller than 0.05, indicating three statistically significant models. The parameter estimates were later used to calculate the confidence interval and the cumulative abnormal return of the firms.

Table 2 Parameter estimates from the market model

Variable	Zoom	Amazon	Facebook
Intercept (αˆ)	-0.0544904	-0.0544904	0.04879421
Slope (β)	1.32797089	1.32797089	1.26902242
Significance F	2.97407811566054E-07	1.87712078010772E-42	3.6742517647361E-23
R square	0.139737882955627	0.527763690024645	0.326571980927717

4.1.2 Event window Event 1: the United States reported first death (02/29/2020)

The event window is FEB.29 to MAR.16, a total of 15 days after the event took place. The following figures are drawn with the orange line being the indication of confidence interval and the blue line being the cumulative abnormal return.

*The vertical axis represents CAR which means cumulative abnormal return. The horizontal axis represents number of days after the event.

We want to qualify the degree of impact so that we introduce a new equation:

Degree of impact $= \frac{Maximum\ CAR - Minimum\ CAR}{Minimum\ CAR}$
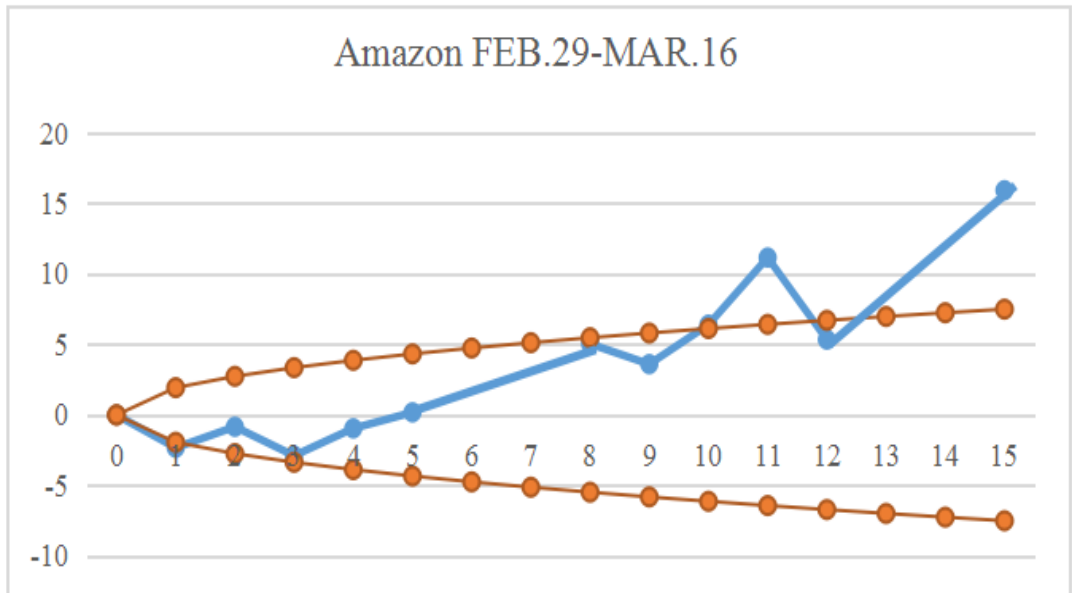
(1) Amazon

Figure13 CAR for Amazon from FEB.29 to MAR.16

The Figure 13 shows a generally increasing trend from FEB.29 to MAR.16. It has a delayed positive impact from the event with a duration of four days: Day10 to Day 12; Day13 to Day15.

Degree of impact: $\frac{15.938366 - (-2.8876338)}{-2.8876338} = 14.938366$
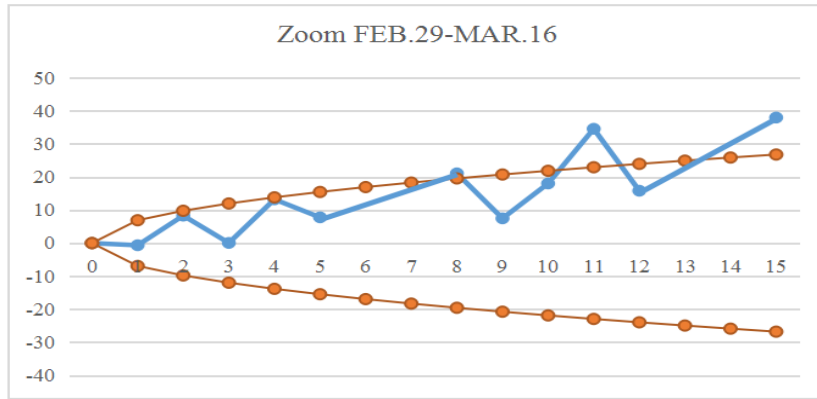
(2) Zoom

Figure 14 CAR for Zoom from FEB.29 to MAR.16

The Figure 14 also shows an overall positive trend from FEB.29 to MAR.16, but with more fluctuations compared with Amazon. Zoom also has delayed positive impact from the event with a duration of four days: Day10 to Day 12; Day 13 to Day15, like that of Amazon.

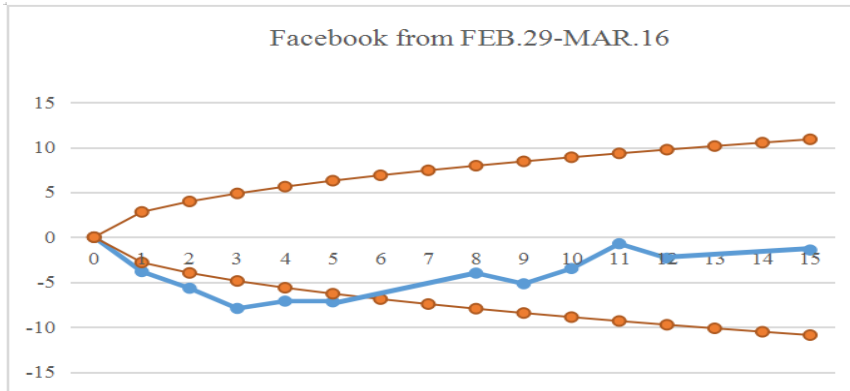Degree of impact: $\dfrac{37.9456201-(-0.6477658)}{-0.6477458}=36.9455892$

(3) Facebook

Figure 15 CAR for Facebook from FEB.29 to MAR.16

As shown in Figure 15, the cumulative abnormal return for Facebook from FEB.29 to MAR.16 stayed negative and is steadier compared with. The event has an immediate negative impact on Facebook with a duration of 5 days: Day0 to Day5. After that, the impact of the event on Facebook is not significant.

Degree of impact: $\dfrac{-0.7244358-(-7.9232074)}{-7.9232074}=$-1.7244358

Accordingly, Zoom benefits the most from the event of the first death in the US with the longest duration and the largest degree of impact.

Event 2: Southern U.S. States saw shape rise in cases (06/20/2020)

The event window taken for this event is JUN.20-JUL.6, 15 days after the event of sharp rise taken place.
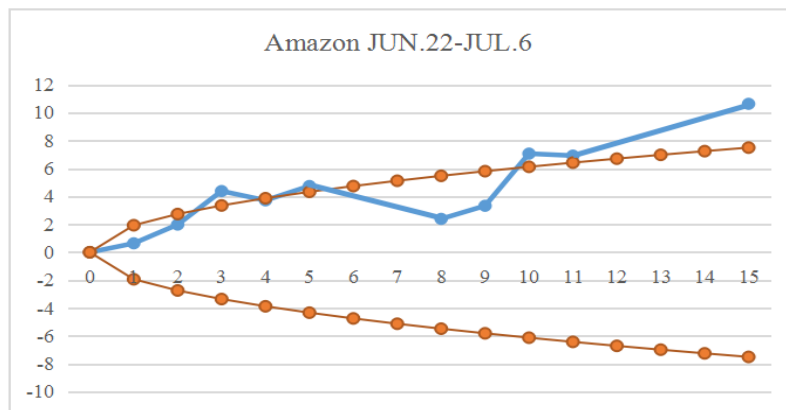
(1) Amazon

Figure 16 CAR for Amazon from JUN.22 to JUL.6

The Figure 16 shows a general increase with exception on Day6-10. The event has a delayed but recursive positive impact on the stock price of Amazon with duration of 6 days: Day3; Day10-15. It is noticeable that the impact is becoming increasingly significant since

Day10.

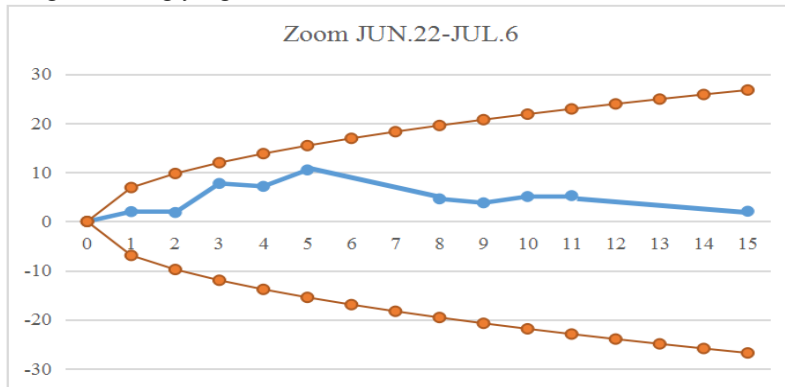Degree of impact: $\frac{10.6428232-0.64130932}{0.64130932}$=9.6428232

(2) Zoom

Figure 17 CAR for Zoom from JUN.22 to JUL.6

No significant impact shown in Figure 17.
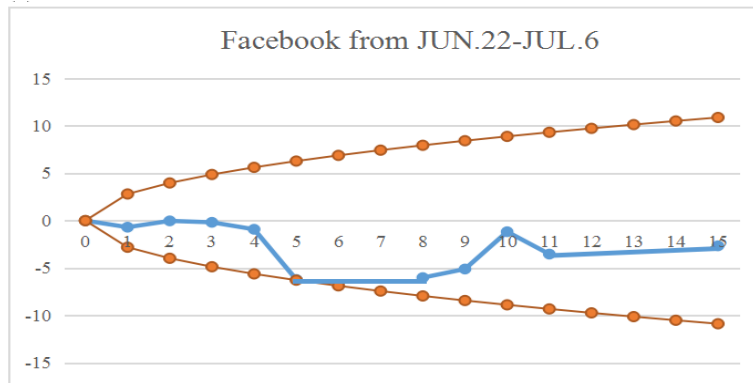
(3) Facebook

Figure 18 CAR for Facebook from JUN.22 to JUL.6

No significant impact shown in Figure 18.

According to Figure 16, 17 and 18, this event had a delayed positive impact on amazon starting on the 10th day, with a continuously increased effect. However, this event didn't have any effect on zoom and Facebook during the period of event window.

The sharp rise in the number of people infected made shopping for food online become a trend. In 2019, online

shopping sales were just about $1.2 billion in the United States. However, by June of 2020, the sales of food purchased online in the United States reached 7.2 billion U.S. dollars. This benefits online shopping markets and some companies like amazon [8].

Event 3: Universities that reopened soon began moving classes online (08/18/2020)
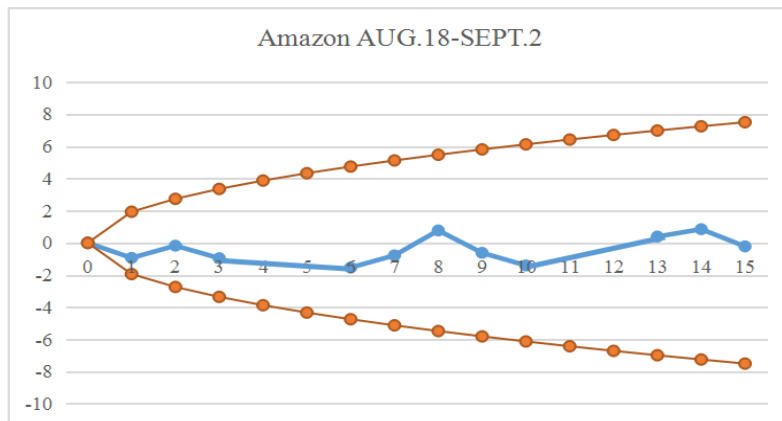
(1) Amazon

Figure 19 CAR for Amazon from AUG.18 to SEPT.2
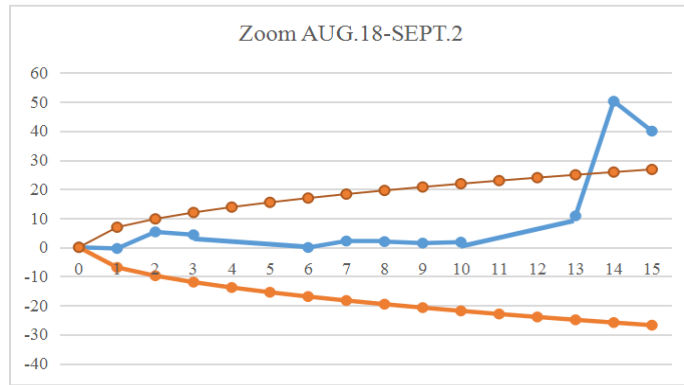
No significant impact shown in Figure 19.

(2) Zoom

Figure 20 CAR for Zoom from AUG.18 to SEPT.2

Degree of impact:

$$\frac{50.2060355 - (-0.3994642)}{-0.3994642} = 49.2060355$$

As shown in Figure 20, Zoom has a delayed positive impact from this event. The cumulative abnormal return for Zoom during the period first stays roughly unchanged, then has the impact with a duration of 2 days, staring from Day13 to Day 15.
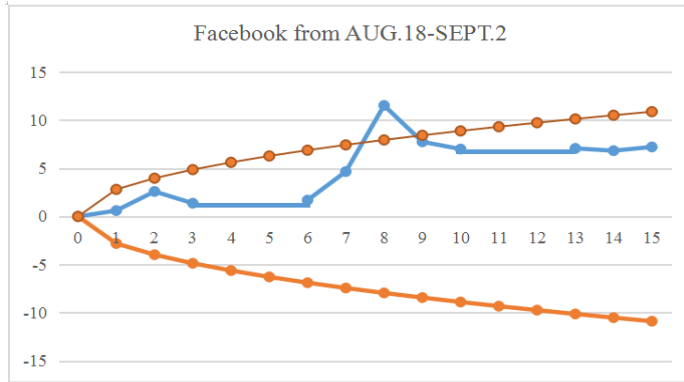
(3) Facebook

Figure 21 CAR for Facebook from AUG.18 to SEPT.2

As shown in Figure 21, the cumulative abnormal return for zoom first increases then decreases but maintains an overall increases trend. It has a delayed positive impact from the event with the duration of 2 days: Day 7 and Day 9. Compared with Zoom, it has shorter delayed period.

Degree of impact: $\frac{11.5377764 - 0.60957565}{0.60957565} = 10.5377764$

During this sub-event, Zoom has the largest degree of impact but longer delay.

As shown in Figure 19, 20 and 21, this event is mainly related to online studying software, such as zoom, and it impacts positively on these apps as it allows more users to use them. In addition, from the 8th of August, it took some time for all universities to start online study. That's why this event had a 13-day delayed effect.

Event 4: the UK approved Pfizer's coronavirus vaccine (12/02/2020)
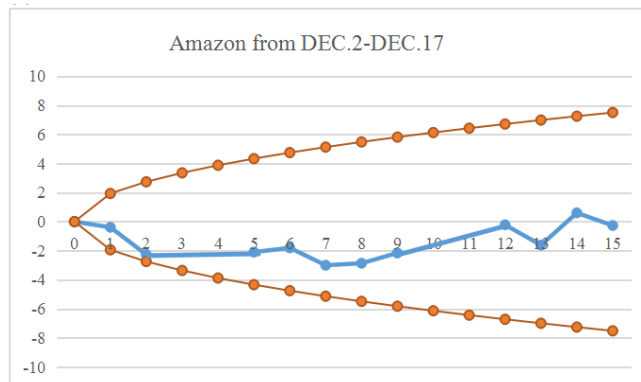
(1) Amazon

Figure 22 CAR for Amazon from DEC.2-DEC.17

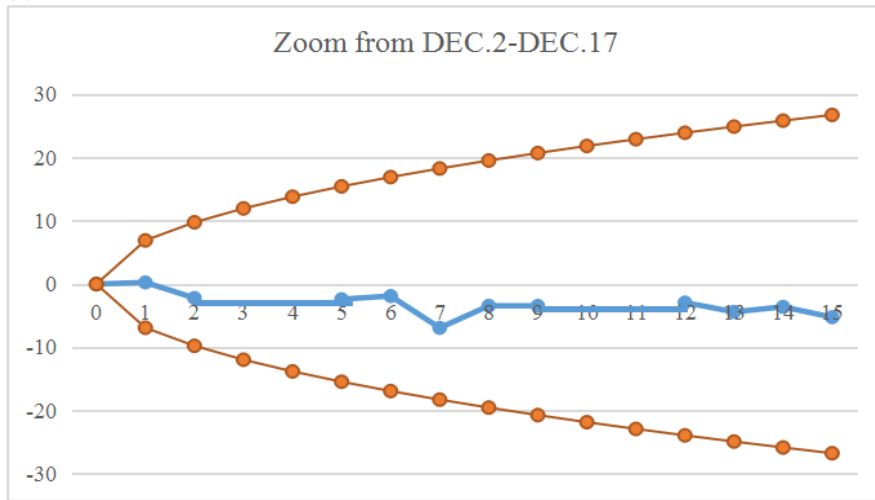No significant impact show in Figure 22. **(2) Zoom**

Figure 23 CAR for Zoom from DEC.2-DEC.17 No significant impact shown in Figure 23.
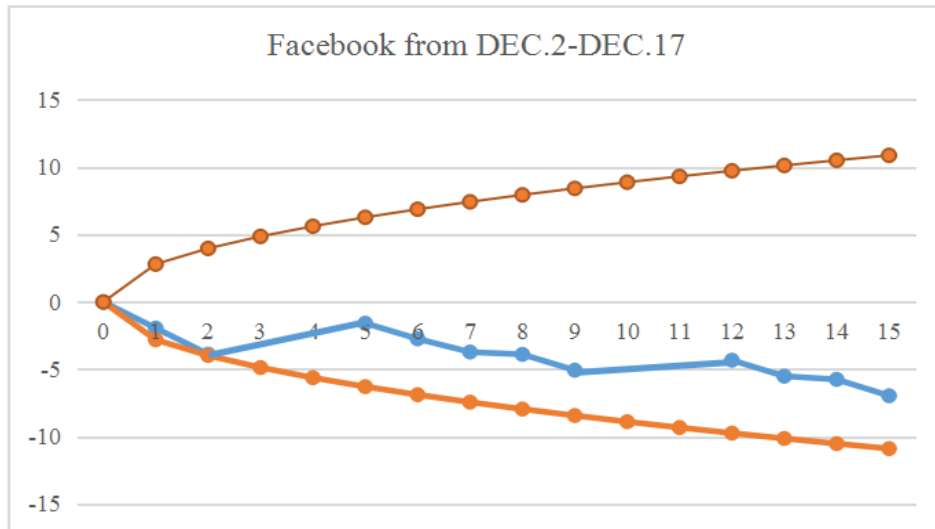
(3) Facebook

Figure 24 CAR for Facebook from DEC.2-DEC.17 No significant impact shown in Figure 24.

According to Figure 22, 23 and 24, this event does not have any effects on all three stocks during the 15 days, which is counter intuitive. It turns out that the effect of vaccine approved was limited in a short period of time. Chris Zakkarelli, Chief Investment Officer of the Alliance of Independent Consultants supported by LPL Financial Corporation, said that before the United States reaches herd immunity, the U.S. Food and Drug Administration officially approving Pfizer's new crown vaccine makes the short-term impact of the epidemic may not obvious, and it will take some time for the United States to achieve herd immunity. Furthermore, according to statistics from the US Centers for Disease Control and Prevention, 11.4 million doses of the new crown vaccine have been issued, of which 2.1 million doses have been vaccinated. This rate is lower than the previously expected plan to distribute 20 million doses of vaccine before the end of the year, which reduces the impact of vaccine [9,10].

Notes: Apart from above reasons, it is also pointed out by Lim, Kian-Ping & Hooy, Chee-Wooi. (2010) that the delayed period of impact is also associated with market size, trading volume, short sales restrictions, and the degree of investability [11].

5. CONCLUSION

In conclusion, COVID-19 has an overall positive impact on e-commerce industry. Instead of investigating the whole industry, we divided it into three aspects and investigated separately using three stocks. While different events in different periods have different degrees of impact, most of them are positive and delayed. According to our calculation, though not very significant, the online shopping division of the e-commerce had greatest impact from the pandemic. E-commerce showed great potential in the pandemic period and more innovation is expected in this area.

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