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COVID-19 and the Dynamics of Disney's Stock Price

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ABSTRACT

The Covid-19 epidemic has caused severe damage to the global economy, including Disney, one of the giants in the entertainment industry. This paper studies the impact of COVID-19 on Disney's stock price and stock returns in different periods and concludes that the epidemic has a negative impact on Disney stock in the short term. However, as time goes on, the stock price of Disney still reflects its fundamentals in the long run. At the end of the paper, it is also proposed that based on this research, future research can pay more attention to how Disney should innovate, to reduce the losses caused by public restrictions on going out.

Keywords: *Covid-19, Disney's stock return, short-term and long-term impact, volatility*

1. INTRODUCTION

Since December 2019, the first confirmed coronavirus disease (COVID-19) in China, the pandemic burst out rapidly. In February 2020, the World Health Organization issued a Public Health Emergency notice. Approximately one month later, by March 11, 2020, epidemiologists at the World Health Organization later recharacterized COVID 19 as a global pandemic [1]. According to the organization called Our World In Data, by November 6, 2021, 249,541,892 confirmed cases and 5,044,839 deaths had been reported worldwide. Moreover, there is still an average increase of 427692 cases per day around the world [2]. The Covid-19 pandemic has influenced more than 200 countries all over the world and has caused unprecedented global health emergencies.

The outbreak of Covid-19 has had profound negative impacts on the global economy. In November 2021, the director of the Russian Audit Office said that the Covid-19 pandemic had caused trillions of dollars in losses to the world economy. It has had a far-reaching influence on wide-ranging industries including the retail industry, medical industry, transportation industry, entertainment industry, and catering industry. For example, according to the survey conducted by Foteini in February 2020 in Greece, 27.2% of participants said that the business turnover declined more than 50% due to the pandemic. Only 5.7% of the participants said they were not affected financially, while the remaining 67.1% had a turnover reduction of 1%-50% [3]. Also, the pandemic has contributed to a dramatic decrease in the employment rate. With entire sectors of the economy on lockdown, millions of workers have immediately lost their jobs. According to Chen, 30 million new unemployment insurance claims have been filed in the first six weeks since the pandemic, implying a dramatic reduction in employment and labor force participation in the United States [4]. In January 2021, ILO said that Covid-19 resulted in a total loss of 255 million jobs in 2020, four times that of the 2008 financial crisis.

The entertainment industry, one of the most vulnerable industries during the pandemic, has experienced significant negative effects due to the Covid-19. People have been forced to quarantine themselves at home for a long time. For instance, by March 2020, the governor of the State of California issued a "Stay at Home" Order and it became the first of many states to implement such orders requiring Americans to remain quarantined at home [5]. The Government of India also decided to hold a roughly four-week lockdown from March 25 until April 14, which was later extended to May 31 [6]. The sudden reduction in demand for going out or traveling led to the wide-ranging shutdown of hotels, restaurants, and other entertainment places. This can be seen by the wide-ranging closure of theaters in the United States. According to Michael, Regal theaters closed about 663 of its movie theaters which generated 90% of its revenue, affecting 40,000 of its employees, mostly due to "Stay At Home" restrictions and the decision by studios to delay the release dates of their films. Besides, Cinemark theaters experienced a similar impact with a decrease from "$957.8 million to $9.0 million" in revenue in its most recent quarter [7].

As one of the most famous theme parks, Disney also suffered a lot. According to the British Daily Mail, on September 29, 2020, Disney announced that it would lay off 2.8W employees in the United States. In the spring of 2020, Disney theme parks around the world were forced to close due to the epidemic, and the company's operation received a huge blow. In the second and third quarters of 2020, the company reported operating revenue losses of $1 billion and $3.5 billion, respectively. At present, Disney parks in Shanghai, Hong Kong, and Florida have resumed limited business, but they may be closed at any time due to the uncertainty of the outbreak of the epidemic. For example, to cooperate with the epidemic investigation, Shanghai Disneyland suspended its opening on October 31, 2021, and closed the park from November 1 to November 2.

Most studies are generally studying the impact of the epidemic on the entertainment industry as a whole, but few looked into how one single company is affected by the epidemic in depth. For instance, one research conducted in 2020 found that Covid-19 led to a continuous decline in the number of tourists, and the impact of different countries varies depending on different economic conditions [8]. Based on the general background that Covid-19 has an obvious negative impact on Disney Company, this paper studies how Disney's stock price changes with the epidemic, according to the timeline of the burst and spread of Covid-19, and analyzes the policies behind the change.

The following parts of the paper are organized as follows: section 2 is the research analysis, which contains background and data, model specification, and introduction of identification strategy; Section 3 contains estimation results of the ARMAX, VAR, ARMA-GARCH model. Section 4 is the discussion. Section 5 is the conclusion.

2. RESEARCH DESIGN

2.1 Data Sources

Finance data (Disney stock price) used in this paper is downloaded from the Yahoo Finance website. Adjusted closed price is selected daily from the day when the first Covid-19 case was confirmed in the worldwide range to the present. Data of newly confirmed cases worldwide and cases in the US is obtained from the "Our World in Data" website organized by Global Change Data Lab, a non-profit organization in the UK. Data from this website is cited and referenced in hundreds of articles and reports every year, inferring the high quality of the data. In the analysis of the rest of the paper, all the data is logarithmic, which means data of stock price refers to the logarithm of the price, newly confirmed cases refer to the logarithm of cases, etc.

2.2 ADF-test

Before constructing models, the stationarity of each variable needs to be tested.

As shown in Table 1, the ADF test shows that the rate of return, newly confirmed cases in the US and worldwide are all stationary, with a p-value less than 0.05, while the stock price is non-stationary, with a p-value larger than 0.05.

Therefore, newly confirmed cases in the US and worldwide are both qualified introduced variables in the ARMAX model, since both of them are stationary.

Table 1. ADF-test

	1% Critical Value	5% Critical Value	10% Critical Value	Z	p-value
Stock price	-3.982	-3.422	-3.130	-2.419	0.3698
Rate of return	-3.982	-3.422	-3.130	-15.920	0.0000
newly confirmed cases (worldwide)	-3.982	-3.422	-3.130	-5.565	0.0000
newly confirmed cases (US)	-3.982	-3.422	-3.130	-15.920	0.0375

2.3 Model Specification: ARMAX

In this part, we begin to build an ARMAX model. The model is as follows:

$$x_t = \emptyset_0 + \sum_{i=1}^{p} \emptyset_i x_{t-i} + a_i - \sum_{i=1}^{q} \delta_i a_{t-i} + \gamma_1 x_{1,t-1} + \cdots$$
$$+\gamma_2 x_{1,t-q_1} + \gamma_{k-1} x_{k,t-1} + \cdots + \gamma_k x_{k,t-q_k} \quad (1)$$

In (1), the part $\sum_{i=1}^{p} \emptyset_i x_{t-i}$ stands for the AR(p) model, which uses the historical real value to forecast, x_t is the time series and i is the time lag we take. Part $\sum_{i=1}^{q} \delta_i a_{t-i}$ stands for MA(q) model, which uses the volatility in the past to estimate the future. Last part of the equation $\gamma_1 x_{1,t-1} + \cdots + \gamma_2 x_{1,t-q_1} + \gamma_{k-1} x_{k,t-1} + \cdots + \gamma_k x_{k,t-q_k}$ considers other variables contributing to the exogenous variable.

To be specific, in this paper, the AR model is to use the historical rate of return of Disney from the beginning of Covid-19 till the present, and the MA model is to employ the error term during the pandemic period to predict the future.

ARMAX model introduces two new stationary variables on the base of the ARMA model, which are newly confirmed cases in the US and worldwide, to estimate the influence of Covid-19 on Disney stock's rate of return in the US and worldwide range respectively.

2.4 Model Specification: VAR

In this part, we construct a VAR model to test the dynamic impact of Covid-19 on Disney's stock returns. The variables are put together and predicted as one single system to make the predictions mutually consistent.

The model is set as follows:

$$y_t = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \gamma_{11} \\ \beta_{21} & \gamma_{21} \end{pmatrix} y_{t-1} + \cdots + \begin{pmatrix} \beta_{1p} & \gamma_{1p} \\ \beta_{2p} & \gamma_{2p} \end{pmatrix} y_{t-p} + \varepsilon_t \quad (2)$$

In (2), $y_t = \{y_{1t}, y_{2t}\}$ is a vector of two-time series, ε_t are the disturbance term and p refers to the time lag we take.

The impulse response function examines how much the impact of one unit disturbance will cause other variables to change with time.

The model is as follows:

$$\frac{\partial y_{t+s}}{\partial \varepsilon_t} = \varphi_s \quad (3)$$

This equation figures out to what extent the value of variable at (t+s)-th period y_{t+s} is affected when the disturbance term ε_t of variable at t-th period increases one unit, while other variables and disturbance terms in other periods remain unchanged.

2.5 Model Specification: ARMA-GARCH

We now construct the ARMA-GARCH model, which is to forecast the rate of return and volatility of Disney stock at the same time. We use the newly confirmed cases in the US and worldwide as exogenous variables respectively.

Hence, we can evaluate the correlation between the epidemic situation and the yield and volatility of the stock.

The model GARCH(p,q) is set as follows:

$$\sigma_t{}^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}{}^2 + \cdots + \alpha_q \varepsilon_{t-q}{}^2 + \beta_1 \sigma_{t-1}{}^2 + \cdots + \beta_p \sigma_{t-p}{}^2 \quad (4)$$

In (4), the term $\alpha_1 \varepsilon_{t-1}{}^2 + \cdots + \alpha_q \varepsilon_{t-q}{}^2$ is ARCH part. $\sigma_t{}^2$ is the conditional variance of the disturbance term ε_t, the subscript t indicates that variance changes over time. $\sigma_t{}^2$ depends on the square of the disturbance term in the previous p periods.

GARCH model is set up based on the ARCH model, with the addition of autoregression of $\sigma_t{}^2$. In (4), the term $\gamma_1 \sigma_{t-1}{}^2 + \cdots + \gamma_p \sigma_{t-p}{}^2$ is GARCH part.

GARCH model is designed to reduce the number of parameters. We can simplify ARCH(p) as GARCH(1,1) by iteration.

3. EMPIRICAL RESULTS

3.1 ARMAX

First, we need to determine the order of the AR model by applying PACF and Varsoc test.

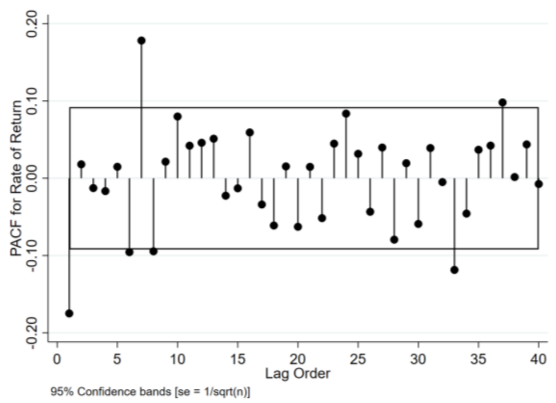

Figure 1. PACF of the log of Disney's rate of return

Note: For some specific time point *r*, the observation x_{r-i} (*i* periods back) is called the *i-th* lag of x_r, and *i* is the lag order. The Y-axis is the dependent variable, PACF of the log of Disney's rate of return, and the X-axis is time lag order. The area bounded by y=-0.1 and y=0.1 refers to the 95% confidence interval for AR(p).

Table 2. Varsoc Test

Lag	LL	LR	df	p	FPE	AIC	HOIC	SBIC
0	996.766				0.00064	-4.51594	-4.51229	-4.50667
1	1003.6	13.662	1	0.000	0.000623	-4.54239	-4.53507*	-4.52384*
2	1003.64	0.09276	1	0.761	0.000626	-4.53806	-4.52709	-4.51025
3	1003.67	0.06205	1	0.803	0.000629	-4.53367	-4.51904	-4.49658
4	1003.72	0.08849	1	0.766	0.000632	-4.52933	-4.51105	-4.48297
5	1003.77	0.10557	1	0.745	0.000634	-4.52504	-4.50309	-4.46941
6	1005.56	3.5869	1	0.058	0.000632	-4.52864	-4.50303	-4.46373

7	1012.83	14.527	1	0.000	0.000614	-4.55704	-4.52778	-4.48287
8	1014.79	3.9197*	1	0.048	0.000612*	-4.5614*	-4.52848	-4.47795
9	1014.88	0.17729	1	0.674	0.000614	-4.55726	-4.52069	-4.46454
10	1016.29	2.8222	1	0.093	0.000613	-4.55913	-4.51889	-4.45713
11	1016.68	0.78331	1	0.376	0.000615	-4.55637	-4.51248	-4.4451
12	1017.15	0.93742	1	0.333	0.000616	-4.55396	-4.50641	-4.43342

It can be seen from Figure 1 that PACF begins to fall in the 95% confidence interval after lag=1. In Varsoc Test, we select the row with the most asterisks to determine the lag order. Table 2 shows that both HOIC and SBIC reach the minimum at lag=1.

Now, we need to determine the order of the MA model by applying the ACF test.

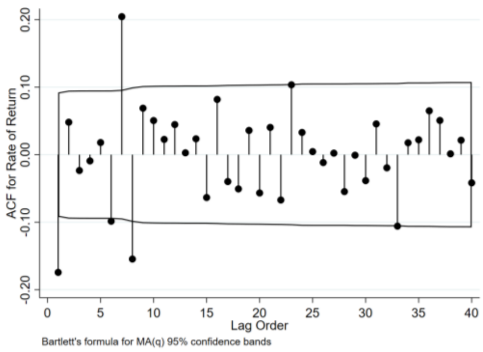

Figure 2. ACF of the log of Disney's rate of return

Note: The Y-axis is the dependent variable, ACF of the log of Disney's rate of return, and the X-axis is time lag order. The bounded area refers to the 95% confidence interval for MA(q).

We can see from Figure 2 that ACF begins to fall in the 95% confidence interval after lag=1.

Hence, we take lag order 2 for the ARMAX model. We then use the ARMAX model to figure out the relation between the epidemic and Disney's stock return.

Table 3 is the estimation results of the ARMAX model. From Table 3, we can see that the coefficient is significant at 5% significance level only when t=0 under both US and worldwide pandemic situations.

The results indicate that in the long run, the rate of return of Disney stock mainly reflects its common state. Covid-19 has no significant impact on its return in the long term, from the perspective of significance.

Table 3. ARMAX

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Newly confirmed cases, the US						
T=0	0.0011**	-0.0004	-0.0010			
	(-0.0108)	(0.0035)	(0.0036)			
T=-1		0.0015	-0.0014			
		(0.0034)	(0.0050)			
T=-2			0.0034			
			(0.0035)			
Newly confirmed cases, the worldwide						
T=0				0.0017**	-0.0009	-0.0002
				(0.0006)	(0.0048)	(0.0055)
T=-1					0.0025	0.0000
					(0.0046)	(0.0069)
T=-2						0.0038
						(0.0051)
AR(-1)	-0.1780	-0.1653	-0.1477	-0.1922	-0.1916	-0.2176
	(0.1442)	(0.1466)	(0.1489)	(0.1471)	(0.1470)	(0.1457)
MA(-1)	-0.0141	-0.0280	-0.0475	0.0038	0.0003	0.0260
	(0.1483)	(0.1505)	(0.1524)	(0.1514)	(0.1518)	(0.1506)

Constant	-0.0108**	-0.0106***	-0.0099**	-0.0207**	-0.1939***	-0.0179**
	(0.0036)	(0.0037)	(0.0039)	(0.0069)	(0.0072)	(0.0084)

Note: Standard errors are reported in parentheses, and the estimated results are rounded-up to 4 digits after the decimal point. ***, **, and * indicate the level of significance of 1%, 5%, and 10%, respectively.

3.2 VAR

We can see from Table 4 that LR, PFE, and AIC reach the minimum at lag=12, while HOIC and SBIC reach a minimum at lag=11.

Therefore, we determine the order of the VAR model as 11.

Table 4. VAR Selection-order Criteria

Lag	LL	LR	df	p	FPE	AIC	HOIC	SBIC
0	-373.226				0.001106	1.70624	1.71721	1.73406
1	932.556	2611.6	9	0.000	3.1*10^(-6)	-4.17486	-4.13097	-4.06359
2	975.078	85.043	9	0.000	2.7*10^(-6)	-4.32688	-4.25007	-4.13217
3	992.389	34.623	9	0.000	2.6*10^(-6)	-4.36458	-4.25485	-4.08641
4	1029.1	73.243	9	0.000	2.3*10^(-6)	-4.49025	-4.34761	-4.12863
5	1036.88	15.567	9	0.076	2.3*10^(-6)	-4.48473	-4.30917	-4.03967
6	1098.77	123.78	9	0.000	1.8*10^(-6)	-4.72459	-4.51611	-4.19607
7	1137.86	78.17	9	0.000	1.6*10^(-6)	-4.86103	-4.61963	-4.24906
8	1151.1	26.487	9	0.002	1.5*10^(-6)	-4.88027	-4.60595	-4.18485
9	1165.1	28.002	9	0.001	1.5*10^(-6)	-4.90295	-4.59572	-4.12409
10	1197.97	65.736	9	0.000	1.3*10^(-6)	-5.0112	-4.67104	-4.14888
11	1330.82	265.71	9	0.000	7.6*10^(-7)	-5.57289	-5.19982*	-4.62712*
12	1341.13	20.609*	9	0.015	7.6*10^(-7)*	-5.5788*	-5.17281	-4.54959

Before we estimate the parameters, we first need to examine the stationarity of the parameters.

The model is set as follows, for k>1,

$$VAR(k): Y_t = C + AY_{t-1} + U_t$$

We need all of the roots of the characteristic equation $|A - \lambda I| = 0$ to be in the unit circle so that we could say this VAR system is stationary.

The result is shown in Figure 3. From Figure 3, we know that all of the black dots fall within the unit circle, so the VAR system is stationary.

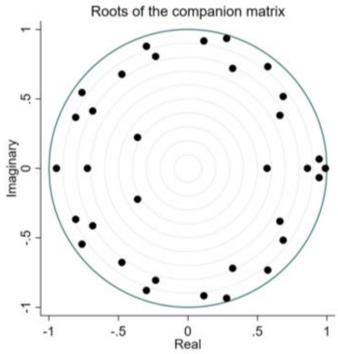

Figure 3. estimation of stationarity using roots of the characteristic equation

We now take the stock return as the response variable and the US or global epidemic as the impulse variable to draw the impulse response diagram respectively. Figure 4 evaluates the relation in the global range, and Figure 5 evaluates the relation within the US.

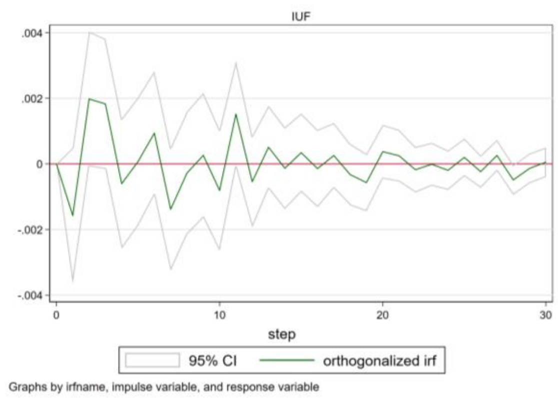

Figure 4. Response of Disney's return to the global epidemic

Note: The Y-axis is the result of the pulse of the global epidemic acting on Disney's rate of return, and the X-axis refers to the change of period.

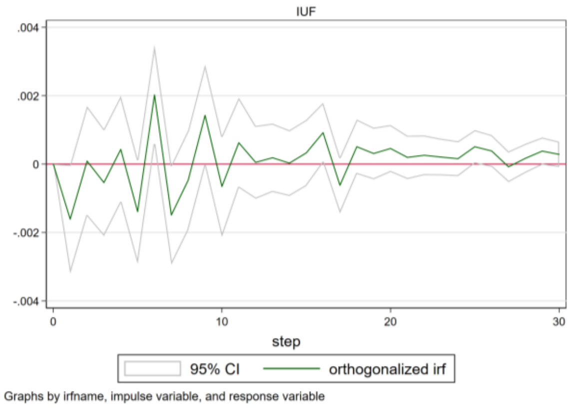

Figure 5. Response of Disney's return to US epidemic

It can be seen in Figure 4 & 5 that, the shock was obvious at first, but gradually decreased over time. This means that the Covid-19 pandemic fluctuated Disney stock return in the short term, while the influence of epidemic on stock return decreased over time. This further illustrates that Covid-19 has little influence on Disney stock price in the long run.

3.3 ARMA-GARCH

Table 5 is the estimation result of the variance equation.

From Table 5, based on the third and sixth columns, newly confirmed cases in the US and volatility of stock return show a negative relation when t=-2.

Newly confirmed cases worldwide and volatility of stock return give a negative relation when t=0 and t=-2, while newly confirmed cases worldwide and volatility of stock return show a positive relation when t=1.

Besides, the coefficients mentioned above are all significant at 1% level.

Table 5. ARMA-GARCH, Variance Equation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Newly confirmed cases, the US						
T=0	-0.2233***	2.0398***	0.9700			
	(0.0362)	(0.3926)	(4.4598)			
T=-1		-2.0180***	1.1481			
		(0.3069)	(4.3181)			
T=-2			-2.0819***			
			(0.3487)			
Newly confirmed cases, the worldwide						
T=0				-0.4148***	-0.7929	-1.6548***
				(0.0287)	(1.8815)	(0.2473)
T=-1					0.4013	2.7063***
					(1.9373)	(0.3816)
T=-2						-1.3713***
						(0.2769)
ARCH	0.0402***	0.0288***	0.0266***	0.0073	0.0337***	0.0916**
	(0.0065)	(0.0065)	(0.0069)	(0.0233)	(0.0071)	(0.0413)
GARCH	0.9439***	0.9453***	0.9443***	-0.2443	0.9411***	0.0009
	(0.0060)	(0.0060)	(0.0066)	(0.2442)	(0.0086)	(0.0032)
Constant	-9.6393***	-12.1269***	-12.1516***	-2.2593***	-6.6287***	-3.8196***
	(0.3341)	(1.1104)	(1.0854)	(0.3826)	(0.9771)	(0.5819)

Note: Standard errors are reported in parentheses, and the estimated results are rounded-up to 4 digits after the decimal point. ***, **, and * indicate the level of significance of 1%, 5%, and 10%, respectively.

4. DISCUSSION

This article finds that the Covid-19 significantly affected the Disney stock return in the short term. At the beginning of the pandemic, the rate of return fluctuated dramatically. However, we can see from the graph that the amplitude of oscillation reduced over time, indicating that the influence of the epidemic decreased gradually. And finally, there is little impact on the stock return in the long run.

Further research could work more on the policies Disney should implement to reduce the possible losses caused by the same situation in the future.

The results of this study confirm that, since the public was restricted from going out, the epidemic caused great fluctuations in the entertainment industry in the short term. This is consistent with previous literature conclusions given by Hough, suggesting that Disney Park division was gradually becoming Disney's largest source of revenue before the outbreak of the epidemic, while it was financially the hardest hit business in this fiscal year due to the evaporated revenue but existing costs [9].

Disney Land amusement parks around the world are an important realization mode for Disney content IP, and the spread of the epidemic is bound to seriously damage the operation of Disney. In contrast to Netflix, the largest global video streaming platform, which was favored by investors with higher operating income and an increasing number of users during the epidemic, showed an obvious differentiation trend with Disney in the stock price [10].

Hence, it is necessary for Disney to promote the innovation of IP creation and realization mode in the future. It can consider combining offline entertainment with an online platform to prevent losses caused by public restrictions on going out in the future. With the support of new technologies, new online entertainment projects will certainly appear, and this is where further research is needed.

5. CONCLUSION

The epidemic has had a significant impact on the global economy. Disney stock returns were also hit hard by the burst out of Covid-19.

This paper focuses on the impact of Covid-19 on the rate of return and volatility of Disney stock and gives further evidence on how the pandemic affects. We find that although in a short period, Disney stock return is negatively affected by the pandemic, there is little impact of Covid-19 on the stock return in the long run.

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