The Impact of Covid-19 on the Performance of Chinese Online-Educational Industry

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ABSTRACT

The outbreak of the COVID-19 was like a catastrophe, rapidly sweeping the world in early 2020. In order to prevent the large-scale spread of the epidemic, the Chinese government restricted people's movement after the outbreak of COVID-19, which has a substantial negative impact on the economic condition overall. This study selects 25 listed online education companies in China as a sample and investigates the impact of COVID-19 on those firms' performance. We find that the epidemic harms Chinese online-educational firms' ROE but positively impacts Tobin's Q. As robustness checks, we also perform unit root tests, add dummy variables, test additional control variables, introduce interaction terms, and utilize the fixed-effects model. These robustness check results are consistent with the main finding of this paper, except that the interaction term indicates the epidemic negatively impacts those firms' Tobin's Q. Although the epidemic negatively impacts the performance of Chinese online educational companies, we are optimistic about its long-term development. These findings in the present study shed light on the impact of COVID-19 on the Chinese online-educational industry and provide short-term and long-term investment suggestions for investors.

Keywords: Corporate performance; online education; COVID-19.

1. INTRODUCTION

As far back as 1999, China's State Council officially announced the implementation of the e-learning project. In the early 20th century, China's distance education has made remarkable enterprise development, project development, industrial relationship development, theoretical research, practical exploration, and talent training, opening a new field for China's distance education (Ding et al. 2010). While in recent years, the online education industry has developed at high speed. Countries worldwide have made various effective attempts at online education, including developing more effective network education platforms and better network infrastructure. With benefits from the convergence of advanced technologies, widespread global internet adoption, and growing demand for regularly trained labor in the digital economy, Online education was expected to become mainstream in 2025 (Palvia et al., 2018).

The critical event happened in early 2020, COVID-19's outbreak has become a global disaster. The epidemic outbreak was a heavy blow to the country's economy and employment rate. At the firm level, the COVID-19 outbreak might affect the stock market (Iyke, 2020a; Liu et al., 2020; Narayan, 2020), firm performance in the energy industry (Fu and Shen, 2020), and other aspects (Hagerty and Williams, 2020). During that period, the Ministry of Education of China issued a notice requiring the spring semester to be postponed in 2020. The training institutions also canceled all kinds of offline courses as needed. Students were not allowed to return to school, forcing them to take online courses at home. However, under the "suspension of study and no suspension of study" policy, China has expressed its willingness to continue the routine online teaching activities during the lockdown period (Zhang et al., 2020). For a time, network education was pushed to the wind, it has become the focus of social attention: with the rapid increase in the demand for online education, good government policy support, and the awareness of a large amount of capital, at the same time, those online education companies also catered to the opportunity. The outbreak of COVID-19 promoted the development of the online education industry to a great extent from several areas, including the supply of interconnection products combining software and hardware; Supply of communication equipment, T.V. network, terminal, and other equipment; Display equipment manufacturers newly increased the construction of distance education platform; Office video conference solution supplier, extending to education classroom; Software technology, system integration, and cloud service provider provide applications in the education industry; Many offline education companies and institutions were transforming to online education, Etc. (Iivari et al., 2020).

There is a controversy that whether the COVID-19 improved online educational-related firms' performance or not? Someone believed that in the short term, driven by the vast demand for online courses and extensive public attention, and the online education-related industry will develop rapidly. However, someone argued that when students were forced to accept online classes, problems were also gradually exposed: the quality of online courses was uneven, the network connection problem was constantly troublesome. Without supervision like offline class, the absorption efficiency of students in the class cannot be guaranteed, and the gap between self-discipline students and indulgent students was gradually widening. The students themselves and the parents of some primary and middle school students call online classes unbearable. After one semester of online class experience, almost everything was back to normal. Students were allowed to return to school to take offline courses. What attitude would they take towards online education? Whether online education was just a fad, bringing false prosperity during the outbreak of covid-19. Perhaps, it was the trend of future development, and it was sustainable. The impact of covid-19 on online education was divergent. Besides, studies on the impact of the COVID -19 on the economy mainly focused on the macro level, including several studies that investigated the connection between COVID-19 and oil price (Gil-Alana and Monge, 2020; Narayan, 2020); some studies focus on the COVID-19 and exchange rates (Iyke, 2020b), and the impact of COVID-19 on U.S. partisan conflict index (Apergis and Apergis, 2020).

This paper selects 25 listed Chinese online education firms to investigate the impact of COVID-19 on those firms' performance. All these firm performance data are downloaded from Bloomberg, quarterly frequency. Covid -19 new cases data are downloaded from World Health Organization (WHO). In this paper, the multivariate regression model is applied to examine the relationship between the epidemic and online educational firm's performance. The regression result of this multivariable regression

indicates that the epidemic negatively impacts Chinese online education firms' performance. However, it has a positive impact on their Tobin Q. In order to test the robustness of this result, this paper also uses the dummy variable method, generates interaction terms, applies the fix effects model, and adds more control variables. While after introducing a dummy variable, applying the fix-effects model, and adding more control variables, these robust check results are consistent with the main finding. Nevertheless, the result after generating an interaction term is slightly different. It indicates that covid-19 harms those firms' Tobin Q.

The main contribution of this paper is to find out how covid-19 impacts the performance of Chinese online educational firms. It helps solve the existing controversy in the literature review, whether the covid-19 has a profound and lasting positive impact, or it is just a roller coaster-like mania or even has a negative impact. Judging from the main result of these regressions, it indicates that the epidemic has a negative impact on those companys' return on equity (ROE), which means the epidemic harms those firms' performance. Nevertheless, the result also shows that the covid-19 positively impacts their Tobin Q. Hence, it suggests we have confidence in the online education market from a long-term perspective. Since, even if the epidemic negatively impacts the industry's short-term performance, we should still be confident about its future development. This paper can provide some short-term and long-term investment suggestions for investors interested in this field.

The rest of the paper is organized as follows. Section 2 is the literature review part, which develops three hypotheses based on the current literature review. Section 3 is the data and methodology part, describing the sample, formulas, and models used in this paper. Section 4 is the result and conclusion part, presents the main results, discussion, and conclusion of this paper.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

During the epidemic, the online education industry was pushed to the forefront. There is an ongoing debate in the corporate finance literature whether the COVID-19 has a positive or negative impact on the EdTech firm's performance in the aftermath of the outbreak. The effect of COVID-19 on EdTech firm performance is empirically ambiguous. We review relevant theories and empirical evidence in the following sections.

2.1.POSITIVE EFFECTS OF COVID-19 ON EDU FIRM PERFORMANCE
The epidemic improved the performance of companies in the online education industry to a certain degree. Dhawan (2020) stated that the severity of the COVID-19 outbreak had isolated many parts of the world. Therefore, many cities have been turned into deserted cities. These adverse effects were also happening in schools, colleges, and universities during such a tough time. COVID-19 has forced schools to remain completely lockdown. According to The Ministry of Education, a "School's Out, But Class's On" campaign was announced during the postponed period, aiming to provide students with learning resources and a learning support service[1] (Zhou et al., 2020). As a result, the demand for online courses increased rapidly, and the user number of EdTech companies has surged. Such a great demand enabled EdTech companies to get customers at a meager cost.

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[1] China Education Daily, 2020

Moreover, Donahoe et al. (2019) pointed out that EdTech companies have proved to help students. Similarly, Dhawan (2020) also recognized that online teaching and learning could be regarded as the panacea for education during pandemics. Except for the suddenly increasing demand, EdTech company also got attention from the capital can government. Regan and Khwaja's (2019) article found that venture capital firms favor EdTech companies. According to Purbasari et al. (2021), the government encourages SMEs to take the initiative to connect with digital platforms to survive the Covid-19 pandemic. Therefore, with the surge in demand for online education, favorable policy support, and significant investment capital, EdTech firms' performance is booming after the outbreak of COVID-19. According to Suneja's research in 2021, he found that COVID-19 has directly benefited the EdTech industry, which has become a substitute for quality teaching and learning in terms of revenue growth, renewal rate, new subscribers, and engagement. Li and Wang's (2021) analysis also proved that point. Based on the analysis of new user growth rate, active usage, 3-day retention rate, and unloading rate, he pointed out that China's online education market's demand for remote conference platforms is increasing, and it has not declined with the end of COVID-19. Although he also mentioned his concern that the demand for online education became inelastic in the aftermath of the epidemic, the number of users of EdTech will decline. Dhawan(2020) argued that the epidemic has dramatically improved its customer base, which may only be temporary. However, they can still retain some customers for their excellent. According to Bettinger and Loeb (2017), online courses provide students with participation opportunities that are not limited by time and region, redefining educational opportunities for students who serve the worst in traditional classrooms. Therefore, this crisis forced students to experience online classes while making part of them feel the benefits of online classes and prompting them to become long-term users of EdTech companies.

Hypothesis 1: COVID-19 *has a positive impact on EdTech firm Performance*

2.2.NEGATIVE EFFECTS OF COVID-19 ON EDU FIRM PERFORMANCE

While COVID-19 also harms EdTech firm performance. After the outbreak of COVID-19, students are forced to take online courses, accompanied by a series of problems exposed. Carey (2020) stated that after the epidemic outbreak, their attention was not whether online teaching methods could deliver quality education but how academic institutions could adopt online learning on such a large scale. Therefore, this led to many negative consequences, ranging from downloading errors, installation errors, login problems, problems with audio and video, Etc. (Dhawan, 2020). Besides, most students have had a certain degree of anxiety and are worried about quickly switching to online completion of a semester (Unger and Meiran, 2020). In addition, students' concentration in class cannot be guaranteed.

Similarly, Bettinger and Loeb (2017) also found that students, especially those lowest-performing, are more likely to drop out of school by taking courses online than taking courses offline. Therefore, Li and Wang (2021) predicted that during COVID-19, the number of online education users should have peaked, and the number will decrease after the epidemic. Despite the perspective of demand and users, those EdTech companies also struggled a lot. Under such a difficult situation, many EdTech firms were forced to develop the online education market. However, according to real options theory, when uncertainty increases, managers tend to postpone investment under such an uncertain circumstance, leading to missing profitable projects (Ming et al., 2016).

Moreover, when the industry became the moment's focus, it also attracted more companies to enter the industry. Consequently, the EdTech market was overcrowded (Schneiderman, 2020). He also mentioned that the assumption of strong market growth in the EdTech industry is wrong. Besides the fierce market competition, budget is also a big issue. According to Schneiderman (2020), government revenue has declined sharply due to the epidemic, and costs have risen, which has caused considerable losses to our economy and tax base. With less government support, those EdTech companies need to bear more costs. However, most EdTech start-ups provided free courses and e-resources to the students (Dhawan, 2020). They hoped to take advantage of the potential long-term users accumulated during the epidemic and gradually turn free courses into paid courses. Therefore, those EdTech companies have bad firm performance in the short term. According to 'Global EdTech Report 2020', the coronavirus harmed EdTech to a certain degree, including lower-income for education companies, tighter budget, Etc.

Hypothesis 2: COVID-19 hurts EdTech firm Performance.

2.3.NEUTRAL EFFECTS OF COVID-19 ON EDU FIRM PERFORMANCE

With the rapid development of technology and network infrastructure construction in recent years, the EdTech industry has risen sharply. Kumar et al. (2017) mentioned that online education had become a long-term strategy of many schools and a global mainstream phenomenon. Many universities around the world were trying innovative online education models. Besides, the development of online education was also inseparable from the government's support and the growth of the internet (Li and Wang, 2021). He also pointed out that the proportion of Internet users in China is relatively high, similar to that in developed countries.

Furthermore, on September 25, 2019, the government published a document named: The Ministry of Education and other 11 departments on promoting the healthy development of online education guidance before the outbreak of COVID-19. Before the epidemic broke out, the EdTech industry had achieved rapid growth and popularity. According to the analysis of Li and Wang (2021), they believed the user number of EdTech companies should have peaked during the crisis and declined after the COVID-19. That is to say. COVID-19 does impact the EdTech industry. However, it is just a kind of roller coaster-like impact.

Hypothesis 3: COVID-19 has a neutral impact on EdTech firm Performance.

3. DATA AND METHODOLOGY

First, we used the financial data of the 25 listed Chinese online education companies from the first quarter in 2018 to the third quarter in 2021, quarterly frequency. All company data are downloaded from the Bloomberg database and yahoo finance, and all COVID-19 data is collected from WHO (World Health Organization).

In order to test the impact of the COVID-19 on corporate performance, we used the following models:

$$ROA_{it} = \beta_0 + \beta_1 COVID_{it} + \beta_2 REV_{it} + \beta_3 Size_{it} + \beta_4 LEV_{it}$$
$$+ \beta_5 ASGrow_{it} + \beta_6 FCF_{it} + \beta_7 ASTurn_{it} + \varepsilon_{it} \qquad (1)$$

$$ROE_{it} = \beta_0 + \beta_1 COVID_{it} + \beta_2 REV_{it} + \beta_3 Size_{it} + \beta_4 LEV_{it} \qquad (2)$$

$$+ \ \beta_5 ASGrow_{it} + \ \beta_6 FCF_{it} + \beta_7 ASTurn_{it} + \ \varepsilon_{it}$$

$$TOBINQ_{it} = \beta_0 + \beta_1 COVID_{it} + \beta_2 REV_{it} + \beta_3 Size_{it} + \beta_4 LEV_{it}$$
$$+ \ \beta_5 ASGrow_{it} + \ \beta_6 FCF_{it} + \beta_7 ASTurn_{it} + \ \varepsilon_{it}$$

$$(3)$$

The firm performance is the dependent variable, represented by ROA, ROE, and TOBINQ. ROA is the return on asset, the net profit return rate, which equals net profit divided ending balance on total assets. ROE is the return on equity, which equals net profit, divides the ending balance on total equity. TOBIN Q is the logarithm of the Q ratio, which equals a company's market value divided by its assets' replacement cost. COVID is the key explanatory variable. It is the new COVID-19 case in China. REV is the logarithm of total revenue for the current period. Size is the size of an enterprise, which is measured by its total assets. LEV is the asset-liability ratio, measured by the total liabilities divided by total assets. ASGrow means the growth rate of assets, measured as the current assets minus previous assets, then divides the previous assets. FCF is free cash flow, is the sum of cash from operating activities, cash from investing activities, and cash from financing activities. ASTurn is the logarithm of total assets turnover ratio, net sales over average total asset measure it.

This paper will use regression results to interpret the impact of covid-19 on those Chinese online educational firms. Furthermore, this paper will also apply a unit root test to examine whether the variable has a stationary time series, use the dummy variable method, add control variables to do robust check, introduce interaction term, apply fixed-effects model and random-effects model, and run a Hausman test.

Table 1: Summary Statistics

Table 1 reports descriptive statistics for the sample of Chinese online education firms covering from 2018:Q1 to 2021:Q3. All these firm performance data, including *ROA, ROE, TOBINQ, REV, SIZE, LEV, ASGROWTH, FCF, ASTURN* are collected from Bloomberg. *ROA* is the return on asset. *ROE* is the return on equity. *TOBINQ* is the logarithm of Q ratio. *REV* is the logarithm of total revenue for the current period. *SIZE* is its total assets. *LEV* is the finanical leverage ratio. ASGROWTH is the growth rate of asset. *FCF* is free cash flow. *ASTURN* is the logarithm of total assets turnover ratio. *COVID* is the new covid-19 case in china, and these data are collected from World Health Organization (WHO). The final sample includes 25 online education companies, quarterly frequency.

Table 1 (con't)

Variables	No. of obs	Mean	StdDev	Min	Median	Max	Skewness	Kurtosis
ROA	375	-1.08	15.13	-56.87	2.89	22.99	-1.52	4.92
ROE	375	-4.30	39.99	-198.54	4.98	82.40	-2.18	9.14
TOBINQ	375	0.94	0.63	-0.28	0.90	2.76	0.33	2.50
COVID	375	4.24	4.59	0.00	0.00	11.28	0.20	1.15
REV	375	6.08	1.40	1.93	6.30	8.90	-0.56	2.98
SIZE	375	6587.36	6307.23	448.22	4002.64	28717.25	1.60	4.98
LEV	375	3.76	6.88	1.04	1.71	52.04	4.16	21.40
ASGROWTH	375	13.64	36.56	-46.51	6.82	238.05	2.35	13.78
FCF	375	104.33	554.91	-3056.11	13.76	2599.22	0.31	12.55
ASTURN	375	-0.82	0.74	-3.95	-0.68	1.04	-1.18	6.37

Table 2 shows the correlations between each variables.

Table 2: Correlations

	ROA	ROE	TOBINQ	COVID	REV	SIZE	LEV	ASGROWTH	FCF	ASTURN
ROA	1.0000									
ROE	0.7976*	1.0000								
	(0.0000)									
TOBINQ	0.3128*	0.2276*	1.0000							
	(0.0000)	(0.0000)								
COVID	-0.0834	-0.0830	-0.0076	1.0000						
	(0.1070)	(0.1086)	(0.8841)							
REV	0.2413*	0.1769*	0.0880	-0.0207	1.0000					
	(0.0000)	(0.0006)	(0.0889)	(0.6895)						
SIZE	0.2591*	0.2223*	-0.1532*	0.0900	0.7138*	1.0000				
	(0.0000)	(0.0000)	(0.0029)	(0.0817)	(0.0000)					
LEV	-0.0678	-0.2663*	-0.0253	0.0357	0.1454*	-0.0695	1.0000			
	(0.1901)	(0.0000)	(0.6253)	(0.4911)	(0.0048)	(0.1790)				
ASGROWTH	0.3769*	0.1292*	0.4713*	-0.1309*	0.3166*	0.1313*	0.0525	1.0000		
	(0.0000)	(0.0123)	(0.0000)	(0.0112)	(0.0000)	(0.0109)	(0.3110)			
FCF	0.1112*	0.1140*	-0.0532	-0.0422	0.1783*	0.1130*	-0.0321	0.1554*	1.0000	
	(0.0313)	(0.0273)	(0.3045)	(0.4153)	(0.0005)	(0.0287)	(0.5357)	(0.0026)		
ASTURN	0.2934*	0.1868*	0.4524*	-0.0904	0.6935*	0.1997*	0.2035*	0.4218*	0.1182*	1.0000
	(0.0000)	(0.0003)	(0.0000)	(0.0805)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0221)	

4.   RESULTS AND DISCUSSIONS

4.1.   MAIN RESULTS

In Table 3, we find that the variable COVID has no unit root, which means it has a stationary time series, making the regression result reliable. Judging from the main results of regression in Table 3, we find that the p-value of COVID for ROE is less than 10%, which means it is kind of significant to ROE. Moreover, the coefficient of COVID to ROE is -0.6256. Thus, we can infer that the covid-19 harms firm performance. We can also find that in Table 3, the p-value of COVID for TOBINQ is less than 5%, which means it is pretty significant to TOBINQ. However, the coefficient of COVID to TOBINQ is 0.0131, which means the covid-19 has increased the market value of those companies. It is unusual to find that the epidemic has had opposite effects on these two indicators ROE and Tobin Q. So, the following are three possible interpretations. Firstly, China's financial market development is not perfect enough at the present stage. Considering the special conditions of China's market, adopting the Tobin Q indicator cannot accurately reflect corporate performance. The Tobin Q indicator supposes to take intangible assets into account, but according to Edmans (2011), intangible assets are not always valuated by the stock market. Hence, the first interpretation is that Tobin Q cannot accurately reflect Chinese online education companies' performance, suggesting we only focus on the negative impacts of covid-19 on firms' ROE. The second interpretation is that the epidemic outbreak has put the online education industry at the forefront, attracting widespread social and capital attention. As a result, the public, capital, and investors are full of confidence in the online education market, which leads them to make overly optimistic judgments about the online education market and make the expected value of the market deviate from the company's actual value. However, the actual firm performance of such companies is not that ideal, showing a downward trend. Therefore, it can explain why the covid-19 positively impacts those companies' Tobin Q indicator and negatively impacts their ROE. However, the subjective judgment of one-sided perceptual knowledge cannot accurately reflect the actual business performance of enterprises. The third interpretation is that ROA and ROE are concerned with previous accounting data, while Tobin Q is related to the firm's prospects viewed by the stock market. The historical accounting data indicate that the epidemic hurt those companies' ROE thanks to the fierce industry competition and free resource provision. However, according to its positive impact on their Tobin Q, we can infer the favorable industry outlook for the Chinese online educational industry.

Table 3: Main regression results

Before running the regression, we should test whether the variable *COVID* has a stationary time series. Since *COVID* represent the number of new cases. Then we develop a null hypothesis: Covid-19 new case has a unit root, or it is not stationary. Suppose the absolute value of the Test statistic is greater than the critical value, or the p-value of the Test statistic is less than 0.05, then we reject the null hypothesis and accept the alternative hypothesis. The result is as follows: the absolute value of the Test statistic is greater than the absolute value of critical value, and the p-value of the Test statistic is equal to 0.0000, which is less than 0.05. Thus we can reject the null hypothesis, and it shows *COVID* has no unit root so that we can run a regression. The following table shows the results of regression by using equations (1), (2), and (3). *ROA* is the return on asset. *ROE* is the return on equity. *TOBINQ* is the logarithm of the Q ratio. *COVID* is the number of new COVID-19 cases. *REV* is the logarithm of total revenue for the current period. *SIZE* is its total assets. *LEV* is the financial leverage ratio. *ASGROWTH* is the growth rate of the asset. *FCF* is free cash flow. *ASTURN* is the logarithm

of the total assets turnover ratio. All these firm performance data are downloaded from Bloomberg. *COVID* data is collected from World Health Organization (WHO). The model parameters are estimated by minimizing the equally-weighted sum of squared errors. *- stat. sign. at 10% level; **-stat. sign. at 5% level; *** -stat. sign. at 1% level. The sample period is from 2018 Q1 to 2021 Q3, quarterly frequency.

	ROA	ROE	TOBINQ
COVID	-0.1900	-0.6256*	0.0131**
	(-1.3600)	(-1.7200)	(2.4600)
REV	-4.9529***	-8.0390***	-0.1608***
	(-5.8900)	(-3.8600)	(-4.6000)
SIZE	0.0011***	0.0021***	0.0000
	(8.3800)	(6.0400)	(-1.0600)
LEV	-0.1359	-1.5649**	-0.0117***
	(-1.56000	(-2.4900)	(-4.6300)
ASGROWTH	0.1159**	0.0246	0.0065***
	(2.1200)	(0.1700)	(6.3400)
FCF	0.0012	0.0051	-0.0001
	(1.2000)	(1.2100)	(-1.5400)
ASTURN	8.1974***	18.6418***	0.5126***
	(5.1500)	(4.6400)	(10.2100)
No. of obs	375	375	375
R-squared	0.2477	0.4386	0.4386

Table 4 shows similar regression results with Table 3 after introducing a dummy variable: dummyC. It equals one after the outbreak of covid-19 and equals zero before the outbreak of covid-19. The result also shows that the epidemic has a substantial negative impact on a firm's ROE, with a coefficient of -5.9303. Moreover, a slightly positive impact on TOBINQ, with the coefficient of 0.1333, indicates that the covid-19 increases those firms' market value but reduces its return on equity. The possible explanations are similar to those mentioned in Table 3 above.

Table 4: Dummy variable

This table shows the result for regression by introducing DummyC as a dummy variable, and the *Perf_{it}* means the performance, which is measured by *ROA, ROE,* and *TOBINQ.*

$$Perf_{it} = \beta_0 + \beta_1 DummyC_{it} + \beta_2 REV_{it} + \beta_3 Size_{it} + \beta_4 LEV_{it} + \beta_5 ASGrow_{it} + \beta_6 FCF_{it} + \beta_7 ASTurn_{it} + \varepsilon_{it}$$

Since COVID-19 broke out in early 2020, any quarter before 2020 Q1, dummyC is equal to 0, and any period after 2020 Q1 is equal to 1. (include 2020 Q1). The following table shows the results of regression by replacing *COVID* with a dummy variable *DummyC* in equation (1), (2), and (3). *ROA* is the return on asset. *ROE* is the return on equity. *TOBINQ* is the logarithm of the Q ratio. *REV* is the logarithm of total revenue for the current period. *SIZE* is its total assets. *LEV* is the financial leverage ratio. *ASGROWTH* is the growth rate of the asset. *FCF* is free cash flow. *ASTURN* is the logarithm of total assets turnover ratio. All these firm performance data are downloaded from Bloomberg. *COVID* data is collected from World Health

Organization (WHO). *- stat. sign. at 10% level; **-stat. sign. at 5% level; *** -stat. sign. at 1% level. The sample period is from 2018 Q1 to 2021 Q3, quarterly frequency.

	ROA	ROE	TOBINQ
DummyC	-1.7133	-5.9303*	0.1333***
	(-1.3300)	(-1.7700)	(2.7500)
REV	-4.9228***	-7.9518***	-0.1623***
	(-5.8200)	(-3.8200)	(-4.6400)
SIZE	0.0011***	0.0021***	0.0000
	(8.3200)	(6.0200)	(-1.0600)
LEV	-0.1365	-1.5650**	-0.0118***
	(-1.5700)	(-2.4900)	(-4.7000)
ASGROWTH	0.1159**	0.0241	0.0065***
	(2.1200)	(0.1700)	(6.3700)
FCF	0.0012	0.0051	-0.0001
	(1.2100)	(1.2100)	(-1.5600)
ASTURN	8.1617***	18.5204***	0.5152***
	(5.1100)	(4.6200)	(10.2000)
No. of obs	375	375	375
R-squared	0.2475	0.1775	0.4405

In Table 5, two other control variables are added to run the regression. NEFIXGROW is the net fixed asset growth ratio, and GROSSFIXTURN is the net fixed asset turnover ratio. The regression results are consistent with Table 3 and Table 4. The epidemic negatively impacts those firms' ROE and positively impacts their Tobin Q.

Table 5: Additional control variables

This table shows the result for regression by adding two control variables: *NETFIXGROW* and *GROSSFIXTURN*. *NETFIXGROW* means the net fixed asset growth ratio, and *GROSSFIXTURN* stands for net fixed asset turnover ratio. Other control variables are the same as equation (1), (2), and (3). *ROA* is the return on asset. *ROE* is the return on equity. *TOBINQ* is the logarithm of the Q ratio. *COVID* is the number of new COVID-19 cases. *REV* is the logarithm of total revenue for the current period. *SIZE* is its total assets. *LEV* is the financial leverage ratio. *ASGROWTH* is the growth rate of the asset. *FCF* is free cash flow. *ASTURN* is the logarithm of total assets turnover ratio. All these firm performance data are downloaded from Bloomberg. *COVID* data is collected from World Health Organization (WHO). *- stat. sign. at 10% level; **-stat. sign. at 5% level; *** -stat. sign. at 1% level. The sample period is from 2018 Q1 to 2021 Q3, quarterly frequency.

	ROA	ROE	TOBINQ
COVID	-0.2181	-0.6744*	0.0141***
	(-1.6000)	(-1.8600)	(2.8000)
NETFIXGROW	-0.0044	-0.0072	0.0070***
	(-0.1700)	(-0.1000)	(7.6200)
GROSSFIXTURN	-0.1533**	-0.2656**	0.0066***
	(-2.1300)	(-2.0200)	(3.2200)

REV	-5.4456***	-8.8942***	-0.1683***
	(-6.0100)	(-4.0400)	(-4.9700)
SIZE	0.0012***	0.0022***	0.0000
	(8.3900)	(5.9600)	(-0.4300)
LEV	-0.1425	-1.5763**	-0.0124***
	(-1.6100)	(-2.5000)	(-5.7700)
ASGROWTH	0.1160**	0.0247	0.0047***
	(2.0300)	(0.1600)	(4.6500)
FCF	0.0012	0.0051	-0.0002**
	(1.2300)	(1.2300)	(-2.0100)
ASTURN	9.1104***	20.2233***	0.4622***
	(5.1500)	(4.6700)	(10.0300)
No. of obs	375	375	375
R-squared	0.2516	0.1789	0.5238

While in Table 6, an interaction term is introduced to run the regression since we believe that the covid-19 has a particular impact on the sales revenue. The interaction term is called *COVID×REV*, Which is the product of *COVID* and *REV*. After introducing this interaction term, we find that the covid-19 slightly negatively impacts Tobin Q, which is inconsistent with the other tables. The possible interpretations are as follows. By taking the impact of covid-19 on Chinese online education companys' sales revenue into consideration, the epidemic hurts the sales revenue of those firms, leading to a negative impact on their Tobin Q.

Table 6: Interaction term

This table shows the result for regression by adding interaction term. In consideration of the covid-19 have certain impact on company's revenue, hence, in this table we generate a variable called *COVID×REV*, which is the product of *COVID* and *REV*. Other variables are the same in equation (1), (2), and (3). *ROA* is the return on asset. *ROE* is the return on equity. *TOBINQ* is the logarithm of the Q ratio. *COVID* is the number of new COVID-19 cases. *REV* is the logarithm of total revenue for the current period. *SIZE* is its total assets. *LEV* is the financial leverage ratio. *ASGROWTH* is the growth rate of the asset. *FCF* is free cash flow. *ASTURN* is the logarithm of total assets turnover ratio. All these firm performance data are downloaded from Bloomberg. *COVID* data is collected from World Health Organization (WHO). *- stat. sign. at 10% level; **-stat. sign. at 5% level; *** -stat. sign. at 1% level. The sample period is from 2018 Q1 to 2021 Q3, quarterly frequency.

	ROA	ROE	TOBINQ
COVID	-0.3362	-0.9287	-0.0495**
	(-0.5700)	(-0.7400)	(-2.1900)
COVID×REV	0.0243	0.0504	0.0104***
	(0.2900)	(0.2500)	(2.6100)
REV	-5.0386***	-8.2166***	-0.1975***
	(-5.9300)	(-3.8100)	(-5.1600)
SIZE	0.0011***	0.0021***	0.0000
	(8.1700)	(6.0200)	(-1.5200)

LEV	-0.1372	-1.5675**	-0.0123***
	(-1.5700)	(-2.4800)	(-5.0400)
ASGROWTH	0.1159**	0.0246	0.0065***
	(2.1200)	(0.1700)	(6.4100)
FCF	0.0012	0.0051	-0.0001
	(1.2100)	(1.2100)	(-1.5900)
ASTURN	8.1927***	18.6321***	0.5105***
	(5.1300)	(4.6400)	(10.6900)
No. of obs	375	375	375
R-squared	0.2478	0.1772	0.4496

Finally, in Table 7, the fix effects model is applied to run the regression. Before choosing this fixe-effect model, the Hausman test is applied. The result of the Hausman test is Prob>chi2 = 0.0024, which indicates the fix-effects model is more appropriate than the random-effects model. The regression result by applying the fix effects model are consistent with tables 3, 4, and 5. The epidemic has a negative impact on firms' ROE and a slightly positive impact on TOBINQ.

Table 7: Fixed effects model

We have run a Hausman test to determine whether we should use random effect or fixed effect. The result of the Hausman test is Prob>chi2 = 0.0024, we should reject the null hypothesis and use a fixed effects model. This table shows the result for regression by applying the fixed-effects model—set firm as panel I.D. variable, and date as time variable to run this regression. *ROA* is the return on asset. *ROE* is the return on equity. *TOBINQ* is the logarithm of the Q ratio. *COVID* is the number of new COVID-19 cases. *REV* is the logarithm of total revenue for the current period. *SIZE* is its total assets. *LEV* is the financial leverage ratio. *ASGROWTH* is the growth rate of the asset. *FCF* is free cash flow. *ASTURN* is the logarithm of total assets turnover ratio. All these firm performance data are downloaded from Bloomberg. *COVID* data is collected from World Health Organization (WHO). *- stat. sign. at 10% level; **-stat. sign. at 5% level; *** -stat. sign. at 1% level. The sample period is from 2018 Q1 to 2021 Q3, quarterly frequency.

	ROA	ROE	TOBINQ
COVID	-0.1276	-0.5607*	0.0056*
	(-1.0200)	(-1.7100)	-1.5200
REV	1.3292	2.4322	-0.0484
	-0.8000	-0.5600	(-0.9800)
SIZE	0.0012***	0.0034***	0.0000
	-3.5600	-3.7600	-0.3000
LEV	-0.1753	-2.6808***	-0.0026
	(-1.2400)	(-7.2200)	(-0.6300)
ASGROWTH	0.0651***	-0.0259	0.0025***
	-3.1600	(-0.4800)	-4.1000
FCF	-0.0006	0.0012	-0.0001***
	(-0.5900)	(-0.4300)	(-3.4500)

ASTURN	14.6655***	30.1902***	0.3512***
	(-5.4400)	(-4.2600)	(-4.3800)
No. of obs	375	375	375
R-squared	0.1893	0.1893	0.1461

5.   CONCLUSIONS

Based on the main result of multivariate regression, we find that the covid-19 positively impacts TOBINQ. However, it hurts Chinese online educational firms' ROE (return on equity). It is unusual to find that a factor has opposite effects on these two firm's performance indicators ROE and Tobin Q. There are several possible explanations. Since Chinese financial market development is not perfect enough, the Tobin Q indicator cannot accurately reflect corporate performance. Furthermore, Chinese students are forced to stay at home and take online courses thanks to the epidemic outbreak. Therefore, all of a sudden, online education has become society's focus. Hence, this field quickly attracts more and more capital and investors' attention, making investors mistakenly think stocks in this field are profitable. Hence the stock price of those companies increased a lot, so as their market value. Another interpretation is that Tobin Q is related to the firm's prospects viewed by the stock market. Therefore, even the historical accounting data indicate the epidemic hurt those companies' ROE. However, based on the positive coefficient of Tobin Q, we should still be confident about the development of this industry.

This paper also applies many methods to test the main finding's robustness, including using the dummy variable method, adding additional control variables, and applying the fix-effects model. These robustness check results are consistent with the main finding. The epidemic negatively impacts Chinese online education firms' ROE. However, it positively impacts these firms' Tobin Q. Many reasons account for negative impacts on ROE, including overcrowded market, fierce industry competition, limited budget constraint, uncertainty avoidance, Etc. Furthermore, many reasons account for positive impacts on Tobin Q. While taking the long view, the negative impact of the epidemic on the company's performance will gradually diminish since those speculator companies will exit from industry competition. Moreover, more people have become regular users of online education applications due to the epidemic. Those accumulated user bases will be paid off and positively impact their firms' future performance. However, by introducing interaction term, after considering the certain negative impact of covid-19 on the firm's sales revenue, it indicates that epidemic has a negative impact on those firms' Tobin Q. The likely explanation is that the falling sales revenues erode investor confidence in this industry.

This paper helps to indicate the impact of covid-19 on Chinese online-education firms' performance, which helps solve the existing controversy in the literature review. Moreover, this paper also provides some short-term and long-term investment information and suggestions for investors interested in this field.

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