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Original Paper

Impact of Metaverse Investment on the Market Performance of Public Enterprise in China

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Abstract

This paper provides evidence on the impact of Metaverse investment on the market performance of public enterprises in China. Our empirical analysis is based on event study and the data of 58 public firms which made Metaverse investment announcements between 2021 and 2022. The results show that Metaverse investment announcements have a significant positive impact on the market value of firms in the short term, but show a downward trend over time. Meanwhile, firms with larger size, stronger innovativeness and higher operation efficiency can obtain higher stoke price, resulting in more returns. Nevertheless, firms in different industries all get positive market feedback. Industry differences have no significant effect on the market performance of enterprise Metaverse investment.

Keywords

Metaverse investment announcements, market performance, event study

1. Introduction

Metaverse refers to an online virtual world parallel to the real world, and its core lies in the carrying of virtual assets and virtual identities (Sparkes, 2021). Users can carry out social and spiritual activities such as socializing, entertainment, creation, display, education, and trading in the metaverse, so as to realize the expansion of human existence/sensory dimension, and then create a new economic system that can be replicated and added (Mystakidis, 2022). It is based on the convergence of technologies that enable multisensory interactions with virtual environments, digital objects and people such as Virtual Reality (VR) and Augmented Reality (AR) (Lee et al., 2022). As an emerging business format, Metaverse is expected to become a next-generation productivity tool, continuously promote the deep integration of digital technology and the real economy, empower the transformation and upgrading of traditional industries, and give birth to new industrial formats and new models. With the continuous

increase of digital economic policies and the heavy volume of virtual reality hardware terminals, a large number of enterprises have announced their entry into the Metaverse field.

Previous studies have shown that technology investment has a positive impact on the size, profit and market value of enterprises. The market often responds positively to emerging technologies, and investors expect that companies' investment in emerging technologies will increase their profits and value, which is conducive to their future development (e.g., Srinivasan, Lilien, & Rangaswamy, 2002; Overby, Bharadwaj, & Sambamurthy, 2006; Sarkees, 2011). Some scholars believe that the emergence and application of the Metaverse will have an impact on the entire industry in the future, and will reshape the new development logic of the entire industry from the bottom up, guide and comprehensively drive the coordinated development of the entire industry, and then bring all-round Linked change (Fang & Shen, 2022; Yuan & Yang, 2022). However, due to its own technical bottlenecks, most Metaverse adoption are still in the early stage of investment and proof of concept, and have not yet formed a landing application. There is obvious conceptual hype and speculation on Metaverse in the market. Under such circumstances, it is an interesting topic whether the market reacts to Metaverse investment.

Most of the current research on Metaverse focuses on technology deployment, and less research has been done on the impact of Metaverse investment on the market value of enterprises. Research on the investment effect of Metaverse of listed companies from a commercial perspective is still an emerging topic. In view of this, this paper explores the market performance of Metaverse investment and its influencing factors by using the stock return change data of listed companies before and after the Metaverse announcement.

2. Method

2.1 Event Study: Analysis of Market Performance Changes Caused by Metaverse Investment Announcements

The event study method was first applied in the financial field, and it is often used to analyze the impact of specific economic events on the value of the company. At present, it is widely used in the market performance changes caused by corporate mergers and acquisitions, additional issuance of new shares, and issuance of convertible bonds. We use event study method to analyse the impact of Metaverse investment announcements on the market value of listed companies. Based on the literature of event study method, we select the day, the day before, and the day after the listed company's Metaverse investment announcement as the event window, denoted as (-1, 1). The day when the announcement is released is recorded as 0. If it does not occur on the stock trading day, it will be postponed to the next day. Setting such a short event window reduces the confusing effect caused by the length of time. The estimated window is set to (-210, -10), and the post-event window is selected as 15 trading days after the announcement. The complete Metaverse investment announcement event analysis window is shown in the Figure below.

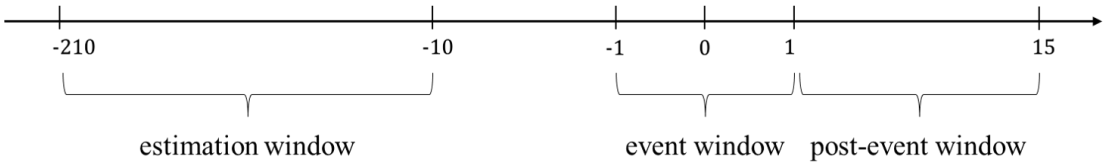

Figure 1. Event Analysis Window

Since the normal rate of return of listed companies' stocks is unobservable, it is necessary to predict the normal rate of return in the event window through the actual rate of return in the estimation window.. We use the Fama-French three-factor model to estimate the normal returns of the sample stocks. The model is as follows：

$$R_{it} - R_{ft} = \alpha_i + b_i\left(R_{mt} - R_{ft}\right) + s_i SMB_t + h_i HML_t + \varepsilon_{it}$$

where, on day t, R_{it} is the normal return for stock i and R_{mt} is the return for market portfolio , R_{ft} is the risk-free rate , SMB_t stands for "Small (market capitalization) Minus Big", HML_t stands for "High (book-to-market ratio) Minus Low" and ε_{it} is a random disturbance.

Once we estimate the normal return, the abnormal return (AR) is computed as follows:

$$AR_{i,t} = r_{i,t} - R_{i,t}$$

where, on day t, $r_{i,t}$ is the actual return for stock i and $AR_{i,t}$ represents the abnormal return. Then, the cumulative abnormal return (CAR) for stock i on event window T and post-event window T is computed as follows:

$$CAR_{i,T} = \sum_{k=0}^{T} AR_{i,k}$$

In order to further verify whether the Metaverse investment announcements can have a significant impact on the market performance changes, we calculate corresponding t-statistics to determine the significance for each event window, which is computed as follows:

$$t_{CAR} = \frac{E(CAR_{i,T}\ )}{S(CAR_{i,T})/\sqrt{n}}$$

2.2 Linear Regression: Analysis of the Influencing Factors of Market Performance Changes Caused by Metaverse Investment Announcements

We establish a regression model, which incorporates firm size, industry category, innovation capacity and operation efficiency variables, to further explain the performance differences. The model is specified as follows:

$$CAR_i = \alpha_i + \beta_1 Size_i + \beta_2 Industry_i + \beta_3 Innovation_i + +\beta_4 Operation_i + \varepsilon_i$$

Where CAR_i is the cumulative abnormal return for stock i and $Size_i$ stands for firm size, which is determined by the total assets of the sample firm at the end of the previous year before the release of the Metaverse investment announcement. $Industry_i$ stands for industry category for stock i. We divide the sample companies into service industry and non-service industry according to China's national economic industry classification, where service industry is denoted as 1 and non-service industry is denoted as 0. $Innovation_i$ stands for the innovation capacity for stock i, which is measured by the number of patents filed by the company. Innovative company is denoted as 1 and non-innovative company is denoted as 0. $Operation_i$ stands for operation efficiency, which is measured by asset turnover ratio. Table 1 summarizes all variables.

Table 1. Variable Definitions

Variable	Computation
CAR	Cumulative abnormal return is the sum of abnormal returns, which is the difference of actual and normal returns.
Size	Size variable is determined by the total assets of the sample firm at the end of the previous year before the release of the Metaverse investment announcement
Industry	Dummy variables: Service companies are denoted as 1 and non-service companies are denoted as 0.
Innovation	Dummy variables: Innovative companies are denoted as 1 and non-innovative companies are denoted as 0.
Operation	Operation variable is measured by asset turnover ratio.

3. Result

We crawled all Metaverse-related announcements from January 2021 through December 2022 from Cninfo, the information disclosure website of listed companies designated by the China Securities Regulatory Commission, using Python Web scraping technology. We focus on the first announcements of listed companies that contain the keyword "Metaverse". In view of the fact that the annual and quarterly periodic reports of listed companies often contain other event information, which leads to data pollution in the event window, we exclude such announcements. Additionally, we also exclude Hong Kong stocks, ST and *ST stocks, stocks whose daily price data cannot be obtained in the research window, stocks whose content of the announcements only mentions the purchase of Metaverse receivables wealth management products and stocks whose earnings announcements, dividends, mergers and acquisitions, and other emergency announcements fell within the research window. In the end, we identify a final sample of 58 unique firms. And the daily stock price data comes from the CSMAR database.

Based on the principle of event study, if the Metaverse investment announcement by the listed company has no significant impact on the enterprise value, the ACAR should fluctuate around 0 during the event window, otherwise ACAR will deviate significantly from 0 during the event window. Figure 2 depicts the change in ACAR of the samples during the event window and the post-event window. The result shows that the ACAR of the samples deviates significantly from 0 during the event window and the post-event window, but show a downward trend over time. Among them, the (-1,+1) event window has the greatest impact, which means Metaverse investment announcements have a huge positive impact on the market value of listed companies around the announcement day. As time goes by, in the post-event window, the ACAR first drops slowly and then rises slowly, reaching the highest on the 9th day. After that, stock prices gradually pulled back, and the ACAR showed a downward trend, indicating that the impact of the Metaverse investment announcement on the enterprise value gradually weakened.

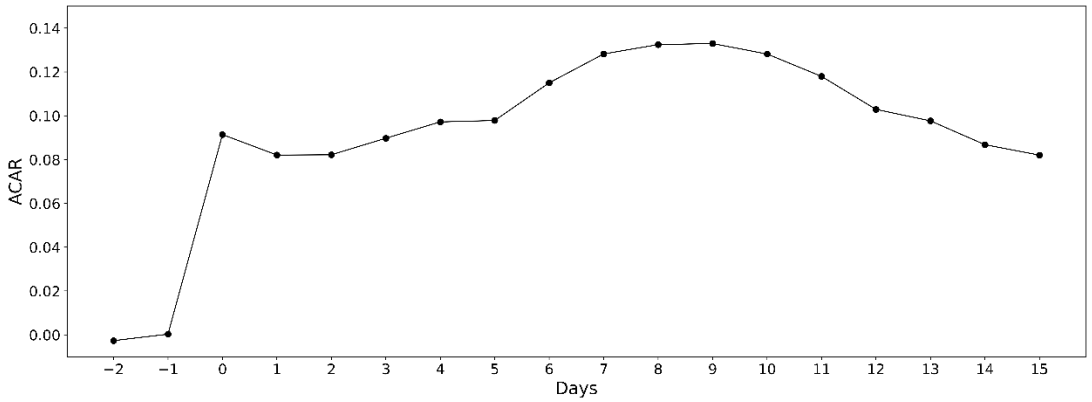

Figure 2. ACARs of the Firms

We report the ACARs and their corresponding t-statistics for significance in Table 2. We find that the companies that issued Metaverse investment announcements had a strongly statistically significant return of 13.70% from day -1 to day +1, 8.21%% from day 0 to day +1 and 8.22% from day 0 to day +2. Yields reach the highest on the 9th day. Then, yields generally trended lower after the day 9. By the end of day 15, the samples averagely earn a return of 8.21%.

Table 2. ACARs and T-Test Results

window	ACAR	t value
[-1,1]	0.137048	4.0302**
[0,1]	0.082098	3.2905**
[0,2]	0.082210	2.5047*
[0,3]	0.089771	2.3680*
[0,4]	0.097220	2.3399*

[0,5]	0.097881	2.3761*
[0,6]	0.115073	2.4514*
[0,7]	0.128250	2.7419*
[0,8]	0.132519	2.5240*
[0,9]	0.132995	2.4606*
[0,10]	0.128216	2.5325*
[0,11]	0.118000	2.4618*
[0,12]	0.102926	2.1517*
[0,13]	0.097681	2.1904*
[0,14]	0.086814	1.9561
[0,15]	0.082053	1.7465

Notes. ** and * denote significance for 1% and 5% respectively, using two-tailed tests.

To further explain the above performance differences, we use regression model to examine the impact of company size, industry category, innovation capacity, and operation efficiency on abnormal returns during the event window when listed companies issue Metaverse investment announcements.

Table 3. Regression Result

CAR	coef	t	P
Size	0.282	4.368	0.000**
Industry	0.017	0.453	0.677
Innovation	0.156	3.686	0.000**
Operation	0.194	2.164	0.035*

Notes. ** and * denote significance for 1% and 5% respectively, using two-tailed tests.

In Table 3, we find that CAR has a positive and significant correlation of 0.282 with company size variable, which means company size has a positive impact on the market value of Metaverse investment announcements. The scale of assets is an important indicator for assessing the capabilities of enterprises. Large-scale enterprises have advanced technology, complete facilities, and sufficient resources to promote flexible strategic adjustments, reduce information costs, and improve competitiveness. Their complete IT infrastructure strengthens the feasibility of Metaverse investment, which makes them acquire a better market performance. The positive and significant coefficient of 0.156 of innovation capacity variable demonstrates that innovative companies experience a much higher abnormal return compared with non-innovative companies. The theory of innovation holds that radical information technology innovation can create more income for investors, and the growth of innovation ability is conducive to enterprises to occupy a favorable market position and obtain

resources for organizational restructuring and business process improvement. The innovation in the metaverse announcement reflects the competitive advantage of the enterprise. Innovative information technology investment companies are more likely to occupy a market position than ordinary companies, gain more resources and experience, and thus gain more market returns. The positive and significant coefficient of 0.194 of operation efficiency variable demonstrates that companies with higher operation efficiency experience a much higher abnormal return. Enterprises generally try to improve their performance by improving operational efficiency, and the improvement of operational efficiency can become a catalyst for the effect of information technology investment, thereby affecting the market value of the enterprise. In the end, the industry category variable also has a positive correlation with CAR, demonstrate service industry experiences a abnormal return, however, the coefficient is not significant.

4. Conclusion and Discussion

This paper uses event study method to analyze the market performance changes before and after the release of the Metaverse announcement issued by listed companies, and further uses the multiple linear regression model to analyze the relationship between cumulative abnormal returns and the four factors of company size, industry category, innovation capacity, and operation efficiency. The research results show that after the release of the Metaverse investment announcement, it will have an immediate and significant positive impact on the market performance of listed companies. In the long run, as the market digests the announcement information, the stock price will gradually pull back. Firm size, innovation capacity, and operation efficiency will affect the effect of corporate metaverse investment announcements on market performance. Firms with larger size, stronger innovativeness and higher operation efficiency can obtain higher stoke price, experiencing a much higher abnormal return. Nevertheless, firms in different industries all get positive market feedback. The industry type of the enterprise has no significant effect on the market performance of enterprise Metaverse investment. These conclusions provide relevant decision-making reference for further mining the commercial value of Metaverse.

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