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메타버스 투자 추진이 기업 가치에 미치는 영향 분석: 이벤트 연구 방법론

How Market Reacts on the Metaverse Initiatives? An Event Study

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요 약

전 세계적으로 유행한 COVID-19로 인해 비대면 행사가 많이 개최되며, 2021년도에 메타버스가 많은 관심을 받게 되었다. 많은 회사들이 메타버스에 대한 투자를 발표하고 주식 시장에도 큰 변화를 일으킴으로써 메타버스의 가치에 대한 연구의 중요성이 커지고 있다. 본 논문은 이러한 사회 현상을 기반으로 메타버스 투자 계획과 주가 사이의 관계를 분석한다. 2019년부터 2021년까지 수집된 Lexis-Nexis 뉴스 데이터를 토대로 이벤트 연구방법론(event study method)을 사용하여 이러한 관계를 실증적으로 검토하였으며, 세부적인 요인들을 설정하여 선형회귀분석을 실시하였다. 결과적으로, 메타버스 관련 계획은 기업 가치에 긍정적인 영향을 미친다는 결과를 확인할 수 있었다. 기술적인 측면에서는 메타버스 가능 기술(예: NFT, VR 기기, 디지털 트윈)과 공통 기술(예: 반도체, 인공지능, 클라우드) 두 변수 모두 시장 수익률에 긍정적인 영향을 미치는 것으로 나타났으며, 특히 가상 환경의 중요성이 강조되었다. 또한 전략적 관점에서 급진적 혁신(예: 피보팅, 기업 인수)은 점진적 혁신(예: 파트너십, 기술 투자)보다 시장 수익에 더 긍정적인 영향을 미치는 것으로 나타났다. 마지막으로 메타버스 산업은 서비스 산업군에 속하지 않은 회사(예: 전자 장치, 기계 장치)에서 더 긍정적일 수 있다는 결과를 보였다. 학술적으로 메타버스의 혁신적 가치와 중요 요인에 대해 실증적으로 규명하였다는 점에서 연구의 의의가 있다.

키워드 : 메타버스, 가상현실, 자원준거론, 이벤트 스터디, IT 혁신

Ⅰ. Introduction

With the emergence of the COVID-19 pandemic, the majority of our daily life has been replaced by the non-contact environments. Many events are canceled due to the pandemic, however, there was one breakthrough that can be a solution to meet in the virtual world. Lots of ceremonies are replaced into a different form by exploiting the “metaverse.” A number of companies started the metaverse business and adopted diverse metaverse technologies.

The term “metaverse” was first coined in the science

fiction novel Snow Crash in 1992 by Neal Stephenson (Dwivedi *et al.*, 2022). Previous literature illustrates metaverse as "the convergence of virtually-enhanced physical reality and physically persistent virtual space" (Smart *et al.*, 2007). The metaverse has not been defined perfectly yet at this moment, so it can be whatever people dream it to be. Unlike current virtual reality (VR) services, which are mostly used for gaming, the metaverse could be used for practical ways such as working, playing, gaming or just hanging out with other friends. Metaverse generally means the post-reality universe, based on the integration of technologies (e.g. VR and augmented reality (AR)) that can facilitate interactions inside virtual environments, with other digital objects or people (Mystakidis, 2022).

The main event that the metaverse drew attention to was made in October 2021. Facebook, one of the major global IT companies, changed its name to Meta. Mark Zuckerberg, the CEO of Meta (Former Facebook), mentions that he plans to refocus his Silicon Valley company on what he sees as the next digital frontier, which is the unification of disparate digital worlds into the metaverse (CNBC, 2021a). This was the moment that the amount of searching the metaverse increased explosively on Google. By this moment, lots of companies started to announce news about metaverse initiatives. The CEO of Nvidia, a representative company for GPU and CPU, made an interview that the metaverse could save companies billions of dollars in the real world (CNBC, 2021c). For matured IT companies, the metaverse can be a new breakthrough for development. Challenging to establish the metaverse is regarded as incumbents' new steps for growth, because digital market leaders and existing IT platforms are finding new phases to develop themselves (Deloitte, 2022).

According to a consumer survey conducted by Mckinsey (2022), approximately 60 percent of consumers are excited about the transition of everyday activities to the metaverse. This result shows that consumers are willing to enjoy the metaverse, and the major factors of excitement for users who attempt virtual environment are connectivity with people and exploring digital worlds. This also indicates that it is important to establish a social connection and real-world elements to satisfy the metaverse users.

As metaverse business grows rapidly, more and more companies announced metaverse investments from various industries. For example, Nvidia, a company that mainly focuses on semiconductors, also attempted metaverse business through "Omniverse," which is a computing platform that enables users to develop 3D workflows and applications (CNBC, 2021c). Additionally, Nike and Ralph Lauren, which are firms that produce clothes, are trying to broaden their boundary to metaverse environment by launching their collection on Roblox (CNBC, 2021b). This study aims to find out what kinds of organization derives positive market reaction in metaverse business by building hypotheses that firm size, prior experiences, or industry sector can impact the firm's value.

There are some technological aspects that are expected as essential factors to establish the metaverse. According to the survey by Mckinsey (2022), executives of firms consider that cryptocurrency, artificial intelligence (AI), and AR/VR as the most critical technologies to establish metaverse environments. There has been various studies about virtual world or AI, however, the metaverse has a significant meaning that it contains whole aspects of the technologies. Also, there has been a huge leap compared to traditional virtual world which was basically focused on socializing through the Internet (e.g., SecondLife, Cyworld). Therefore, this study includes the analysis of technological aspects of metaverse in the resource-based view.

Additionally, this study considers the strategy per-

spective of the business value of metaverse. Growing number of organizations have attempted metaverse business by their own strategy to accomplish the desire to establish metaverse environments. Therefore, this study categorizes the strategies into two types of innovations, radical innovation and incremental innovation, among our news data to find out which strategy can be the most powerful to the market value.

Prior studies about metaverse were generally based on theoretical knowledge, therefore, the economic value of metaverse can be questioned with empirical evidence. This study emphasizes the value of metaverse initiatives by using the event study method to empirically analyze the stock price. In this paper, we first identify important factors that can be related to the metaverse business value to build hypotheses and explain related background. We then describe the news data we collected and the process of restricting the data. After that, this study analyzed the correlation between these factors by using a cross-sectional analysis to examine with the market reaction with 352 announcements which is collected from 2019 to 2021.

Ⅱ. Theoratical Background

2.1 Resource-Based View (RBV)

The resource-based view (RBV) is a traditional theory to explain the background of the influence of IT investment. According to the previous literature about RBV, it can be a competitive advantage in the market when the firm has valuable and sustainable IT resources with their internal IT capability (Barney, 1991). Lots of IS studies refer RBV to explain the concept of how IT resources are regarded as a competitive advantage and how the firm establish a strategy to get efficient performance by IT assets. This context also applies in metaverse market because various resources are necessary to construct the frame of metaverse. Metaverse is rapidly spreaded due to technology advancement such as VR, AR, and XR. These technological resources provide interactive and immersive experiences (Dwivedi *et al.*, 2022). Businesses are now beginning to explore how they can incorporate metaverse into their existing business models, based on its potential. According to the Mckinsey report (2022), technology advancement (i.e., back-end engine, computing power, 5G, devices or software) can facilitate development of metaverse.

It is crucial to prepare underlying infrastructure to realize realistic metaverse. RBV, which focuses on the identification of valuable, rare, and non-substitutable resources, can provide a robust theoretical framework for analyzing and understanding metaverse. This theory can demonstrate competitive advantages of metaverse business based on the resources of firms. In addition, RBV emphasizes the integration of resources with a firm's business model to create values, therefore, it is appropriate theory to explain the companies exploring metaverse to broaden their business area.

2.2 IT Capabilities

Adopting a resource-based perspective, key IT-based resources are generally classified in three major categories: (1) technology asset, (2) strategy asset, and (3) human asset (Ross *et al.*, 1996). The IT capability literature explains that various IT-related resources can be formed as valuable, rare, non-imitable, and non-substitutable IT capability (Mata *et al.*, 1995). In this study, we aim to find out the market reaction based on resource-based theories. Especially, there are various types of technologies in metaverse context, therefore, it is worth finding out what kinds of technologies can generate more market reaction. Also, on the strategi-

cal side, firms attempt their own strategy to break through metaverse business. There might be advantageous strategies among various strategies, which this study aims to find out. However, it is not easy to analyze human IT resources by news data, because it is not publicly open information. Organizational human resources typically consist of internal resources such as staff training, education experience, internal relationship, and insights of employees (Barney, 1991). It is one of the important factors in IT capabilities, however, it is an internal factor of the firm so it cannot be measured by news data which is published officially on the press.

Therefore, this study examines firm-specific factors instead of human IT resources. The firm-specific factors can explain the correlation between market reaction and metaverse initiatives because firm-specific factors can elucidate heterogeneous characteristics of each organization (Tornatzky *et al.*, 1990). To set variables that can represent firms' heterogeneity, we refer to the previous IS literature, which applied the event study method to find the business value with the cloud computing announcements with the extended resource-based view (Son *et al.*, 2014). As a result, firm size and prior experience of firms are used for firm-specific factors in this study. Specific explanations of the hypotheses development of firm-specific factors, as well as resource factors (technology factors, strategy factors), are described in the next section.

Ⅲ. Hypotheses Development

3.1 Market Reaction on Metaverse Initiatives

Previous IS studies examine the impact of new technology initiatives with stock price. In the phase of adopting new technologies, initiatives can be an important factor that can influence a firm's value. <Table 1> presents the empirical studies that have analyzed the relationship between new IT innovation and firms' business values. This research follows the methodology of previous studies but adopts the resource-based theory regarding IT capabilities. According to a previous literature, the market shows positive reaction to virtual world announcements, which can be the basic concept of metaverse (Yang *et al.*, 2012). Yang *et al.* (2012) suggests that virtual world investments derive positive returns in investors' perspective, and the findings also indicate that investors' reactions to virtual world initiatives shows more significant values in four key characteristics of virtual world initiatives: interpretive flexibility, divisibility, strategic importance, and exploitable absorptive capacity. Also, virtual world has important characteristics: the social and economic behaviors of

〈Table 1〉 Studies about Measuring Market Value with New Technologies

Literature	Technology	Key finding
Son *et al.* (2014)	Cloud computing	Firms' cloud computing initiatives effect to the market value positively.
Agrawal *et al.* (2001)	E-business outsourcing	Stock markets shows favorable reaction to firms with E-business outsourcing announcement.
Yang *et al.* (2012)	Virtual World	By investing in Virtual World initiative, a firm can increase firm's business value.
Oh *et al.* (2014)	IT Outsourcing	The results indicate that IT outsourcing will significantly influence investors' perceptions of the risks in stock market.

participants in the virtual world and establishing a spatial features in the virtual world (Animesh *et al.*, 2011).

We consider metaverse as an expanded concept of virtual world with more sophisticated technology and various interface. Traditional virtual world (e.g., SecondLife, Cyworld) has already been studied by previous research in IS field (Animesh *et al.*, 2011; Yang *et al.*, 2012). These studies illustrate the virtual world by these characteristics; (1) connection through the Internet, (2) socializing-based platform, and (3) 3D environment. However, the traditional virtual world has limitations compared to metaverse recently. First, lack of technologies was considered to be the biggest problem in virtual world. Computing power is one of the most important resources to establish virtual environment. (Animesh *et al.*, 2011). In order to operate graphical environment with 3D backgrounds with interaction, powerful computing is very necessary. Also, one of the necessary feature of metaverse is ubiquity, which means whether metaverse is accessible through all existing digital devices, from desktops to mobile devices. However, SecondLife for example, was only available by desktop, and computing power was not as powerful as these days.

Second, the traditional virtual world was basically focused on socializing platforms. For example, Cyworld in Korea was a frequently used platform by the young generation to upload their own photos and communicate with each other. However, Cyworld's popularity gradually declined with the advent of a new chatting platform. Metaverse, on the other hand, has several aspects other than socializing. For example, Zepeto in Korea has lots of contents in the platform including communicating, game, live streaming, crew activities, creating new item or game, and customizing their own avatars. Also, the previous virtual world utilized the monetization concept, however, the cyber money wasn't able to exchange in the real world. Unlike these traditional virtual world, the cyber money (e.g., Robux in Roblox, Zem in Zepeto) can be exchanged in real world. Therefore, we can find that metaverse is an extended and developed version of the traditional virtual world.

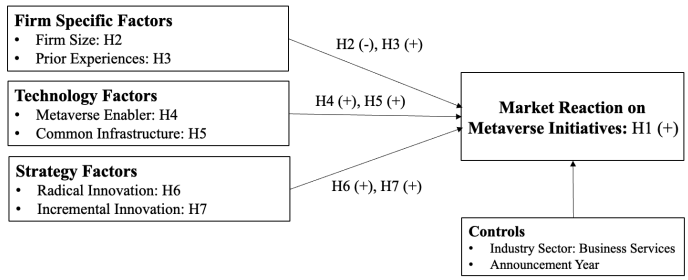
By these features, metaverse can be considered as a new IT innovation that can impact on the business of organization. We build our main hypothesis as follows:

H1: The stock return will be positive to metaverse initiatives announced by a firm.

3.2 Contextual Factors on Metaverse Initiatives

However, the previous event studies about the virtual world analyzed market reactions based on five characteristics among 12 real options perspective of Fichman (Yang *et al.*, 2012). Unlike this study, we aim to find out other practical resource-based factors that affect market reaction in metaverse business based on resource-based view. This study conducts a cross-sectional analysis to find out what kind of resources of the firm can derive especially positive market reaction.

As metaverse concept drew lots of attention in 2021, various types of companies jumped into the metaverse market. Therefore, heterogeneity can exist among firms in metaverse business. To find out specific empirical results, we discuss contextual factors on Metaverse initiatives based on IT capabilities in this section. This paper will find out how specific factors can affect to the market returns. Contextual factors are split into three categories: firm-specific factors, technology factors and strategy factors. This study categorizes these groups based on the principles of resource-based theory, with each category consisting of two factors. Firm



〈Figure 1〉 Research Model

size and prior experiences are significant criteria for assessing a firm's IT value. Technology factors and strategy factors are essentially derived from the theory of IT capabilities, which comprises (1) technology assets, (2) strategic assets, and (3) human assets. Human assets are excluded from our study because they cannot be measured by publicly reported news data. The specific details of each factor within the categories are explained in the next section. Figure 1 represents details of our research design about market reaction on metaverse initiatives.

3.2.1 Firm-Specific Factors

3.2.1.1 Firm Size

Previous literature suggests that size of organization is an important standard to estimate the IT value of organization (Lee and Xia, 2006). Size of organization has been considered as an important factor in phase of adopting IT innovations in managerial perspective (Gremillion, 1984). Large firm tends to have some advantage in the early steps, however, they can be confronted a critical step later when the firm aims IT innovation (Lee and Xia, 2006). Dewan *et al.* (1998) find that, as the organization is bigger in scale and scope, it is more intense to present IT investment due to the level of vertical integration of organization. Bigger firms are more likely to have organizational obstacles and external policies which can make the process not flexible when the firm intends to start a new IT investment (Zhu and Kraemer, 2005). Also, using event study method, it is possible to capture substantial industry and potential firm size effects (Konchitchki and O'Leary, 2011).

This research covers various firms across different industry sectors, and each firm possesses distinct assets. For instance, in 2021, Microsoft's total assets were 73 times larger than Roblox's, highlighting a significant difference between the two firms. In this context, we expect that smaller firms can be more fluctuate than bigger firms in the stock market when metaverse initiatives are released in the press. Therefore, we suggest next hypothesis:

H2: The stock return will be more positive to metaverse initiatives announced by smaller firms.

3.2.1.2 Prior Experience

In IT innovation, some friction of prior knowledge of the organization can make it easier to acquire and retain new knowledge because it provides associative connections needed for insights related the new innovation. Fichman and Kemerer (1997) called this phenomenon as "economies of scale in learning," which means knowledge of organization also be applied by economies of scale. Thus, based on path dependency, firms can predict the market and commercial potential of technological advances more accurately in an un-

certain environment (Zhu *et al.*, 2006).

In resource-based view, starting new IT investment without prior experience can be a risky challenge. Wade and Hulland (2004) argue that internal IT technical skills, infrastructure, and cost efficiency in IS operations are very important attributes as IS resources. These internal IT resources cannot be established without prior experiences, therefore, firms with prior experiences have benefits because they might already have internal IT resources. Specifically, comprehensive knowledge of an organization's culture and goals, and IT applications and infrastructure on IT business that has already been established can be a key to compensate for its inexperience (Nevo *et al.*, 2007).

In metaverse context, VR and AR are fundamental technologies to establish environments. Large firms (e.g., Meta, Microsoft, Google) have been investing in AR/VR technologies from few years ago. Various types of extended reality (XR), including the type of AR or VR will be the cornerstone of future metaverse design. As metaverse itself is a combination of infrastructure of platforms and technologies, therefore, we expect that firms with prior experiences (e.g., VR, AR) are more likely to react positively than firms don't have any prior experiences. So, we propose the following hypothesis:

H3: The stock return will be more positive to metaverse initiatives announced by firms with prior experiences than firms without prior experiences.

3.2.2 Technology Factors

In metaverse business, the most vital resource is definitely the technology. The physical IT asset forms the core value of the firm's comprehensive IT infrastructure, and also be a key source for long-term competitive advantage (Bharadwaj, 2000). Various technologies are necessary to establish metaverse, therefore, this study intends to make clear to verify each technology. From the collected news data, there are various categories of technologies such as AI, VR devices, NFT, cryptocurrency, semiconductors, cloud, and 5G. To measure the technical factor of metaverse, we classified technologies into two specific categories: metaverse enablers, and common infrastructure.

3.2.2.1 Metaverse Enablers

In this study, metaverse enablers mean that technologies that mainly construct metaverse environments so that it is impossible to establish metaverse without these technologies. Dwivedi *et al.* (2022) suggests metaverse enabling technologies as follows: blockchain, NFT, 3D technologies, AR, VR, digital twin, and Internet of Things (IoT). For example, one of collected news data has the title 'Facebook's Oculus Is Developing a New Quest VR Headset,' which marks the initiation of efforts to establish VR environment for expanding the metaverse business. Another example, 'Warner Music Group and Genies Sign Partnership to Bring WMG's Roster of Artists to Life as Avatars,' demonstrates an initiative to advance digital twin technology. Therefore, we expect these technologies (e.g., NFT, VR, and digital twin) can reflect some characteristics that is necessary to establish metaverse.

First, the boundary between the real world and the virtual world is divided by the VR device such as Oculus. Meta attempted metaverse business by acquiring Oculus so that they can make their services possible in the virtual world. To establish virtual environments, powerful computing power is necessary because 3D backgrounds requires operation of a highly interactive and graphical environments (Yang *et al.*, 2012). A physical device is necessary to provide the user's realistic visual sense to create a 3D metaverse environments in sense of immersion (Dwivedi *et al.*, 2022). Therefore,

we considered VR devices as a metaverse enabler in this study.

Secondly, there are various news about avatars in metaverse environments. This characteristic was generated from the early stage of the virtual world (e.g., Second Life or Cyworld) and is still considered an important technology. Recently, this concept was developed as 'digital twin.' Digital twin, which is a replicated version in the virtual environment, can provide users with immersive experiences through a seamless operation and superior virtual experience (Dwivedi *et al.*, 2022). In metaverse, having own identity is the first step to trying a virtual environment, therefore, avatars need to be fascinating to attract users, keep them in the virtual world and make them modify their avatars. The spatial environment is organized by the navigation of the avatars inside the virtual world, especially by the avatar's interaction with virtual objects or other avatar (Animesh *et al.*, 2011).

Lastly, 2021 was the booming year of newly made technology "NFT." NFT is a non-fungible token, which means a unique digital identifier that is recorded on a blockchain. NFT is used to certify ownership and authenticity, and cannot be traded or exchanged at equivalency (e.g., bitcoin) (Dwivedi *et al.*, 2022). This characteristic is very necessary in metaverse, because the trade inside the virtual world can be guaranteed by NFT, and it cannot be copied by anyone else so that copyright can be protected. Also, NFT can be the key to solve the monetization gaps between real and virtual worlds by its guaranteed characteristic (Dwivedi *et al.*, 2022). Sociability inside the virtual world includes interaction with other participants and presenting their own virtual identity through time, effort, and money spent (Animesh *et al.*, 2011). Therefore, we categorized these technologies (e.g., VR devices, avatars, NFT) as metaverse enablers which can enhance the makret value of the firm.

H4: The stock return will be more positive to metaverse initiatives announced by firms with metaverse enablers than firms without metaverse enablers.

3.2.2.2 Common Infrastructure

Unlike metaverse enablers, common infrastructure includes informstion technologies which can be used in various ways and can facilitate metaverse environments, such as semiconductors, AI and cloud computing. According to the IT capability literature, technology assets are essential for integrating systems and making IT technologies cost-effective in their operation (Ross *et al.*, 1996). Computing power in metaverse is very important in spatial establishment and network inside the environment (Mystakidis, 2022). With frequent technical disruptions and unstable services, users might be disappointed and irritated which can consequently lead to leaving the platform (Biocca, 2000).

For example, gaming GPU from from Nvidia has significant impact on metaverse business, because it is impossible to establish metaverse without semiconductor. One of our datasets includes a title like 'AMD Launches AMD Ryzen 5000 Series Desktop Processors: The Fastest Gaming CPUs in the World,' which represents an initiative to develop infrastructure for enhancing the gaming environment, thereby contributing to metaverse. Also, AI can be a vital background technology of metaverse because AI can make improvements and constant self-learning from the behavior of digital customers and interactions inside the virtual environment (Dwivedi *et al.*, 2022). We can provide an example from our data, such as 'Microsoft to Buy Artificial Intelligence Provider for $16 Billion,' which illustrates their investment in AI technology－a fundamental technology for metaverse. In metaverse context, these technologies comprise a significant proportion than before because metaverse requires much

more complicated infrastructure than ever. Therefore, we consider semiconductors, AI, cloud comupting, and 5G as common infrastructures, which can facilitate metaverse initiatives.

H5: The stock return will be more positive to metaverse initiatives announced by firms with common infrastructure than firms without common infrastructure.

3.2.3 Strategy Factors

Metaverse initiatives have various types of strategies. In this study, we found four major types of strategies from the collected news data: acquisition, partnership, investment and pivoting. We categorized these strategies based on the previous literature about IT innovation with radical perspective and incremental perspectives.

Zaltman *et al.* (1973) define innovation as "an idea, practice, or material artifact perceived to be new by the relevant unit of adoption." Focusing on adoption of technological innovations, radical innovation means changing fundamental part that is considered as revolutionary changes in technology (Dewar and Dutton, 1986). Radical innovation can bring huge changes to the firms by starting a new business. These changes can be a good opportunity for the firm to enter in new business market, however, it might be a risky challenge to the firm's value in the same time. In contrast, Dewar and Dutton (1986) define incremental innovations as "minor improvements or simple adjustments in current technology", and mention an important standard as "the degree of novel technological process content" to determine whether the innovation is radical or incremental. Compared to radical innovation, incremental innovation can be a safe choice because modifying existing technology of the firm can provide an exit to go back in case of negative market situation. By adopting various strategies, firms can attempt to enhance their own value through radical or incremental innovation. This study tries to figure out what kind of strategies can generate more positive market reaction.

3.2.3.1 Radical Innovation

Fichman (2004) defines radicalness as "the extent of potential improvements in organizational products or processes enabled by the technology." Development of technology generally includes the learning curve in mature phases of evolution, which is widely used in academic fields as different other name, such as progress curve, improvement curve, or experience curve (Yelle, 1979). Radical innovation and technological paradigm can be required in the early stage of evolution (Coccia, 2017). With the new paradigm, incremental innovation of technologies can be progressed gradually over time. In metaverse context, the duration of explosive attention did not last more than a year from 2021. This reduced attention, of course, resulted from the economic recession and crashed stock market, however, metaverse has been mentioned continuously in the news from time to time. Therefore, we can assume that the period from 2020 to 2021 might be the radical step of the metaverse business to make a leap for new revolution.

For example, there was a news with the title of "Apple buys virtual reality company NextVR" (CNBC 2020). This news includes the information about Apple's plan about VR and AR technologies, and Apple CEO Tim Cook directly mentioned the introduction of VR headsets by acquisition. This initiative has characteristics of radical innovation because acquiring a VR company is a radical decision for Apple to develop VR headsets. Starting a VR business for Apple is a revolutionary challenge considering that Apple traditionally focused on mobile devices and PCs. Thus, we determine initiatives about acquiring other organ-

izations as a radical innovation in this study.

According to Google Trends, the search volume of “metaverse” exploded in October 2021, exactly matched with the timing when Mark Zuckerberg made an interview about changing the name of Facebook to Meta (CNBC, 2021a). The interview was mainly with the description about its vision to working and playing inside the virtual world and there was a mention about a new VR headset, too. After this big news, a number of companies (e.g., Adobe, Nvidia, and Microsoft) announced new business plans for metaverse initiatives continuously. These initiatives are kinds of pivoting, which means fundamental changes in the direction of a business in situation when the market or consumer needs a new area of trends (Forbes, 2022). The main goal of a business pivoting is to enhance the value of firm itself and survive in the current competition. Initiatives that pivot new business generally includes future plan about fundamental changes or new investment. Starting a new business is a huge deal for a company, therefore, this study determines pivoting as a radical innovation. Radical processes are generally promoted by a radical trend of the market or technical specialists (Ettlie *et al.*, 1984). By these circumstances and findings, we can establish our hypothesis as follows:

H6: The stock return will be more positive to metaverse initiatives announced by firms with radical innovation.

3.2.3.2 Incremental Innovation

However, not every company can attempt aggressive strategies in the first step of the business. Dewar and Dutton (1986) argue that the major difference between radical and incremental is “the degree of novel technological process in the innovation, especially the degree of new knowledge in the innovation.” Complexity and knowledge are less important for incremental innovations because this type of adoption requires less knowledge resources, however, contact with the external environment may be necessary for adoption (Dewar and Dutton, 1986). Some firms do not have their own technology or knowledge so that they cannot easily start a new business on their own. Additionally, metaverse can show another aspect of evolution Metaverse is not composed of one simple technology and requires the development of various technologies so that it can show new progress of evolution.

In metaverse context, clothing firms, such as Ralph Lauren or Nike, tried to expand their new business by collaborating with other firms. For example, Ralph Lauren launched its first digital collection on Roblox in 2021 (CNBC, 2021b). By utilizing the virtual environment of Roblox, Ralph Lauren also could promote its metaverse business. These kinds of strategies can avoid complexity and do not have to fulfill the fundamental knowledge and technology. Also, investing other firms can be regarded as incremental innovation. New York Times (2019) released a news of Microsoft’s investment on AI, with the title of “With $1 billion from Microsoft, an AI lab wants to mimic the brain.” This investment is rather incremental compared to acquisition, because it requires less risk and less cost. Ettlie *et al.* (1984) argue that incremental strategy tends to support new product introduction process adoption in traditional way. Our study determines two types of strategies as incremental innovation: investment and partnership. The last hypothesis of this study is as follows:

H7: The stock return will be more positive to metaverse initiatives announced by firms with incremental innovation.

Ⅳ. Data

To collect metaverse-related announcements, this research applies procedures and mechanisms similar to those employed in previous event studies (e.g., Yang *et al.*, 2012). The data was collected by searching representative keywords related to the metaverse concept (e.g., metaverse, virtual world, AR, VR, digital twin). Full-text news with publishers and dates were collected via Lexis-Nexis Database which compiles daily major newspapers, and other business publications including PR Newswire and Business Wire.

According to Google Trends, search volume for metaverse exploded in October 2021, when Facebook announced the change of the company name to Meta. However, there has been the concept of the metaverse before 2021, therefore we collected various keywords related to metaverse. First, we listed general keywords that are related to metaverse: metaverse, virtual world, virtual space, 3D, virtual reality (VR), augmented reality (AR), mixed reality (MR), extended reality (XR), digital twin, mirror world, and sandbox. Second, we also listed companies that are related to metaverse: Apple, Adobe, Autodesk, AMD, Activision Blizzard, Bentley Systems, Disney, Electronic Arts, Epic Games, Facebook (Meta), Fastly, Google (Alphabet), Immersion, Intel, Microsoft, Matterport, Nvidia, Qualcomm, Roblox, Snap, and Unity Software. Lastly, we listed services or technologies that are related to metaverse: Horizon (Facebook), Oculus Quest (Facebook), Minecraft (Microsoft), and Hololens (Microsoft). By these keywords, we collected 19,611 news data as an initial sample.

However, there was some missing news that was not included in Lexis-Nexis Database. For example, “Apple Headsets: New iOS 15 Tech Could Have AR and VR” was published in Bloomberg on June 11, 2021. This news was related to metaverse, however, it was missed in the Lexis-Nexis database. Therefore, additional data was collected through Google search. It is impossible to get every news through Google search, so we restricted the publishers: CNBC, Bloomberg, and Yahoo Finance. This process included 2,510 new data as an initial sample.

With these keywords, we collected overall keywords over 3-year period, from January 1, 2019, to December 31, 2021－22,121 news data was collected for the initial sample. After reading the news carefully, we restricted the news data through the steps in <Table 2>. First, we removed 1,986 news data that contain general meaning of metaverse without firm-related events. Second, announcements that contain either man-

〈Table 2〉 Restrictions to Leading to Final Sample

Steps	Details	Sample
Step 1	Initial news samples from Lexis-Nexis Database keyword Searching	19,611
	Additional samples from Google Searching (CNBC, Bloomberg, Yahoo Finance)	2,510
Step 2	Less:	
	- Announcements that contain general meaning of metaverse without firms’ events	(1,986)
	- Announcements that contain events not related to metaverse businesses (e.g., changes of executives, financial performance such as earnings, dividend payments)	(16,327)
Step 3	Less: Announcements with duplications	(1,789)
	Less: Announcements of the unlisted firms	(1,004)
	Less: Announcements of the overseas firms (based on the US stocks)	(660)
	Less: Announcements missing CRSP data	(3)
Final Sample Size		352

agement staff changes (e.g., hiring or retiring of executives) or financial announcements (e.g., dividend payments) were excluded from the data. Third, we removed 16,327 news data that are irrelevant to metaverse. As a next step, we removed 1,789 duplicated announcements, 1,004 announcements by the unlisted firms, 660 announcements by overseas firms (based on the US stocks), and 3 announcements with missing CRSP data.

Ⅴ. Empricial Method: Event Study

We adopt the event study method to measure whether the metaverse initiative announcement has an abnormal impact on the firm's stock price. According to the literature, the event study is "a reliable method to determine whether there is an abnormal stock price effect associated with an unanticipated event, and the researcher can infer the significance of the event from this determination" (McWilliams and Siegel, 1997). The event study method has become widely used in IS field because it considers the necessity to analyze accounting-based measures of profit.

The event study method calculates cumulative abnormal return (CAR) to measure the significance of the events. Positive CARs mean most shareholders perceive that events might impact on the firm's value in a positive way, however, negative CARs mean shareholders have negative perspectives about the impact of the event on the firms' valuation (Yang *et al.*, 2012). This research followed the conventional process applied in previous IS event studies. In the event study, using a short time window might reduce the possibility of a confounding effect than a long time window so that the market's response can be analyzed more clearly (Konchitchki and O'Leary, 2011). Also, for estimation window, wide range of dates, from 120 trading days (roughly six months) to 255 trading days (roughly one year) are generally used in IS studies. Therefore, this study set the event window from -1 day (the day before event) to +1 day (the day after event), with 255 days of estimation window.

We calculated abnormal return (*AR*) and *CAR* as follows. $R_{ft} = \alpha_f + \beta_f R_{mt} + \epsilon_{ft}$, where R_{ft} is the daily return of share price of firm *f* on day *t*, R_{mt} is the market return on day *t*, α_i is the intercept term, and ϵ_{ft} is the random error term, with E(ϵ_{ft}) = 0. $AR_{ft} = R_{ft} - (a_f + b_f R_{mt})$, where AR_{ft} is abnormal return of *f*th firm for the time period *t*, R_{ft} is actual return of *f*th firm for the time period *t*. The three-day return for the sample of *N* firms is calculated over days -1 to +1, where day 0 is the day of the announcement. This yields *CAR* as $CAR = \frac{1}{N}\sum_{i=1}^{N} CAR_f$, where $CAR = \sum_{f=-1}^{1} AR_{ft}$. As the event window and estimation window are specified, *CAR* and the variance of *CAR* are calculated as follows: $\mathrm{var}(CAR) = \sum_{f=-1}^{1} \mathrm{var}(AR_{ft})$. From the equations above, we can calculate the value of average *CAR* (ACAR) as follows: $\overline{CAR} = \frac{1}{N}\sum_{f=1}^{N} CAR_f$, $\mathrm{var}(\overline{CAR}) = \frac{1}{N^2}\sum_{i=-1}^{1}$ $\mathrm{var}(AR_{ft})$, where *N* is the number of samples in the study.

To calculate the statistical test of *CAR*, this study specified a cross-sectional regression model. This model helps to validate the hypotheses proposed in this research. The model uses the value of *CAR* as a dependent variable and 6 factors as independent variables which are illustrated in hypothesis development. The specified model in this study is described as follows:

$$CAR_i = \mathrm{Constant} + \beta_1 FS_i + \beta_2 \mathrm{EXP}_i + \beta_3 META_i + \beta_4 INFRA_i + \beta_5 RAD_i + \beta_6 INCR_i + \beta_7 SER_i + \sum Year_i + \epsilon_i$$

CAR_i is the dependent variable which refers to cumulated abnormal return about the metaverse initiatives of firm *i*. This research adopted the event window for *AR* as day -1 to day +1.

For the independent variable, FS_i indicates firm size of each firm. This variable is calculated as natural log-transformed total $assets_{t-1}$ one year prior to the announcement year. EXP_idenotes prior experiences in hypothesis 3. These two variables are belong to firm-specific factors. $META_i$ denotes metaverse enabler in hypothesis 4, and $INFRA_i$ denotes common infrastructure in hypothesis 5, which belong to technology factors. RAD_i denotes radical innovation strategy in hypothesis 6, and $INCR_i$ denotes incremental innovation strategy in hypothesis 7. For control variables, indicates whether the firm that is included in the business service industry sector which is categorized by SIC code. Also, we controlled each announcement year because 2021 was the year of metaverse boom, so the samples of each year might be different. We used a dummy variable for the control variables, both service industry sector and announcement year. <Table 3> shows the industry composition of the news data, which shows the biggest percentage (65%) in service industry.

〈Table 3〉 Industry Composition

SIC code	Industry	Number (%)
23	Apparel and other textile products	1 (1%)
30	Rubber and Miscellaneous Plastics Products	1 (1%)
33-36, 38-39	Machinery, electronic, equipment	14 (19%)
48	Communications	4 (6%)
50	Wholesale trade-durable goods	1 (1%)
65	Real estate	4 (6%)
73, 78 - 79, 82, 87	Service	45 (65%)

〈Table 4〉 Variable Description

Variable	Description	Measurement
CAR	The cumulative abnormal return for Metaverse of firm *i* over day +1 and day +1	CAR_i
Firm size (*FS*)	Natural log-transformed total ; the total asset was collected from COMPUSTAT	$LNAT_{t-1}$
Prior Experiences (*EXP*)	Whether the firm has previous experience on VR technology or AI technology which is related to metaverse	1 = with prior experiences; 0 = otherwise
Metaverse enabler (*META*)	Whether the firm announced Metaverse enabler technologies in the news (i.e. NFT, crypto, VR devices, avatars)	1 = with metaverse enabler; 0 = otherwise
Infrastructure (*INFRA*)	Whether the firm announced common infrastructure technologies in the news (i.e. semiconductors, AI, cloud, 5G)	1 = with infrastructure; 0 = otherwise
Radical innovation (*RAD*)	Whether the firm announced the news with radical innovation such as acquisition or pivoting	1 = with radical innovation; 0 = otherwise
Incremental innovation (*INCR*)	Whether the firm announced the news with incremental innovation such as partnership or investment	1 = with incremental innovation; 0 = otherwise
Service industry (*SER*)	Whether the firm *i* belongs to service industry; 1 if firm *i* is in the service industry; 0, otherwise	1 = service industry; 0 = otherwise
Announcement year (*Year*)	The year of announcement for firms' meaverse initiatives	1 = announcement year; 0 = otherwise

Specific details of the variables are described in <Table 4>. Each variable description is based on a thorough review of full-text news data. Every news data includes initiatives related to new improvements, and we repeatedly check each news item to categorize them for each variable. For example, the news title 'Nike Launches Nikeland on Roblox' showcases a partnership between Nike and Roblox. In this case, we treat this news as an example of incremental innovation for both firms: Nike and Roblox. Also, if the news contains multiple contents in the full-text, we check each one for each variable. For instance, news articles like 'Apple buys virtual reality company NextVR' are categorized as metaverse enablers because they initiate VR technology, and they are also classified as radical innovation because Apple acquired a new firm.

Ⅵ. Empirical Results

<Table 5> shows the average standardized *CAR*s for the ranging of event window day -1 to day +1. The table shows that market reaction to the metaverse initiative is positive by the CARs. Therefore, hypothesis 1 was supported.

〈Table 5〉 The Average Standardized Cumulative Abnormal Returns

Windows	Sample size	t-value
(0,1)	352	2.538**
(-1,1)	352	2.564**
(-1,0)	352	1.872*

*, ** Significant at the 0.10 and 0.05 levels, respectively.

<Table 6> shows the descriptive statistics about the variables in the analysis. Among 352 total samples, 149 samples (42%) were regarded as firms with prior experiences, 99 samples (39%) have a metaverse enabler technologies, and 69 samples (20%) have a common infrastructure technologies. For strategy factors, 109 samples (31%) have a radical innovation (i.e., acquisition, pivoting) and 104 samples (30%) have incremental innovation (i.e., investment, partnership). For the control variables, 225 samples (64%) are identified as the sample of the service industry. For the announcement years, year 2019 has 71 samples, year 2020 has 85 samples, and 2021 has 196 samples.

〈Table 6〉 Descriptive Statistics

Variables	Min	Max	Mean	Std dev
CAR	-0.238	0.483	0.006	0.064
FS	0.786	5.563	3.732	1.396
EXP	0 (N = 149)	1 (N =203)	0.423	0.494
META	0 (N = 99)	1 (N = 253)	0.281	0.450
INFRA	0 (N = 69)	1 (N = 283)	0.196	0.397
RAD	0 (N = 109)	1 (N = 243)	0.310	0.462
INCR	0 (N = 104)	1 (N = 248)	0.295	0.456
SER	0 (N = 227)	1 (N = 125)	0.645	0.479

With the calculation of the stock market evaluation on metaverse initiatives, we analyzed a cross-sectional regression of the *CAR*s clustered by firm level. As reported in <Table 4>, the value of CAR is effective in the overall time window. This model is significant by *F*-statistics ($F = 2.68$, $p < 0.001$).

〈Table 7〉 Regression Results

Variable	Coefficient	Std. error	P > | t |
FS	-0.002	0.003	-0.79
EXP	-0.012	0.007	-1.74*
META	0.018	0.009	2.05**
INFRA	0.017	0.007	2.51**
RAD	0.017	0.008	2.19**
INCR	0.005	0.007	0.76
SER	-0.012	0.007	-1.69*
YEAR 2020	-0.003	0.103	-0.31
YEAR 2021	-0.003	0.008	0.33
Constant	0.011	0.010	0.63

Note: *, ** Significant at the 0.10, 0.05 levels, respectively.

The OLS results are reported in <Table 7>, indicating that four out of six independent variables are associated with the *CAR* value, which is *EXP* ($p < 0.10$), *META* ($p < 0.05$), *INFRA* ($p < 0.05$), and *RAD* ($p < 0.05$)－H3 (i.e., *EXP*) was marginally supported at the 10% level, and H4 – H6 are strongly supported.

To figure out which technology is specifically deriving a positive impact among metaverse-enblers (*META*), we conduct additional analysis and the result is repored in <Table 8>. Among various technologies in metaverse-enablers (e.g., VR device, avatar, NFT, crypto), we divided them to specific two categories: virtual environment (*ENV*), and virtual monetization (*MON*). *ENV* includes technologies that establish the virtual environment that can provide users to feel immersion (e.g., VR device, digital twin). On the other hand, *MON* includes technologies that enable virtual economy such as trading, earning money, or guaranteeing own properties in the virtual environment (e.g., NFT, crypto, creators' platform). This classification is based on the Deloitte report, "The Metaverse Overview: Vision, Technology, and Tactics" (Deloitte, 2022).

〈Table 8〉 Regression Results about Specific Technologies

Variables	Coefficient	Std. error	P > | t |
FS	-0.002	0.003	-0.79
EXP	-0.012	0.007	-1.74*
ENV	**0.024**	0.008	**2.94****
MON	**0.017**	0.015	1.16
INFRA	0.017	0.007	2.51**
RAD	0.017	0.008	2.19**
INCR	0.005	0.007	0.76
SER	-0.012	0.007	-1.69*
YEAR 2020	-0.003	0.103	-0.31
YEAR 2021	-0.003	0.008	0.33
Constant	0.011	0.010	0.63

Note: *, **, *** Significant at the 0.10, 0.05, 0.01 levels, respectively.

MON shows no relevant association with CAR value, however, *ENV* shows strong significance in particular ($p < 0.01$). Therefore, we can conclude that virtual environment (*ENV*) has a positive impact on the *CAR* value in metaverse enabler categories, rather than virtual monetization (*MON*).

We conducted the correlation analysis between explantory variables, and we found that the highest value is 0.561. We also examined the variance inflation factors (VIFs) and none of the values were greater than 2.07. Taken together, we did not find multicollinearity problems in our dataset.

Ⅶ. Discussion

This study analyzed the market reaction to metaverse initiatives with the event study method. We find that metaverse investments lead to a positive firm's value in the stock market. Specifically, the market reacts positively to metaverse initiatives with technological factors, and radical innovation factors. <Table 9> shows the test results and key findings of hypotheses.

From a firm-specific perspective, firm size does not significantly affect the firm's value. However, we can estimate a negative flow by the coefficient value even though it is not significant. Also, the firm's prior experience has a negative effect on the *CAR* value at the 10% significance level. From this result, we can estimate that prior experience, such as VR or AR, does not have a positive impact on stock reaction, and even firms without experience might have a positive reaction in some degrees. Therefore, hypothesis 2 is not supported, and hypothesis 3 is marginally supported.

From a technology perspective, both technologies－metaverse enablers (e.g., VR devices, NFT, digital twin) and common infrastructure (e.g., semiconductor, 5G, AI)－show a significant association with positive market reactions ($p < 0.05$). Thus, hypotheses 4 and

〈Table 9〉 Findings of Hypotheses

Hypothesis	Constructs	Hypothesis test	Key findings
H1	Market value of Metaverse	Supported	Metaverse investments lead positive market reaction.
H2	Firm Size (FS)	Not Supported	Firm size does not have direct impact on positive returns.
H3	Prior Experience (EXP)	Not Supported	Prior experience (e.g. VR, AR) of a firm doesn't have a positive impact on market reaction, and even firms without experience have positive returns in some degree.
H4	Metaverse Enabler (META)	Supported	Investing in technologies such as NFT, VR devices or avatars can impact positive returns on stock market.
H5	Common Infrastructure (INFRA)	Supported	Establishing infrastructure (e.g. semiconductor, AI, 5G) can create firms' positive value.
H6	Radical Strategies (RAD)	Supported	Pivoting or acquisition create positive value on Metaverse stock market.
H7	Incremental Strategies (INCR)	Not Supported	Partnership or investment don't directly impact a firm's value in Metaverse perspective.

5 are well supported. Also, we conducted additional analysis for which specific technology in metaverse business has a more positive effect on a firm's value. We categorized metaverse enabler technologies into two specific categories, which are virtual environment and virtual monetization. We found that virtual environment (e.g., VR devices) is regarded as significant technologies, however, virtual monetization (e.g., NFT, crypto) shows no relevant association with market reactions. From the results, we can estimate that technological factors are important, especially environmental factors.

From a strategic perspective, radical innovation (e.g., pivoting, acquisition) shows significant association with market reactions in a positive way ($p < 0.05$). Incremental innovation (e.g., partnership, investment), on the other hand, is not statistically significant with market value. In conclusion, hypothesis 6 is supported, but hypothesis 7 is not supported.

For control variables, the service industry is negatively significant at the 10% level. This result indicates that firms from other industries (e.g., electronic devices) can derive more favorable market reactions rather than the service industry.

Ⅷ. Conclusion

This research suggests several theoretical and managerial implications. First, from a theoretical perspective, this study shows the empirical result based on a resource-based view of the metaverse context especially about IT capabilities. From the perspective of RBV and IT capabilities, this study extends the boundary of the study about IT innovation and business phenomena in IS field. Consequently, this research can contribute to the IS research in establishing the concept of business phenomenon about the newly arising concept of "metaverse."

Also, there are various studies about business impacts of metaverse. However, there were lack of empirical studies on metaverse which measure the value of financial market. This study can broaden the knowledge about metaverse by empirically analyzing metaverse initiatives to prove business impact on the stock market.

Third, this study also refers to previous literature on virtual world to build the theoretical concept and compare with the traditional virtual world with metaverse (Animesh *et al.*, 2011; Yang *et al.*, 2012). However, these studies were based on the previous

virtual world (e.g., SecondLife), which was popular more than 10 years ago. So, it cannot reflect the recent metaverse context (e.g., Roblox, Zepeto) which is a far more developed version of the virtual world with more sophisticated infrastructure (e.g., VR devices, NFT).

Compared to previous literature on virtual worlds, where the emphasis was on constructing short-term strategies to maximize market reaction (Yang *et al.*, 2012), this study presents a different perspective, highlighting the greater importance of developing fundamental technologies over implementing incremental short-term strategies. These distinctions underscore that the primary differentiation between metaverse and the traditional world primarily revolves around technological advancements. Furthermore, the traditional virtual world has a shortage of IT technological resources; thus, there has been an emphasis on the importance of securing additional organizational resources for the development of proprietary IT systems (Yang *et al.*, 2012). This research has practical implications for analyzing organizational resources to address the research gap in the context of virtual worlds. It also highlights the technological advancements in metaverse.

From a practical perspective, this study provides preliminary factors of metaverse that can affect an organization's value from firm-specific, technological, and strategical capabilities. This study provides implications to managers of each organizations in IT technology fields. The result of the research can give a conceptual advice to help managers to understand key resource factors that affect the stock market and the beneficial use of metaverse initiatives. Basically, managers can attempt new IT innovations about metaverse based on the result that announcing metaverse initiatives can get positive market reactions from investment perspectives. Announcements about metaverse initiatives can be an effective way to get attention from investors and shareholders.

Second, the results of the study provide the importance of technological factors in metaverse business. Both metaverse enablers and common infrastructure show a significant impact on a firm's value with strong association. Therefore, managers can focus on the technological part for IT innovation when considering metaverse business. In specific, we analyzed detailed technology categories inside metaverse enablers, and found that technologies about virtual environment (e.g., VR device, digital twin) show high association, therefore, we can assume that establishing virtual environment is of particular significance in this stage. Establishing immersive metaverse environment can capture the game-players, who are a majority of metaverse users in the recent stage. Virtual monetization, on the other hand, still can be considered as volatile asset because it does not have enough history in this stage. Therefore, a controversy about security problems or availability about digital monetization (e.g., NFT, crypto) can be the obstacle for innovation. Consequently, the findings can provide comprehensive knowledge and advice for organizations to build their own strategy for metaverse business.

Third, this study suggests a strategic advice to managers in the industry. We found that radical innovation can derive positive market reactions, on the other hand, incremental innovation does not significantly affect market reactions. Therefore, managers can consider IT investment in radical ways, such as pivoting or acquisition, rather than incremental ways. As discussed in hypothesis development, we can assume that metaverse business is in the early stage of evolution. However, managers or investors should consider that the radical paradigm of metaverse might have already been finished at this moment as time passed. Therefore, it is important to adopt adequate strategies at the right time regarding the evolutionary phases.

This study also has some limitations, which also can be opportunities for future research. First, the data period can be a limitation. Establishing metaverse initiatives cannot be completed in just a few years because ultimate metaverse is regarded as “perfectly replicated version of the real world.” It is the very early stage of the metaverse progress so that 3 years from 2019 to 2021 can be the period to cover metaverse initiatives. Additionally, metaverse keywords were boomed in the second half of 2021, which can be conflicted with the other data from 2019 and 2020. This research tried to cover this limitation by collecting various keywords about metaverse related technology and firms. Therefore, future studies can attempt relevant research with longer periods and bigger sample that can cover the progress of metaverse innovation.

Finally, by adopting the event study method, market value is measured only by the stock price. That means these whole findings are basically based on investors’ perspectives. However, in the real world, young generations are the majority of metaverse users. This study aimed to explore various resources in order to identify the core components of the metaverse, but there are still unresolved questions concerning its actual user base. Therefore, this limitation can be a huge challenge for future research to resolve.

In conclusion, from the resource-based perspective, we studied the relationship between market reaction and metaverse investment from an investor and shareholder’s view. Metaverse initiatives are deriving positive market reactions, therefore, metaverse business has the potential to grow bigger in the future. Although the recent metaverse shows further development compared to the previous virtual world, it is still in the early stage of full-version of metaverse. Therefore, the result of this study also can be a preliminary study about metaverse. We hope more innovative and constructive ideas to appear in metaverse business in the future.

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How Market Reacts on the Metaverse Initiatives? An Event Study

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Abstract

Due to the COVID-19 pandemic, lots of occasions need to be held in online environment. This is the reason why "Metaverse" gets lots of attention in 2021. A number of companies made announcements on Metaverse, and this situation also boomed stock market. This paper investigates the relationship between Metaverse initiatives and business value of the firm (i.e., stock prices). We examine this relationship by using event study method with Lexis-Nexis News data from 2019 to 2021. The results indicate that Metaverse initiatives significantly impact positive influence on firm's value. In the technological perspective, technical factors affect more positive market returns, including Metaverse enablers (e.g., NFT, VR devices, digital twin) and common infrastructure (e.g., semiconductor, AI, cloud), and especially virtual environment was emphasized. Additionally, in the strategical perspective, radical innovation (e.g., pivoting, acquisition) impact more positive market return rather than incremental innovation (e.g., partnership, investment). Also, firms from non-service industries can achieve benefits from Metaverse initiatives rather than service industry in some degree.

Keywords: Metaverse, Virtual World, Resource-based View, IT Capabilities, Event Study, IT Innovation

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