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Private Equity Investments in Virtual Reality Technology: Valuation Dynamics Across Different Stages

Qianyi Chen[1,a,*]

[1]*School of Accounting, Liaoning University of International Business and Economics, Dalian, 116052, China*
a. 2022102177@luibe.edu.cn
**corresponding author*

Abstract: Accompanied by the rapid development of digital technology in recent years, virtual reality (VR) technology is the inevitable trend of modern development. Virtual reality technology mainly refers to the use of digital technology to build a world beyond reality, to achieve a kind of interaction between the virtual world and the real world of the living space. The combination of the virtual world and the real world has always been a hot topic that human society has always been concerned about. This paper focuses on the different stages of private investment in the development of virtual reality technology and the changes in valuation through these stages as well as some advantages and disadvantages of these valuation methods for the VR industry. This paper focuses on the four stages of development experienced by the VR industry, what products are available in these four stages and some of the contributions made by these products. These four stages correspond to the private investment, valuation analysis of the four stages, this paper discusses with three valuation methods (PEG valuation method, market present rate valuation method, and price-to-sales (PS) valuation method). The enterprise value and market capitalization of some well-known VR companies outside China are unfolded, pointing out that for such a high-risk and high-growth industry as VR, sometimes there may be no equivalence. This article stands in the investor's point of view to think about whether some private investment in VR industry should be reasonable.

Keywords: Virtual Reality Technology, Private Equity Investment, Valuation

1. Introduction

Virtual reality technology is a computer simulation system that emerged in the 20th century. Divided into four phases, virtual reality technology is briefly summarized as the ideation phase, the embryonic phase, the initial conceptual and theoretical formation phase, and the refinement phase [1]. The hallmark of virtual reality is technologically multisensory immersive realism, the earliest future expectations of virtual reality in Star Trek: the creation of a whole new world to immerse the user in a completely fictional room [2]. Some of the industry developments in virtual reality technology in recent years are mainly in: reconstructing virtual environments and cultural heritage, exploring the experience of virtual environments, combining the real with the unreal to improve efficiency, and interacting with virtual environments for learning and education. Virtual reality technology has been

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in development for more than 40 years, but as of now it is still a new industry and it still has a lot of promise for its development [3].

At present, there is a lack of statistics on the type of VR users consume, and some data are mostly concentrated in the fields of art and literature, games, education, etc., with less involvement in some industries such as science and technology and medical care [4]. Some investment data is also limited to film and television, game industry, valuation analysis is also more one-sided. Early VR was powered by mobile phones, with different brands of smartphones competing with each other for access to virtual reality. Current systems mixed reality systems use HMDs and are designed to be used mainly for business, production industry, education, and gaming. Virtual reality has a different texture than some non-immersive experiences, but the risk of face-collar is minimal and some necessary safeguards are put in place before collaborative projects [5]. In addition to considering the user's sense of experience, it is more important to study how the system is developed, whether the result of the development is good or bad, whether it will destroy some human morality, whether it will make the customers have some mental illnesses that can't distinguish between the virtual and the real, and be too addicted to the unreal [6].

This paper is mainly to explain some private investment and valuation performance of virtual reality technology at various stages, and at the same time to find suitable investment direction for this industry in some previous overviews, and to give some feasible investment suggestions for this industry.

2. Valuation Performance at Various Stages of Virtual Reality Technology

2.1. Conceptualization and Early Development

In 1838, viewing pictures through a stereoscope gave users an immersive experience. The first with virtual technology was invented in 1929 the first flight simulator, played a key role during World War II, but then used in the military did not trade as a commercial business, early virtual technology does not exist in the industry investment in private investment. Investment should not only look at the development prospects of the industry, but also to combine the current market, technology and other external conditions, and in the enlightenment thought stage of the development of a great prospect, but the market range is very small, immature technology and a series of factors lead to the virtual reality technology did not get the development it deserves [7].

2.2. Emerging Technology and Research

When it comes to VR, the first person who comes to mind is Ivan Sutherland, who is known as the ‘father of computer graphics’ and ‘father of virtual reality’, but there was another person before him, Morton Heilig. But there was another figure before him, Morton Heilig, who personally designed the prototype Sensorama 3D simulator in the earliest days of virtual technology, which was developed into a new type of gaming machine by companies that wanted to put it on the market. However, due to the high cost of investment, the return on profits was too low at the time to formally develop this stopped [8]. 1953, based on Morton Heilig's research, 3D film industry large-scale emergence, from the game machine to the film industry across the virtual technology of the idea stage gradually formed [9].

2.3. Commercialization and Growth

Virtual Reality technology began in earnest in 1968 with the introduction of the Virtual Reality Headset (HMD) by Ivan Sutherland, the first VR/AR head-mounted display [10]. By the 1980s, it was most common for open-source vendors to use virtual reality technology in the gaming field and

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the military, but there was only a small trend because of the large amount of investment in manufacturing and overhead costs and the large gap in experience compared to mature technologies. In 1979, McDonald Douglas Company applied virtual reality technology to the company's enterprise technology, forming a diversified development [11]. The company developed the VITAL helmet is the first commercial use of virtual reality technology products. In 1987, the U.S. VPL company founder Jaron Lanier first proposed the 'virtual reality', virtual reality technology officially entered the development stage. Virtual reality technology is closely commercially linked to the gaming industry, but most of it is commercially traded in the educational, military, and medical fields [12].

2.4. Mature Market and Integration

Nintendo's three forays into VR led into the 1990s, when virtual reality technology had its first real high point, and it was after this that VR was heavily commercialized and integrated with multiple industries. In the gaming sector, for example, Nintendo was and still is at the forefront of the industry.

Nintendo's three forays into VR have contributed to virtual reality technology in varying degrees.

Stage 1: Nintendo was the first to launch the Virtual Boy console, but it was withdrawn from the market after only six months on the market, with only 770,000 units sold worldwide. To summaries the reasons for the Virtual Boy's failure: it was limited by technology at the time. The color palette was not as good as that of the 'PS series'. The visual effects, coupled with poor user feedback and high price, were once described as a complete commercial failure [13, 14]. Because the future of the industry is not yet known, many investors do not have confidence in this new industry and consider it risky and do not have great confidence in the VR industry. Private equity and venture capital are especially important at this time, but considering the technology, market, and capital, virtual reality technology has not been well developed [15].

Stage 2: In 2019, Nintendo went online with the Nintendo Labo VR Kit, which was the second VR technology product after the Virtual Boy. Facing an audience that is generally younger, a study used the level of participation and interaction between teachers and students, the results are not the most important, the process of learning and the accumulated experience to reflect the advantages brought by VR [16]. For this stage of the VR industry, it can be called a technical industry, there have been a lot of VR products, enterprises in the middle of the development of the need for equity investment, the market has been successful cases, private investment is only a little bit of a limitation, but does not affect the industry's development of the direction of financing and profitability optimism [16].

Stage 3: In 2020, Mario Kart Live set the game scene to real life, compared to the previous two VR games, this reform is very successful. For investors, they are more interested in the return on investment and internal rate of return, which is not only a matter of metrics, but also lies in the short-term and long-term development, how much can be returned in the short term, in for their own investment in the next step in the planning. Financial modelling techniques need to be used to analyze the conditions of inputs, costs, investments, valuations, profits, etc. at each stage from the start of the investment to commercial development to maturity. There are some potential risks during the development period, which investors claim to consider [17].

3. Valuation Analysis

The valuation method of VR industry will be different compared to the traditional industry, VR industry belongs to the technology industry, the proportion of intangible assets will be relatively large, the magnitude of the change in earnings is unstable, mainly rely on the level of technological capabilities to develop, there is no excessive historical data and other characteristics, so some common traditional valuation methods may not be perfectly applicable [18]. The methods available

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for the VR industry include PEG valuation method, market-to-present valuation method, P/S market-to-sales valuation method and other valuation methods. When a virtual technology company first goes public, it is a great test for investors. Because many emerging industries have a common problem is: early investment capital is too large, but the short-term cannot profit even to the mid-development for the enterprise valuation cannot be predicted, which cannot guarantee the interests of investors [19].

The process of valuing a business is a process of estimating and analyzing the overall economic value of the business. The internal value of a business is important to investors, and the inability to understand the value of a business can lead to a situation where the share price is not equal to the value of the business. Efficiently estimating the value of the enterprise and proposing a reasonable feasible development plan for the enterprise is the right direction to protect investors. For the VR industry, which relies on technological development, the traditional valuation method will have some defects and disadvantages [20]. From the shareholders' point of view, profit maximization is the basic objective, and it is fundamental to maximize shareholder wealth and maximize enterprise value. In the case of a constant number of shares, the value of the stock determines the extent to which shareholder wealth can be maximized [21]. VR industry again in recent years there are many financing situations, different financing methods will lead to changes in equity value, but the value of the enterprise during the valuation of the constant. The bonds issued by the enterprise should be able to reflect its own social image and brand value, and strive to maximize the rights and interests of investors, in order to maximize the value of the enterprise as much as possible, the equity value and bond value should have the maximum degree of protection [22].

$$Enterprise\ Value = Equity\ Value + Bond\ Value \tag{1}$$

The P/E ratio can show the market value and net profit of a company, and the current VR industry can still be valued by the P/E ratio, and is still in the steady growth stage.

$$Price\text{-}to\text{-}Earnings\ Ratio = \frac{Market\ Capitalization}{Net\ Profit} \tag{2}$$

The P/E ratio is more suitable for the VR industry than the P/E ratio, and is more widely used in companies that are high-risk investments. The P/E ratio reflects the investor's assumptions and analyses of the company, and gives a clearer picture of whether the company is investable or not.

(1) PEG valuation method: This is one of the more common methods used by financial analysts for growing companies that have a lot of room for growth in the future. Market multiples, cash flows and most commonly price earnings P/E are often used. The price-earnings ratio (PE) of the enterprise can only reflect the value in the current stage, PEG can combine the return received in the present with the possible return in the future, only if the value of PEG is greater than 1, the return that the enterprise can receive can be higher than the market value, for the investment this way of valuation approach can help them to solve some of the unnecessary risks, and put the money into the enterprise with lower risk [23].

$$Price\ Earnings\ to\ Growth\ Ratio = \frac{Price\text{-}to\text{-}Earnings\ Ratio}{Net\ Profit\ compound\ growth\ Rate} \tag{2}$$

(2) Market Present Rate Valuation Method: Cash flow reflects the profitability of a company, then the market present rate can more accurately reflect the value of a business, the internal rate of return (IRR) of a business is such that the net present value of cash flow is equal to 0 [24]. The smaller the market present rate of a business, it also means that this is a greater increase in capital per share. The lower the market present rate of a business for an investor to invest in, the easier it is to get the cost in the short term and the lower the risk.

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$$Price\ Cash\ Flow\ Ratio = \frac{price\ per\ share}{Operating\ Cash\ Flow\ per\ share} \quad (3)$$

(3) Price-to-sales (PS) valuation method: investors are willing to invest in companies with a low price-to-sales ratio when the cost of inputs is small, which is the preferred choice of most people - investing at a low price, even if it is a business that may lose money, without taking into account other indicators [25].

$$Price\text{-}to\text{-}sales\ Ratio = \frac{share\ price}{Sales\ per\ share} \quad (4)$$

Table 1: Comparison of Valuation Metrics for Overseas VR Companies.

Ranking	Code	Company	Market Capitalization	P/E ratio	P/B ratio	Enterprise Value (Including Money Funds)
1	MSFT.O	MICROSOFT	1787806825409.68	34.84	13.73	1848329825409.67
2	AMZN.O	AMAZON	1579043071567.39	74.03	16.91	1610859071567.38
3	PTC.O	PTC	15445841572.14	130.06	10.33	16433698572.14
4	AAPL.O	APPLE	20944.83	32.76	31.63	2206525856960.00
5	GOOGL.O	GOOGLE	14037.01	34.86	6.31	1420534996938.22
6	FB.O	FACE BOOK	8087.67	27.75	6.30	808766742783.51
7	QCOM.O	QUALCOMM	1521.00	22.61	20.61	167864120000.00
8	SNE.N	SONY	1309.71	23.21	3.41	155829693963.42
9	AMD.O	AMD	1001.31	40.21	17.15	100418067143.67
10	OLED.O	OLED	108.57	82.02	11.90	10857282445.23
11	OMR.DF	OMRON	5,299,425.51	17.74	—	52994235.51
12	0GRX.L	HEXAGON	20,404,083.13	36.29	—	21,611,641.94
13	6501.T	HITACHI	31,112,699.81	59.61	—	49,174,725.44

Data source: Asset Information Network & Millennium Investment Bank

In Table 1, enterprise value is the value number of total assets created by a company, the total market capitalization represents the total value of the company's shares. Under normal circumstances market capitalization and enterprise value are closely related, with enterprise value determining the internal indicators of a company's market value and market value reflecting the external performance of enterprise value. For a high-risk, high-growth investment sector such as the VR industry, many of the partners are large institutional investors, most of whom use venture capital to raise funds, and while many of the venture-backed companies have ended up failing, there have been some success stories. By the end of 2021, several of the largest U.S. companies by market capitalization received most of their early funding from venture capitalists (Apple, Microsoft, Amazon, Google, Facebook). Investors have to make a judgement call on whether the business should be invested in based on market conditions. In an established market, a company's enterprise value is generally able to be reflected in the market, and the market capitalization equals the enterprise value. Investors are most interested in the value that a company can create, as this is the most intuitive way to show it on the books and in the money they can get. However, in some emerging industries - the VR industry, which is still in the continuous development stage - market capitalization and enterprise value are sometimes not equivalent, and sometimes even the opposite, so some companies need to do market value management. That the market value of the company can reasonably and accurately reflect the value of the enterprise and maximize the value of the company [26]. Shareholder wealth (market capitalization) = number of shares * share price. When the estimated value of the stock > market price, the market capitalization will also increase; on the contrary if it is lower than the market price, the

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market capitalization will decrease. Investors will invest when they think that the market capitalization of this business is at the desired value in their mind.

At present, according to the current development trend (see Table 2), Nintendo's annual net profit shows an upward trend. the development prospect of VR industry is immeasurable. Nintendo's net profit for the last 20 years, with corresponding products from different periods.

Table 2: Comparison of Valuation Metrics for Overseas VR Companies.

year	period	Net Profit JPY	Exchange rate of the United States dollar at that time	Net profit in US dollars ($million)	Average net profit in US dollars ($million)
2001	GBA+NGC	106,444	131	813	637
2002	GBA+NGC	67,267	118	570	
2003	GBA+NGC	33,194	107	310	
2004	GBA+NGC	87,416	102	857	
2005	NDS+WII	98,378	101	974	1879
2006	NDS+WII	174,290	119	1465	
2007	NDS+WII	257,342	111	2318	
2008	NDS+WII	279,089	90	3101	
2009	NDS+WII	228,635	93	2458	
2010	NDS+WII	77,621	81	958	
2011	3DS+WIIU	43,204	77	561	112
2012	3DS+WIIU	7,099	86	083	
2013	3DS+WIIU	23,222	105	221	
2014	3DS+WIIU	41,843	119	352	
2015	3DS+WIIU	16,505	120	138	
2016	3DS+WIIU	102,574	116	884	
2017	Switch	139,590	112	1246	2932
2018	Switch	194,009	109	1780	
2019	Switch	258,641	108	2395	
2020	Switch	480,376	103	4664	
2021	Switch	477,691	115	4154	
2022	Switch	432,768	131	3304	
2023	Switch	420,000	141	2979	

4. Conclusion

Through the study, this paper finds that virtual reality technology in the growth stage still belongs to the emerging industry, for the VR industry such as high-risk industries, some of the traditional valuation methods are not applicable to combine with the current market situation to estimate the future development of the enterprise, the ultimate goal of the enterprise is to maximize the wealth of shareholders and maximize the value of the enterprise as the fundamental, investors should be based on the changes in market value to want to invest in the enterprise to determine whether to invest or not. This paper analyses the investment situation of VR companies using three valuation methods: PEG valuation method, market-to-present valuation method, and market-to-sales (PS) valuation method, and analyses and predicts the net profit of Nintendo over 20 years, using Nintendo as an example. For some emerging companies in the VR industry, there are cases where the enterprise value will cause the share price and enterprise value to be unequal, but these cases are few and have little impact on the overall situation. Some of the planning and prediction of the enterprise are for the better development of prospects, some of the rights and interests of investors can give the greatest protection. Although virtual reality technology has matured a lot more than in previous years, but the prospects

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of the VR industry is still very large, there is no efficient integration with some industry development, some initial development has been achieved, the future can be more in-depth research in a number of areas.

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