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Measuring videogame publishers' stock returns to announcements, beta versions and general releases of Esports in comparison to Traditional videogames

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Abstract

This dissertation studies the impact on the stock prices of videogame publishers generated by three moments of Traditional videogames and Esports development: announcement, beta release and general release.

Due to being recent phenomena, the research around videogames and, more specifically, Esports is scarce. We contribute to the existing literature by studying which event generates most of the return to investors. We also study the market's reaction towards Traditional videogames and Esports to understand which type of videogame generates higher returns. Using an event-study methodology based on the market model, supported by a model-variation robustness test based on the CAPM, we analyse the impact of 198 events on the stock prices of eight videogame publishers between July of 2009 and June of 2020.

We find that the announcement of Traditional videogames generates the highest cumulative abnormal returns, which is obtained by holding the investment for ten days. The best option to achieve the highest daily average cumulative abnormal return is to opt for a day-trade on the beta release date of Traditional videogames. We also find that investors should avoid investing in the general release of videogames, independently of the videogame's type. Finally, we find that the market's reaction is always more favourable - and often only favourable - towards Traditional videogames compared to Esports.

JEL-codes: G14; Z23

Keywords: Event Studies; Announcements; Sports

Resumo

Esta dissertação estuda o impacto nos preços das ações de empresas que desenvolvem e publicam videojogos gerado por três momentos de desenvolvimento de Videojogos tradicionais e *Esports*: Anúncio, Lançamento da versão beta e Lançamento da versão final.

Por serem fenómenos recentes é escassa a investigação científica em torno de videojogos e, mais especificamente, de *Esports*. Com esta dissertação, contribuímos para a literatura existente ao estudar qual momento e qual tipo de videojogo gera maior retorno para os investidores. Para tal, utilizamos uma metodologia de estudo de eventos com base no modelo de mercado, suportada por um teste de robustez de variação de modelo baseado no CAPM. Analisamos o impacto no preço das ações de oito empresas que desenvolvem e publicam videojogos, decorrente de 198 eventos observados entre junho de 2009 e junho de 2020.

Concluímos que é o momento do anúncio de videojogos tradicionais que gera os maiores retornos anormais acumulados, sendo estes obtidos ao manter o investimento por um período de dez dias. A melhor opção para obter o maior retorno anormal acumulado médio diário é optar por um *day-trade* na data de lançamento da versão beta de videojogos tradicionais. Concluímos também que os investidores devem evitar investir no lançamento da versão final de videojogos, independentemente do tipo de videojogo. Por fim, descobrimos que a reação do mercado é sempre mais favorável (e muitas vezes apenas favorável) em relação a videojogos tradicionais em comparação com *Esports*.

Códigos JEL: G14; Z23

Palavras-chave: Estudos de evento; Anúncios; Desporto

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1. Introduction

In 2020 the Videogame and Esports industries were valued at USD 159.3 billion and USD 24.9 billion, respectively (Ahn et al., 2019; Newzoo, 2020b). Esports teams' valuations are rapidly increasing, with the most valuable team being close to reaching a value of USD 500 million. (Forbes, 2020b). Remarkably, an industry worth USD 70.6 billion in 2012 has, since then, more than doubled in value, presenting a compound average growth ratio of over 10% for the last eight years (Statista, 2020b). Maybe even more remarkable is the announcement from the International Olympic Committee to include Esports under the umbrella of Olympic-licensed events, with the creation of the Olympic Virtual Series (International Olympic Committee, 2021).

Videogames are now everywhere, from consoles, desktops, and laptops to the smartphones that we carry in our pockets. At the same time, they are more connected than ever, allowing players to compete or cooperate in real-time and share and compare their achievements, among many other possibilities (BBC, 2020).

Videogames and Esports are, however, very recent phenomena, fostered by the development of more powerful and affordable hardware components, as well as by the broader access to faster and more stable internet connections. By looking back only 15 years ago, we would see a different reality, where videogames were played mainly offline, putting players versus the so-called "bots", which were nothing more than computer-controlled non-playable characters. The videogame market was dominated by products intended to be played offline and that had an expected gameplay duration, i.e., there was only a specific number of missions, a campaign, or a career to be completed. As soon as this was achieved, the consumer could repeat the same videogame or invest his time in another product. Videogames that follow this concept, independently of having online features, are, throughout this paper, what we will refer to as Traditional videogames.

As a shift from the paradigm of Traditional videogames, we have witnessed the growth of a new concept within the videogame industry during the last decade: Esports.

Esports consists of a highly competitive, performance-focused, award-distributing model, pushing the best players to the status of professionals, with some achieving six-digit contracts and millionaire prizes based on their in-game performance and attractiveness to sponsors.

This model is designed to work on an online competitive basis, with match-making algorithms that will put players or teams with similar skill-level playing against each other. Nowadays, almost all of the most successful videogames are Esports (Newzoo, 2020d), with titles such as *League of Legends* (2009), *Counter-Strike: Global Offensive* (2012), *Rocket League* (2015), and *Fortnite* (2017) generating billions in revenues for videogame publishers and millions in prizes for the best players. As explained by Collis (2020), some of the most successful Esports display "SCAR factors", which stands for Skill, Community, Accessibility, and Reward. These factors contribute to Esports' popularisation and help the industry grant their fans' prolonged engagement by developing videogames that are easy to understand and try but difficult to master.

Despite the fast-paced growth of videogames in general and even faster-paced growth of Esports specifically, the amount of scientific research available on the topic is still very scarce. While reviewing the available scientific literature, we have noticed that the vast majority of existing papers were published during the second half of the last decade and that the research in the areas of Finance and Economics represents a small portion of what has been studied so far (Reitman et al., 2020).

We believe that investors can benefit from having more profound knowledge about the moments in which the market incorporates information about new videogames and significant differences between returns generated from Traditional videogames and Esports. To the best of our knowledge, no studies have been conducted to investigate potential abnormal returns due to the announcement and testing versions of videogames, and only one paper investigated the abnormal returns generated on the general release date. Such a combination of factors – a successful growing phenomenon and a scarcity of investigation about it – creates an interesting opportunity to fill the knowledge gap.

To address this gap, we analyse the impact of three key events of the software development cycle on the stock prices of eight videogame publishers listed in the United States of America, Japan, and France. The three key events are the announcement, the beta release, and the general release date. We have collected 198 events spread across the period between July of 2009 and June of 2020, subdivided into 72 announcements, 54 beta releases, and 72 general releases. Using an event-study methodology over the collected data, we investigate two research questions. First, do markets react differently to Traditional videogames' events and

Esports' events? And second, announcement vs beta release vs general release: which event generates the highest return to investors?

Our goal with the first research question is to understand if the market shows different expectations towards the value creation from Traditional videogames compared to Esports. Our interest in this relates to the existence of substantial differences between these two types of videogames, especially concerning the revenue models and consumer engagement. The purpose of the second research question comes from the fact that the three events in our study have different and well-defined characteristics, each one of them bringing different types of information. The announcement provides non-empirical information, in the sense that players cannot experience the videogame, but they get to know the title, characters, storyline, game modes, among others. The beta version brings empirical information because players experience the gameplay, the videogame's performance, and the graphics' quality. Finally, the general release brings information about the stability, quality and flawlessness of the videogame. Our purpose is to draw a conclusion about which event most positively impacts investors wealth.

In response to the first question, we find that the market shows a clear preference for events related to Traditional videogames compared to Esports. Our results show that Traditional videogames generate higher returns in almost all event windows for any event. Regarding the second question, we find that it is the announcement of Traditional videogames that generates the highest cumulative abnormal return, creating an opportunity for an investor looking for short-term investment (in the case of this paper, 11 days). We also find that the highest daily average return comes from doing a day-trade on the beta release of Traditional videogames by acquiring stock when the beta version is launched and selling at the close of the market.

In the following sections, we present our findings in greater detail. Section 2 contains a detailed literature review on videogames, Esports, and the announcement of new products. Section 3 describes the methodology used. Section 4 details the timeframe and sample under study. Section 5 reports our results and findings. Section 6 summarizes the conclusions, limitations, and suggestions for future research.

2. Literature review

2.1. Video Gaming

2.1.1. Videogame's concept

A Videogame[1] can be defined as a game in which the player controls moving pictures on a screen by pressing buttons (Online Cambridge Dictionary, 2020b). Some attempts to define the concept are found within the literature, such as Esposito (2005) and Tavinor (2008). To be considered a videogame, the object under analysis needs to qualify as a game, must be playable, must have an electronic system with computing capabilities, input devices (e.g., mouse and keyboard), and output devices (e.g., screen and speakers) (Esposito, 2005). Aditionally, Esposito (2005) refers to a possible storyline but concludes that this is not a *sine qua non* condition for a videogame to be considered as such. The author presents *Tetris* (1985) as an example due to the abstract environment in which the videogame unfolds.

The definition in Esposito (2005, p. 2) is:

"A videogame is a game which we play thanks to an audiovisual apparatus and which can be based on a story."

Tavinor (2008) proposes a set of conditions that best defines videogames. Not all conditions are individually necessary, but they are sufficient for a videogame to be considered as such when correctly combined.

The definition provided by Tavinor (2008, p. 11) is:

"X is a videogame if it is an artefact in a digital visual medium, is intended primarily as an object of entertainment, and is intended to provide such entertainment through the employment of one or both of the following modes of engagement: rulebound gameplay or interactive fiction."

In this paper, we consider videogames as software developed to be played on smartphones, tablets, consoles, laptops, or desktops played individually or in a team and online or offline.

[1] There is an ongoing discussion about the term, specifically about the correct form of its written presentation: "video game" or "videogame". Throughout this paper, the nomenclature adopted is "videogame", as it is widely accepted and used in scientific literature and technical articles.

2.1.2. Videogames' history

In 1952, British professor A.S. Douglas recreated tic-tac-toe in digital format as part of his doctoral dissertation at the University of Cambridge. Six years later, William Higinbotham developed *Tennis for Two* (1958). The first videogame that could be played in multiple computer installations was *Spacewar!* (1962), developed in what was a high-capacity computer by Steve Russel (American Physical Society, 2008; History Channel, 2019).

The first home console was the Magnavox Odyssey, developed by Ralph Baer in 1966, designed initially for military training. This attempt was deemed unsuccessful, and in 1972 the concept was adjusted to fit Americans' homes (Cohen, 2020).

The 1970s and 1980s brought the arcade systems, and some of the most iconic videogames in history were born, such as *Space Invaders* (1978), *Pac-Man* (1980), and *Street Fighter* (1987). By 1995, the top-5 arcade videogames measured by revenue had generated around USD 12 billion, strongly contributing to the expansion of the industry (Rignall, 2016).

In 1995 one of the major revolutions in video gaming history occurred, with the first 3D video games' commercialisation. Opening the new millennium, Sony launched PlayStation 2 (2000), which has become the best-selling videogame console of all time. In 2005 and 2006, three top players disputed their share of the market with the launch of the first consoles of the Modern Era. Microsoft's Xbox 360 (2005), Sony's PlayStation 3 (2006), and Nintendo's Wii (2006) brought major improvements compared to the previous generation, with increased computing power and support for motion capture (GameDesigning, 2020; History Channel, 2019).

Nowadays, videogames are accessible to anyone with a smartphone, tablet, console, laptop, or desktop. Videogames of several different genres are released daily, for different platforms, some paid and some free. Videogames are also highly connected, with players being able to have their records and results' historic saved in the cloud. The introduction of smartphones made videogaming an activity that is now seen with less prejudice and is more socially accepted, increasing the industry's importance (Chang et al., 2013). The videogame business is evaluated in 2020 at USD 159.3 billion, with mobile gaming (smartphone and tablet) having the most significant contribution at 49% (Newzoo, 2020b).

2.1.3. The contemporary videogame industry

Today, videogames are everywhere, from smartphones in our pockets to large venues with several thousand spectators cheering for their favourite team up until international TV channels including ESPN, TBS, and CBS (Forbes, 2020a). The industry, which in 2012 was valued at around USD 70.6 billion, is worth USD 159.3 billion in 2020, representing a Compound Average Growth Rate (CAGR) of 10.7% across the last eight years and a 9.3% growth on a year-on-year basis (Newzoo, 2020b; Statista, 2020b).

Mobile gaming is now the primary source of income for videogame publishers. In 2020 this industry segment was expected to generate USD 77.2 billion from the 3.5 billion smartphone users worldwide (Newzoo, 2020c). This dominance from mobile platforms is attributable to increasing smartphone penetration across the globe and increasing demand for tablets due to the advantages to gaming brought by larger displays (Grand View Research, 2020). Mobile gaming dominance is expected to increase, given the low entry barriers to mobile gaming (due to lower hardware and software costs) and the lower impact that the Covid-19 crisis has on mobile videogames' development due to their lower complexity (Newzoo, 2020b).

Console gaming occupies the second position in generated income, representing 28% of the market, corresponding to USD 45.2 in revenues. Growth in this market is deemed to have peaked in 2018 in anticipation of the new generation of consoles in 2020. The launch of Sony's PlayStation 5 (2020) and Microsoft's Xbox Series (2020) is expected to boost the segment's growth, given that, on top of the expected millions of units sold worldwide, plenty of new videogames are being developed for these platforms. Additionally, the enabling of in-game footage sharing and the more extensive availability of high-end displays and sound systems contribute to the forecasted continued growth of this segment (Grand View Research, 2020; Newzoo, 2020b).

2.2. Esports

2.2.1. Esports' concept

The word "Esport"[2] refers to the activity of playing computer videogames against opponents, often for money, and often watched by spectators using the internet, sometimes at specially organized events (Online Cambridge Dictionary, 2020a). One of the first publications to use the term was a press release from 1999, where it was used to compare Esports and traditional sports (Wagner, 2006).

Esport was, back in 2006, defined by Wagner (2006, p. 3) as follows:

> *"Esports is an area of sport activities in which people develop and train mental or physical abilities in the use of information and communication technologies".*

This definition was a pioneer in Esports studies, but it soon triggered some criticism from the following research. It was considered too broad by Hamari & Sjöblom (2017) and simplistic because it makes little reference to the intricated connection between the player and the computer-based platform (Witkowski, 2012). In this paper, we consider a significantly narrower definition of Esports.

For someone unfamiliar with the Esports culture, it is a common mistake to understand the concepts of "videogaming" and "Esports" as the same thing. The former consists of playing any videogame, with this being facilitated by an online or offline structure. The latter has a much more specific scope, being a competitive player vs player or team vs team videogame, where the focus is to beat an opponent during one or more matches with a defined duration, played either online or in local-area-network (LAN) competitions (Llorens, 2017). Esports are played by amateur or professional players, often under organized seasonal leagues and tournaments, where players can belong to organized, third-party sponsored teams (Hamari & Sjöblom, 2017). Esports should not be confused with regular, recreational gaming, being instead organized videogame competitions (Jenny et al., 2017). As a logical exercise, one can

[2] The coining date of the term is not precise since it was a neologism created by the actors involved in the Esports' culture development. From an etymological perspective, similarly to how the aggregation of the words "Electronic" and "Mail" resulted in "Email", the aggregation of the words "Electronic" and "Sport" resulted in "Esport". Despite the ongoing discussion about how the word should be spelt (with the most popular options being Esport, E-sport, eSport, and e-Sport), for the sake of consistency, the adopted spelling across this dissertation will be "Esport", following the decision from the American Associated Press Esports Insider (2017).

look at Esports as a videogaming component, meaning that all Esports belong to the videogame culture, but not all gaming or videogames qualify as Esports.

In this paper, the definition considered for Esports is the one from Ahn et al. (2019). This choice comes from the need to consider the whole market of Esports, i.e., all its players (from amateurs to professionals), its spectators, and the companies providing them with the hardware and software to play. The consumers define the popularity and consequent success of a videogame, and therefore could not be excluded from the scope of Esports.

2.2.2. Esports' history

The concept of competing for the best score or performance was born almost simultaneously with videogames themselves. Videogames such as *Space Marines* (1962) and *Pong* (1972) were played on a standalone basis and have helped to develop the industry into what it is today (Bányai et al., 2019). The integration of online and LAN support to videogames in the 1970s and its development in the following decades allowed videogames to accommodate more players, team-play, dedicated servers, and a permanent track-record of users' information, such as the number of wins/losses and ranking (Deloitte & The Esports Observer, 2019).

One of the first documented videogame competitions happened in October 1972, when a couple of dozens of students gathered at Stanford University to compete for the victory in one of the first videogames ever developed, *Spacewar!* (1962). Less than a decade later, in 1980, Atari launched the Space Invaders Championship, having received more than 10,000 competitors to fight for the win on the Atari 2600-based videogame (Li, 2017).

The nineties were the decade that established the foundations for what the culture is today. The development of personal computers (PC) allied to the increasingly higher quality of internet connections and LAN environments shifted the competition model to player vs player instead of players vs computer (Chikish et al., 2019; Molgaard & Mac, 2018). During this decade, Esports became widely appreciated in South Korea, where competitive videogame communities started to flourish around the most popular videogame genres, such as First Person Shooters, Real-Time Strategy, and Massively Multiplayer Online Role-Playing Games (Bányai et al., 2019; Wagner, 2006).

After the year 2000 and up until today, Esports have been growing faster year after year. The reasons for this rapid growth are the increased consumer literacy and popularity of computer videogames, the evolution of the internet and digital platforms, the ability to compete or

cooperate with multiple players, and the capacity to offer an immersive experience (Seo, 2013). Esports has become a global phenomenon, attracting millions of new viewers every year, enlarging the genres available, and offering ever-growing financial opportunities such as prize-pools, salaries, and sponsorships, among others (Deloitte & The Esports Observer, 2019; Hollist, 2015).

2.2.3. The contemporary Esports' industry

As mentioned in the *2020 Global Esports Market Report* (Newzoo, 2020a) and by Ahn et al. (2019), the concept of the "Esports industry" can have different definitions, which will lead to different figures in terms of earnings, sales, fan base engagement and growth, and, ultimately, market size.

We follow the concept found in Ahn et al. (2019), and therefore we consider amateur players as part of Esports, as well as streamers and all consumers that play videogames classified as Esports. Additionally, based on Ahn et al. (2019), other stakeholders should be considered when evaluating the current's market size, such as hardware developers (e.g., Razer, Nvidia, Intel), videogame publishers (e.g., Electronic Arts, Konami) and support software developers (e.g., Discord, Team Speak). Based on this concept, Esport's market is valued at USD 24.9 billion in 2019. According to the study, Game publishers control Esport's revenues with a market share estimated at 64% of total industry revenues.

According to Esports Charts (2020), in 2019, Esports accumulated, over all the videogames classified as such, a total of 1.8 billion hours watched. *League of Legends* (2009) broke the record for peak viewership, with nearly four million viewers during one of 2019's World Championship semifinals. Several other Esports videogames registered record peak viewerships in their most important tournaments, such as *Fortnite* (2017) (2.3 million spectators), *Free Fire* (2017) (2 million spectators), and *Dota 2* (2013) (1.9 million).

Dota 2 (2013) is the Esport with the highest figures in terms of prize pools. In *Dota 2's* world cup "The International", the prize pool surpassed USD 34 million in 2019. The world cup finals for *Fortnite* (2017) distributed total prizes above USD 30 million in 2019, and in 2021 *Playerunknown's Battlegrounds* (2017) distributed USD 7 million (Esports Earnings, 2020). As a comparison, the 2019 US Open (Tennis) and the 2019 World Series Poker, which are both the highest paying tournaments of their discipline, had prize pools of USD 62 million and USD 47 million, respectively (Statista, 2020a).

2.3. Studies on videogames and Esports

2.3.1. Videogames and Esports

Videogames have a relatively short history, and their relevance in society has seen a sharp increase only during the last decade. Consequently, research is scarce, although it has significantly increased in the last years due to the concept's popularisation.

Some papers have worked on the definition of Esports and assessed the possibility of classifying Esports as traditional sports. In Wagner (2006), Esports have their first published definition. The author broadly defines the concept, quoted before in this work, and interestingly explores the concept of virtual high-performance teams, which is the case nowadays. A decade later, Esports are defined as amateur and professional videogaming, often coordinated by leagues and tournaments, where players belong to teams sponsored by business organizations (Hamari & Sjöblom, 2017). A more specific definition of Esports came in the following years, where they are described as organized competitive video gaming played on a computer, console, or mobile device (Jenny et al., 2017). Mangeloja (2019) brings professionalization to the concept, maintaining the elements of competition, organization, and video gaming. Within this body of literature, research has been conducted around the possibility of considering Esports as a traditional sport. In this area, the opinions tend to cluster around the idea that Esports are not sports, given the lack of physicality and whole-body development (Hallmann & Giel, 2018; Jenny et al., 2017; Parry, 2019).

The research on the economics of videogames is focused mainly on the revenue models of the stakeholders involved in the business, from videogame publishers to players. Davidovici (2014) analyses the pay-to-play (P2P) and free-to-play (F2P) revenue models, as well as hybrid models, focusing on the rationale of each model from consumers' and producers' perspectives. By defining the components and drivers of the two first revenue models, the author provides insight into each model's advantages and disadvantages. No significant conclusions are drawn from this paper, given that its purpose is to explain each model's architecture and help decision-makers choose between them. Marchand and Hennig-Thurau (2013) analysed, among other things, the business models within videogames (paid, hybrid and free) and in-game advertising, which is present in the three models. The paper supports that a critical challenge for F2P videogames lies in the pricing strategy of in-game items. F2P videogames should be able to gather a large player-base and to have the ability to set prices of in-game items in a way that grants the highest number of sales without compromising the

rarity of paid items. In similar research, Wu et al. (2013) identify several direct network effects, concluding that F2P videogames will maximize their revenues when the network effect of the videogame is high (large player base), and the negative effect of the in-game items is low (i.e., the ideal balance between sales and item rarity is maintained, using price as the controller factor).

Esports live streaming has also received relevant attention from literature, with some papers written about the topic during the last four years. Hamari and Sjöblom (2017) focused on the motivations for watching Esports, concluding that knowledge acquisition about the specific Esport played, new teams entering the competitive scene, and the aggressiveness showed between players contribute positively to spectatorship. Qian, Wang, et al. (2020) added the motivations of skill improvement and vicarious sensation. Johnson and Woodcock (2018) investigated the streaming platform Twitch, analysing live streaming from the perspective of a) videogame reviewing, b) a method to increase a videogame's visibility, and c) a tool to expand the reach of gaming development knowledge. The findings indicate that live streaming has reshaped gaming reviews, allowed independent videogames to reach extraordinary success, and can be an important development in the gaming industry. Qian, Zhang, et al. (2020) found that Esports-specific characteristics of live streaming (i.e., characteristics not applicable to traditional sports, such as chat room, streamer traits, stream quality and virtual rewards) can influence the consumers' behaviour.

To the best of our knowledge, the research dedicated to stock performance and stock price reactions is very scarce. Suh and Lee (2011) evaluated stock price reactions in the South Korean online videogame industry. Their research shows that continuous technological innovation makes a difference in the industry, putting independent publishers and developers at a substantial disadvantage. Another interesting finding is that casual videogames, which are more straightforward than Traditional videogames and Esports in general, generate stronger market reactions in the short term. Abramova (2013) has investigated the stock price reaction on the video gaming industry to M&A, dividends, and videogame releases using an event-study methodology. The results showed that M&A generated a positive reaction on stock prices, dividend payments generate negative returns, and that on the general release date, new videogames generate negative abnormal returns to investors, especially if these videogames are new and not sequels.

From the literature reviewed, Abramova (2013) is the only paper that investigated stock returns to investors on the videogame release date. Although the author investigated dividends and M&A, our focus is on the tests performed over the stock returns generated by the release of new titles. Abramova found significant negative abnormal returns across almost all event windows and almost all sub-samples around the release date of some of the most waited videogames between April of 2007 and April of 2013. In her study, videogames releases are subdivided by Rating ("Mature"; "TEEN"; "Everyone"), Game ("New"; "Sequel") and Made ("Out-sourced"; "Self-made"), while in our paper videogames are split by type of videogame, i.e., "Traditional videogames" and "Esports". Abramova (2013) uses the publication of videogame reviews as a potential explanation for the negative returns generated on the general release date. The author refers to an article from Reuters where a link is established between below-expectation reviews and stock prices decrease. That link remains valid for the above-expectation reviews, which have a positive stock prices impact as a consequence. This reasoning is presented as a potential cause, but the author has not tested a correlation between reviews and returns. Hermansens and Bratli (2016) examined the release of 611 videogames and found that the impact on stock prices originated by third party reviews is limited to good reviews, while bad reviews do not affect stock prices alone. This finding goes against the reasoning presented by Abramova (2013) to justify the negative returns on the general release date.

As a possible explanation for the negative results found by Abramova (2013), we hypothesize the stock price decrease relates to the expectations from investors of error-free versions and, consequently, a lower level of tolerance towards technical issues in the final version of the videogames. From the announcement until the general release, the market gradually receives information about the videogame and incorporates it into the stock price. At the general release date, the focus and expectation of the market are no longer on the available features of the videogame, or gameplay, or storyline, because information about these characteristics has been already provided by the beta version and other disclosures made by the videogame publishers. We argue that the focus of investors will then be on the reaction from the market to the first days of sales, which are impacted not only by third-party reviews but also by discussion and comments on social media, opinions in specialized magazines and public sentiment overall. Collecting data to analyse market sentiment towards a release of a new videogame exceeds the resources that we have available, and therefore we have no way to quantify it. However, we find support in the literature on loss aversion within the scientific

area of Behavioural Finance. The loss aversion theory (Kahneman et al., 1991; Tversky & Kahneman, 1991) states, among other things, that investors tend to overvalue the downside of information. At the general release date, the market has already been exposed to large amounts of information about a videogame, which it has then incorporated into the stock price of the respective videogame publisher. Based on this, we argue that investors will not react to positive information on the general release date of a videogame because the positive expectation towards the videogame was already reflected in the stock price. On the opposite direction, in case of negative news at the general release date, investors will tend to overreact to avoid losses, which will ultimately bring stock prices down.

Therefore, based on the findings from Abramova (2013) and the theoretical framework provided by the loss aversion theory, our null[3] research hypotheses are:

- Traditional videogames do not generate returns on general release;
- Esports videogames do not generate returns on general release.

2.3.2. Announcement and testing of new products: Theoretical framework

This paper examines the three essential moments of the software development cycle of new videogames, which are, in essence, new products. Based on this, literature that studies the impact on investor wealth generated by the announcement, testing and release of new products can bring valuable input to this literature review. A common expectation would be that, in general, new products bring positive returns to investors, based on the assumption that companies pursue options that will increase their value and, ultimately, investor's wealth.

In the case of announcements, this expectation seems to be confirmed by most of the literature on the topic. Chaney et al. (1991) conducted an event study over 1,101 events across ten years and have found that the market reacts positively to the announcement of new products in opposition to the announcement of updates. Chen et al. (2002) focused on the strategic interaction between competitors to determine if announcements of new products generated abnormal returns. Their findings suggest that companies that compete in strategic substitutes (which is the case of new videogames) have a positive effect on the announcement. In contrast, companies competing in strategic complements show an

[3] For the null hypotheses, the respective alternative hypotheses are Traditional videogames generate negative returns on general release and Esports videogames generate negative returns on general release.

insignificant effect on the announcement. Lee and Chen (2009) studied a sample of 409 new product announcements and concluded that companies that introduce new products do enhance shareholder's value, as long as they are equipped with the necessary marketing resources to promote and market the new products. Natarajan et al. (2010) found, over a sample of 75 announcements, that the market perceives as positive the announcement of new products, while the abandonment of products and delays in production are negatively perceived. Lin and Chang (2012) examined the relationship between corporate governance and market response to the announcement of new products between 1997 and 2004. The researchers found that the announcement of new products was generally associated with significantly positive abnormal returns. Their results also demonstrated that corporate governance-related traits of companies were related to the size of the abnormal returns, namely a smaller board size, greater board independence, more independent audit committee, higher CEO equity incentives, more analyst coverage and greater shareholder rights.

The list of scientific research covering the topic goes on, and in general, there is strong evidence that the announcement of new products generates positive returns, although some papers suggest that evidence is inconclusive. To the best of our knowledge, only one study has been performed on new videogames' announcements. Suh and Lee (2011) investigated the stock returns of South Korean companies at the announcement date, having concluded that there were no significant returns generated from these announcements. That paper, however, is focused on the South Korean market only and captures a timeframe between 2004 and 2009, when the relevance and size of the industry were significantly smaller than today. As a result, to the best of our knowledge, no paper investigated the announcement of videogames on a global level, and this paper aims to do precisely that.

Based on the above, our null[4] research hypotheses are:

- Traditional videogames do not generate returns on the announcement;
- Esports videogames do not generate returns on the announcement.

[4] For the null hypotheses presented, the respective alternative hypotheses are Traditional videogames generate positive returns on announcement and Esports videogames generate positive returns on announcement.

From the three moments of the software development process covered in this study, the beta release or demo release (concepts are different, but as explained further ahead, these two are treated as the same in this study and referred to as "beta release date" or "beta release" from now on) comes after the announcement. We could not find any paper to have investigated abnormal returns or impact on stock prices resulting from beta or demo versions.

The software's beta version will generally provide a large amount of information about the functionalities, look, and usability. In the specific case of videogames, the beta version works nowadays as both an operational and marketing strategy under a win-win framework.

From an operational perspective, videogame publishers allow consumers (called at this stage beta testers) to test their videogames for free, giving them the chance to experience in the first place the upcoming title. In exchange, they receive automatically generated reports or manually written feedback providing insight about potential issues and suggestions to enrich the videogame's quality. This approach eases the development process and allows videogame publishers to tackle a higher number of problems without investing resources in in-house testers.

From a marketing perspective, the beta release is interesting as well for both parties. As soon as a videogame's beta version is released, social networks get flooded with articles, news, videos, and discussions about the testing version of the new title, which spreads information about the upcoming videogame for the benefit of the videogame publishers. At this point, the customers' focus is on the videogame's functionalities and look instead of on the technical imperfections and instability that the videogame may still show. This condescendence towards potential problems is related to the nature of the beta itself because beta versions are expected to have minor issues, and their existence is supported precisely on the knowledge that problems may exist and should therefore be identified and fixed. This results in higher flexibility and tolerance from the market towards the beta version than to the general release, which is expected to be error-free. From the perspective of beta testers, the release of a beta version allows them to play the videogame and create content for their platforms, such as YouTube, Twitter, or Twitch, allowing them to generate advertising income and capturing the attention of potential new followers.

It is, therefore, acceptable to assume that in general, due to: a) the fast and broad diffusion of different types of content about the upcoming title on social networks b) the large amount of information that beta versions provide in terms of graphics, storyline and gameplay and c) the market tolerance to potential technical problems, the returns expected in association to this event are positive.

Our null[5] research hypotheses for beta releases are then:

- Traditional videogames do not generate returns on beta release;
- Esports videogames do not generate returns on beta release.

Finally, we investigate two additional hypotheses to evaluate if reacting to all three moments of the software development would yield positive or negative returns to an investor on any event window. This hypothesis is particularly interesting to understand which videogame type generates the overall highest return to investors. Based on our expectation of positive returns on the announcement and the beta release and negative returns on the general release, we hypothesize that the cumulation of the three moments does not generate statistically significant returns to investors. The third event would partially or more than offset the returns of the first and second events. Therefore our null[6] research hypotheses are:

- Traditional videogames do not generate returns;
- Esports videogames do not generate returns.

[5] For the null hypotheses presented, the respective alternative hypotheses are Traditional videogames generate positive returns on beta release and Esports videogames generate positive returns on beta release.
[6] For the null hypotheses presented, the respective alternative hypotheses are Traditional videogames generate returns and Esports videogames generate returns.

3. Methodology

3.1. Event study

We use an event study methodology over our sample. This methodology has become a popular method amongst researchers, which, based on the assumption of market efficiency, measures the impact of an event or series of events on the price and transaction volume of securities, and, consequently, on the wealth of firm's security holders (Binder, 1998). On a more specific scope, this is the case of the analysis of new information in the context of corporate disclosures (Alves & Teixeira Dos Santos, 2008). Its purpose is to identify potential abnormal returns generated by the events under study.

3.2. Normal and abnormal returns

To measure an event's impact on stock prices, a way to measure the abnormal return is necessary. As defined by Campbell et al. (1997), the abnormal return is the actual *ex-post* return of a stock throughout the event window minus the firm's expected return over the event window.

The actual return corresponds to the *ex-post* returns on any day t. In this paper, daily closing prices are used for all Esports and Traditional videogames stocks i. Using daily closing prices p of each stock i for day t (p_{it}) and $t-1$ (p_{it-1}), the daily rate of return R for day t (R_{it}) is defined as the continuously compounded return

$$R_{it} = ln\left(\frac{p_{it}}{p_{it-1}}\right).$$

Using a similar approach for any market index j in any day t, the daily continuously compounded rate of return is given by

$$R_{jt} = ln\left(\frac{p_{jt}}{p_{jt-1}}\right).$$

Therefore, the abnormal return of a stock i on date t (AR_{it}) is represented by the difference between the *ex-post* return (R_{it}) and the expected return for that date $(E(\mathrm{R}_{it}))$, which is given by

$$AR_{it} = R_{it} - E(R_{it}).$$

The estimation of the expected rate of return is explained next.

3.3. Estimation procedure and interval

For each event studied in the final sample, an estimation window that captures the 120 calendar days before the beginning of the event window is computed. The expected return of stock i on day t $\left(E(\mathrm{R}_{it})\right)$ is its expected return based on the market model

$$E(R_{it}) = \alpha_i + \beta_i RM_{it}\,, t = \{-125, \dots, -6\},$$

where α_i and β_i are obtained by OLS and represent the average return from a specific stock compared to the market's average and the stock's market risk, respectively. RM_{it} represents the return of the market where stock i is listed during period t. Period t corresponds to the estimation interval, explained in detail further ahead.

This paper also uses the CAPM as the model to perform the model-variation robustness test presented further ahead. Similarly to the procedure followed with the market model, we use the CAPM to estimate the expected return of any stock i on day t $\left(E(\mathrm{R}_{it})\right)$. To do so, we compute the expected return as

$$E(R_{it}) = R_{ft} + \beta_{it}\left(ER_{mt} - R_{ft}\right), t = \{-125, \dots, -6\},$$

where R_{ft} represents the risk-free rate of return at time t, ER_{mt} the expected return on the market portfolio at time t and β_{it} the stock's market risk. Period t corresponds to the estimation interval, explained ahead.

Three different market indexes are used as proxies for the market performance, corresponding to the main indexes of the markets in which the videogame publishers are listed. The companies analysed in this dissertation are listed in France, Japan and the United States of America. As a result, the market indexes used are the CAC, NIKKEI, and NASDAQ.

The cumulative abnormal return (CAR) of any given stock i on any given day t (CAR_{it}) corresponds to the value of the sum of AR_{it} during the event window, as per below

$$CAR_{it} = \sum_{t \in \omega} AR_{it},$$

where ω represents the range of each event window measured in days.

3.4. Statistical significance test

A significance test must be applied to validate and demonstrate with a certain degree of confidence that, for any date, the average difference between the actual returns and the expected returns (if any) in samples studied is likely to be due to the hypothesized event's influence. The most appropriate significance test to be used depends on the characteristics of the underlying data.

For samples with a number of events $n \geq 30$, the assumption of normality in the distribution of abnormal returns can be maintained. This is the case for the hypotheses testing abnormal returns in Traditional videogames $(n = 40)$ and Esports $(n = 32)$. Based on this, a Student's t-test is applied to the actual returns compared to expected returns of each event for each event window, assuming unequal variance (heteroskedasticity).

For all the research hypotheses in this study, the null hypothesis reflects that the event produces no abnormal return, i.e., that the actual return's deviation from the expected return is not large enough to serve as evidence that the event studied is responsible for that deviation. If the t-test's p-value is significant for the relevant hypotheses, then the null hypothesis is rejected in favour of the alternative.

The t-test's value is

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sigma_d},$$

where $\bar{x}_1$ represents the mean value of the values in the first sample, $\bar{x}_2$ represents the mean value of the values in the second sample, and σ_d represents the standard deviation of the differences between $\bar{x}_1$ and $\bar{x}_2$.

The standard deviation (σ_d) is given by

$$\sigma_d = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}},$$

where n_1 is the number of values in the first sample, n_2 is the number of values in the second sample, and σ_1^2 and σ_2^2 are the variances of the first and second samples.

4. Timeframe and dataset

4.1. Timeframe

4.1.1. Period of study

The period defined for the study is the timeframe between July 1st, 2009 and June 30th, 2020. There are two main reasons for this choice.

The first is that Esports are a very recent phenomenon. The top-10 Esports measured by prize pool distributed to players were all released during or after the second half of 2009. From those, eight have been released during or after 2012. For this study, a set of 32 Esports was extracted from the list of the top 100 Esports by prize pool. These 32 Esports have as common characteristics to be available for PC, console, or both, to have publicly available information about their announcement date and general release date, and to have been published by a listed company. Having a beta release date was not strictly necessary.

The second one is the exclusion of the period most impacted by the 2007-2008 Global financial crisis. The period impacted by the recent financial crisis that resulted from the Covid-19 pandemic will not be excluded. The dataset includes only one event in this timeframe, and videogame publishers' stock prices were only mildly affected by the correction. The pandemic has increased Esports and Traditional videogames' consumption because many national sports leagues were cancelled and fans were forced to stay at home, which increased their availability to play videogames in general and Esports in specific (Ke & Wagner, 2020; Kim et al., 2020). By keeping the analysis between July of 2009 and June 2020, confounding effects arising from the turmoil related to the 2007-2008 financial crisis are significantly reduced, consequently increasing the quality of the results.

4.1.2. Event window

The moment 0 will be the day of occurrence of each event (announcement, beta release or general release). If the event happened during a weekend or public holiday, then an adjusted event date is used, which corresponds to the first day of trading after the event. The interval of study will have a total of 16 days, from day -5 until day 10, meaning the interval between five days prior and ten days after the event.

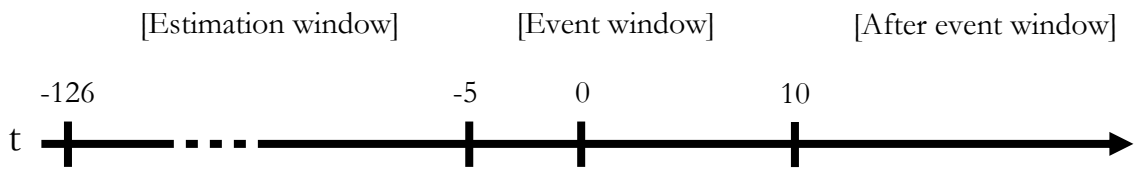

Figure 1 - Timeline of the event study

The event window is, for the purpose of testing, subdivided in 13 different windows, out of which five ([-1;0], [0;0], [0;1], [0;3], [0;10]) are presented in the "Results and discussion" section of this paper and the remaining eight ([-5;10], [-5;5], [-5;1], [-3;3], [-1;1], [0;5], [1;5], [1;10]) can be consulted in the annex.

4.2. Dataset

4.2.1. Events definition

Three moments have been collected for each videogame in the database: announcement date, beta release date, and general release date. Some videogames did not have a beta version, and therefore, for those videogames, a beta release date has not been collected. All the dates are supported by online articles, social media posts, videos, or other forms of publicly available information, with all the respective sources being mentioned in the annex. A great effort has been put into the accuracy of the event dates, given that deviations from the actual date could significantly impact the result of the event study (Brown & Warner, 1980).

The criteria to consider an announcement date as such is that the videogame publisher has shared relevant information about the videogame, such as title, main topic/storyline, gameplay footage or main features. As a marketing strategy, videogame publishers often release teasers before the official announcement, which have not been considered in this study. Teasers come in the form of images or videos that do not bring information about the videogame's name, characters, or storyline. When videogame publishers release teasers of sequels of videogames (in opposition to new videogames), the market can arguably identify the videogame and create some expectation, but this has been disregarded in this study. Therefore, the announcement date corresponds to the trading day where relevant information about a videogame is revealed to the public, independently of rumours and teasers, as long as these do not carry information about the videogame's name and topic/storyline.

For the beta release date, the criteria followed for all observations is that this event corresponds to the first open beta, closed beta or demo, in this order. Although the concepts of beta and demo are different, they have not been distinguished in this study. A beta version is released before the general release and corresponds to the complete videogame but is still in the testing phase. In this testing phase, the early adopters likely face technical issues, functionalities not working as expected, lack of stability, performance issues, among other problems. The demo's release also happens before the general release, but, in a sense, it can be seen as the inverse of the beta. We say that it can be seen as the inverse of a beta version because it contains only a tiny portion of the videogame experience (e.g., a very limited number of missions or characters, compared to the complete videogame), but technical issues are not expected. The reason to measure beta and demo as similar events is to understand if the market reacts to early, truncated, or non-definitive information about a videogame. It is essential to keep in mind that many videogames reach the beta stage before being cancelled, and therefore would be reasonable to expect a careful approach from the market at this point.

Finally, the general release is the date when a videogame is released to the public. At this date, the videogame is distributed in full and without the expectation of technical issues. For this study, the release date has been considered the first date between the release in Europe and the United States of America because often the releases happen on different days.

4.2.2. Database

A database with a list of Traditional videogames and Esports events is not readily available. The same applies to a database with a representative sample of the videogame publisher's market. Due to this, the approach followed was to create the database[7] from publicly available information.

We have based the list of Esports' events on the most relevant Esports' titles released within the study period. The source is the website Esports Earnings, which is a community-driven competitive gaming resource based on freely and publicly available information (Esports Earnings, 2020).

[7] The database is available for consultation by request done via email to up201702977@up.pt.

The first set of data collected were the events and respective dates under study, which corresponds to the Traditional videogames' and Esports' announcement, beta release and general release dates. All the titles were picked from trusted sources, such as Esports Earnings, IGN and other online specialized platforms that regularly issue information about the top titles of each year. In this paper, the relevance of an Esport is based on the cumulative amount of tournament prize pools distributed as of the 2020 year-end, given that the prize pools are a relevant part of players' income (Ahn et al., 2019) and are usually related to an Esport's dimension and popularity. Our sample contains the top Esports that were released between July 1st of 2009 and June 30th of 2020 and that were developed for PC, Console or both, that have publicly available information at least about their announcement date and general release date and that were published by a listed company.

The list of Traditional videogames' events is based on specialized websites that produce yearly articles listing the most relevant videogames. Usually, such reports come in the format of web pages, and the article's publisher assesses the relevance of the videogames. These sources guarantee independence from the videogame publishers and are recognized as authorities in technology and gaming circles.

Once a comprehensive set of titles was gathered, the respective videogame publishers' financial information was collected from Yahoo! Finance, namely daily stock prices. The list contains eight stocks, and their details can be found further ahead and in greater detail in the annex. The stocks are listed in three different stock exchanges: four are listed in Japan, three in the United States of America, and one in France. Therefore, to compute the Expected Market Return, NIKKEI's, NASDAQ's and CAC's daily stock prices have been extracted from Yahoo! Finance for the period under study. As a proxy for the risk-free rate, the yields of the three-month government bonds for the three markets mentioned before have been extracted from Yahoo! Finance.

4.2.3. Exclusions

Some relevant titles were excluded from this study, even though they fulfil all the requirements to integrate the dataset. This is because the companies that published such titles are significantly involved in other sectors than gaming. For example, Microsoft (via Xbox Game Studios) and Sony developed several titles during the period under study. However, even in 2020, where gaming reached the peak of weight in the revenues of both companies, gaming represented only 10% and 27% of total revenues, respectively. Another example is

Riot Games, the developers and publishers of *League of Legends* (2009), which is widely considered the most successful Esport ever. Riot Games is owned by Tencent Holdings, which is a listed entity in China. The weight of Riot Games in Tencent's Portfolio is only 2.3% of the group's revenues, resulting in the impossibility to draw conclusions from the study of its shares. Therefore, Riot Games was also excluded from this study.

4.2.4. Descriptive Statistics

The dataset is composed of 72 videogames, 32 classified as Esports and 40 classified as Traditional videogames. All the videogames have one announcement date and one general release date per videogame. Regarding the beta release dates, some of the videogames in the dataset did not have a beta stage as part of the software development cycle, resulting in a total of 54 observations, 30 from Esports and 24 from Traditional videogames. There is a total of 3,772 days between the first observation (12/12/2009) to the last observation (10/04/2020), under a total of 4,017 days in the study period.

The videogames in the sample have been developed by the eight listed videogame publishers shown in table 1. Of those eight companies, four are listed in Japan (Bandai Namco Games; Capcom; Konami; Square Enix Holdings), three are listed in the US (Activision Blizzard; Electronic Arts; Take-Two Interactive), and one is listed in France (Ubisoft). These companies have, on average, a market capitalization of USD 23.1 billion, 8,850 employees and annual revenue of USD 3.9 billion.

Table 1 – Details of videogame publishers

Company name	**Market Cap (USD billion)**	**Employees**	**Last FY revenue (USD million)**	**Country**
Activision Blizzard	74.9	9,500	8,086	USA
Bandai Namco	15.6	9,550	6,711	Japan
Capcom	8.7	2,988	1,059	Japan
Electronic Arts	40.6	9,800	5,537	USA
Konami	8.6	9,072	2,383	Japan
Square Enix Holdings	7.8	5,077	2,362	Japan
Take-Two Interactive	21.1	5,800	3,089	USA
Ubisoft	7.1	19,000	2,224	France

5. Results and discussion

To summarize the research hypothesis that will be discussed ahead, table 2 presents a numbered summary sorted by type of videogame in the first place and chronologically by type of events in the second place.

Table 2 – List of null hypotheses

#	Null hypotheses
H1	Traditional videogames do not generate returns in the announcement
H2	Traditional videogames do not generate returns in the beta release
H3	Traditional videogames do not generate returns in the general release
H4	Traditional videogames do not generate returns
H5	Esports videogames do not generate returns in the announcement
H6	Esports videogames do not generate returns in the beta release
H7	Esports videogames do not generate returns in the general release
H8	Esports videogames do not generate returns

5.1. Traditional videogames

Table 3 – CAR and p-value of Traditional videogames' events – market model

Event window	[-1;0]	[0;0]	[0;1]	[0;3]	[0;10]
Announcement	0.30%	0.71%	1.08%	1.10%	2.09%
	(0.254)	(0.024)**	(0.006)***	(0.037)**	(0.039)**
Beta release	0.70%	1.28%	0.97%	0.73%	0.87%
	(0.202)	(0.008)***	(0.099)*	(0.204)	(0.307)
General release	-0.08%	-0.63%	-0.30%	-0.13%	-0.62%
	(0.437)	(0.032)**	(0.23)	(0.415)	(0.263)
All events grouped	-0.87%	0.68%	1.37%	1.51%	1.15%
	(0.383)	(0.428)	(0.196)	(0.283)	(0.688)

* Significance level of 10%; ** Significance level of 5%; *** Significance level of 1%

Evidence from the empirical tests presented in table 3 suggests that abnormal returns are generated from the announcement day of Traditional videogames at least during the first ten calendar days. This result allows us to reject the null hypothesis H1 – *Traditional videogames do not generate returns in the announcement*. In the event window [0;1], we find a positive CAR of

1.08%, significant at a 1% significance level. The results are statistically significant for all the post-announcement windows tested at least at a 95% confidence level. The event window [0;10] generates the highest CAR of any event windows related to Traditional videogames, returning investors 2.09% on average. Event window [-1;0], which serves to control situations such as insider trading or information leakage, shows no significant evidence of abnormal returns ahead of the public disclosures reaching the general market.

The beta release event for Traditional videogames suggests that again the market reacts positively to the information. On the event day [0;0], we report positive abnormal returns of 1.28% at a 1% significance level, strongly suggesting that the market incorporates relevant information at this stage of the software development. Event window [0;1] returns on average 0.97% to investors, which is statistically significant at a 10% significance level. This is a decrease in CAR when compared to the event window [0;0]. Therefore we reject the null hypothesis of H2 – *Traditional videogames do not generate returns in the beta release.* The results also suggest a fast reaction from investors on the day of the event, which is then slowly corrected in the following days. Event window's [-1;0] non-significant p-value indicates no evidence of insider trading or information leaks. The non-significant p-values of event windows [0;3] and [0;10] indicate that the market's reaction is fast and significant over a short period after the event and then deaccelerates.

The general release, which corresponds to the last phase of the software development analysed in this study, yields negative abnormal returns in the event window [0,0], which amounts to -0.63% and is significant at a 5% significance level. This result allows us to reject the null hypothesis of H3 – *Traditional videogames do not generate returns in the general release.* This negative return suggests that investors react, on average, negatively to the general release of videogames to the public. These results are in line with the paper from Abramova (2013), which reported negative returns for Traditional videogames on the announcement day. Similarly to other events, there is no evidence of insider trading or information leakage.

Having analysed all events for Traditional videogames, we find that the event that generates the highest return is the announcement date, which yields positive returns in all event windows between the event date and the tenth day. Interestingly, on the event date itself, the highest return comes from the beta release, but this effect quickly loses intensity, and on the first day after the event, the results are barely significant at 10%. Lastly, the general release

impacts investor's wealth negatively, being the event that yields the lowest figure in terms of return and is only significant on the event day itself.

Finally, we present the aggregation of all events, computed by adding the event windows of the three events. To do this, we have added the expected returns of three events in one set of information and the actual returns of the three events on another set of information for any event window. Then a Student's t-test has been performed on those figures. Traditional videogames' CARs show no evidence of abnormal returns. Based on these results, the null hypothesis associated with H4 - *Traditional videogames do not generate returns* is accepted.

5.2. Esports

Table 4 – CAR and p-value of Esports' events – market model

Event window	[-1;0]	[0;0]	[0;1]	[0;3]	[0;10]
Announcement	0.13%	0.23%	0.41%	0.45%	0.21%
	(0.341)	(0.175)	(0.143)	(0.195)	(0.38)
Beta release	0.59%	0.33%	0.77%	0.72%	-0.55%
	(0.104)	(0.13)	(0.062)*	(0.145)	(0.308)
General release	0.20%	-0.50%	-0.39%	-1.21%	-2.82%
	(0.369)	(0.175)	(0.262)	(0.057)*	(0.002)***
All events grouped	0.89%	0.01%	0.80%	0.11%	-3.52%
	(0.326)	(0.987)	(0.454)	(0.933)	(0.043)**

* Significance level of 10%; ** Significance level of 5%; *** Significance level of 1%

The empirical tests performed over the announcement of Esports, presented in table 4, show no significant abnormal returns in any event window under analysis. Due to the lack of statistical significance of the results, we do not reject the null hypothesis associated with H5 - *Esports videogames do not generate returns on the announcement*.

The beta release date for Esports returns positive abnormal returns to investors during the event window [0;1], which are statistically significant at a 90% confidence level. This allows us to reject the null hypothesis H6 – *Esports videogames do not generate returns on beta release* for the event window [0;1]. Event windows [0;0] and [0;3] and [0;10] do not return statistically significant results. Similarly to what happens in Traditional videogames, the market reacts positively to the release of beta versions, although for Esports, the evidence of this reaction is significantly weaker.

The general release's CARs show a similar tendency to the CARs of the correspondent event in Traditional videogames. Ahead of Esports general releases, the event window [-1;0] does not show statistically significant results, supporting the inexistence of insider trading. Event windows [0;0] and [0;1] also do not generate abnormal returns. Despite the initial lack of reaction from the market, there is statistically strong evidence that the negative reaction builds after the event. In the event windows [0;3] and [0;10], the CAR amounts to -1.21% and -2.82% at confidence levels of 90% and 99%, respectively. These results allow us to reject the null hypothesis of H7 – *Esports do not generate returns in the general release* for the event windows [0;3] and [0;10].

Regarding the grouping of the CARs of all Esports' events, we find that these are statistically significant only in the event window [0;10], generating a CAR of -3.52% for investors at a 95% confidence level. Evidence from this sample suggests then that the null hypothesis is rejected and that Esports generate negative abnormal returns in the event window [0;10]. This negative result on the cumulation of the events can be due to the negative result generated on the window [0;10] at the general release date, which is not counter-balanced by positive results from the other events. Also, this negative result can come from the fact that by adding the three events, we ignore the two time intervals that mediate the three event windows.

5.3. Discussion

The results obtained indicate that there is a different response from the market towards events related to Traditional videogames in comparison to events related to Esports. Table 5 presents information split per type of videogame, then per type of event and finally per CAR and daily Average Cumulative Abnormal Returns (ACAR). For convenience and ease of visualization, only the results with statistical significance have been kept in table 5. All the other results are omitted.

Table 5 – CAR and daily ACAR per event for each type of videogame

Event window		[-1;0]	[0;0]	[0;1]	[0;3]	[0;10]
		Panel I - Traditional videogames				
Announcement	CAR	-	0.71%**	1.08%***	1.10%**	2.09%**
	ACAR	-	0.71%**	0.54%***	0.28%**	0.19%**
Beta release	CAR	-	1.28%***	0.97%*	-	-
	ACAR	-	1.28%***	0.49%*	-	-
General release	CAR	-	-0.63%**	-	-	-
	ACAR	-	-0.63%**	-	-	-
All events	CAR	-	-	-	-	-
	ACAR	-	-	-	-	-
		Panel II - Esports				
Announcement	CAR	-	-	-	-	-
	ACAR	-	-	-	-	-
Beta release	CAR	-	-	0.77%*	-	-
	ACAR	-	-	0.38%*	-	-
General release	CAR	-	-	-	-1.21%*	-2.82%***
	ACAR	-	-	-	-0.30%*	-0.26%***
All events	CAR	-	-	-	-	-3.52%**
	ACAR	-	-	-	-	-0.32%**

* Significance level of 10%; ** Significance level of 5%; *** Significance level of 1%

On the announcement date, the market reaction is different towards the announcement of Traditional videogames compared to the announcement of Esports. Traditional videogames generate positive returns at 5% or 1% significance levels on all post-event dates. The CAR reaches 2.09% on the event window [0;10] and up to 0.71% of daily ACAR on the event date itself. On the other hand, the market does not react to the announcement of Esports on any

event date. To our first research question, "Do markets react differently to Traditional videogames' events and Esports' events?" we find a clear reply in our results, with markets reacting positively to the announcement of Traditional videogames and showing no evidence of reaction to the announcement of Esports.

One possible reason for the strong reaction towards Traditional videogames is the number of sequels within our sample and the time between the release of each sequel. From the 40 Traditional videogames in our sample, 31 are sequels of titles that previously proved successful. We argue that a sequel of a title that already proved successful can be more attractive to investors due to the successful track record of the title's franchise. Based on Abramova (2013), the general release of new videogames yields higher returns to investors when the titles are sequels than when the titles do not have a predecessor. Additionally, none of the Traditional videogames in our sample is released yearly or with any other defined frequency, unlike 16 videogames in the Esports' sample. The interval between the release of new Traditional videogames within the same videogame franchise is always above two years, resulting in more time and resources invested in the videogame development. This is reflected in the increased number of improvements from one iteration to the next and ultimately on investors' perception of value creation.

The market again reacts with positivity to the available information at the beta release date, showing a strong reaction on day 0 towards the release of beta versions of Traditional videogames, generating the highest daily ACAR of any event and event window 1.28%. This effect loses intensity on the first day after the event, but it is still, nonetheless, significant at a 10% level. Therefore, there is strong evidence of a sharp reaction that seems to be corrected in the following days, represented here by the lack of statistical value of results in event windows [0;3] and [0;10]. We find that the reaction towards beta versions of Esports is significantly weaker. Based on our results, beta versions of Esports generate positive returns only on event window [0;1], at a significance level of 10%. These positive returns amount to a CAR of 0.77%, corresponding to a daily ACAR of 0.38%. Interestingly, the market's reaction towards this stage of the software development is again more intense for Traditional videogames than for Esports, with the former generating CAR and daily ACAR up to 1.28% on the event date. Comparing the event window [0;1], which is the only event window with significant results for both types of videogames, Traditional videogames come again on top, generating CAR of 0.97% compared to Esports' 0.77%.

The market's reaction is either not significant or negative at the general release date, depending on the event window, but the tendency is similar for both types of videogames. Traditional videogames face a negative reaction from investors on event day at a 5% significance level, and no significant reaction on the post-event windows, while Esports generate negative returns on event window [0;3] at a 10% significance level and [0;10] at a 1% significance level. These results indicate that the reaction to Traditional videogames is sharp on day 0, generating a CAR and daily ACAR of -0.63%, but evolves to a situation where the market quickly contains the negative tendency from the event date. The reaction towards Esports is, on the other hand, not verified on the event date itself but instead with increasing strength in the days that follow the event.

Finally, on an overall perspective, given by the "All events" section of table 5, there is evidence that, on the aggregation of events and windows, the market's reaction is positive towards Traditional videogames and negative towards Esports. Traditional videogames capture this positive reaction rather quickly, on event window [0;1], while Esports capture the negative reaction later and throughout a more extended period.

We hypothesize that this different reaction to Traditional videogames and Esports is mainly due to the periodicity of the release of some Esports. In our sample, we have included Sports videogames (*FIFA*, from Electronic Arts and *Pro Evolution Soccer*, from Konami) and a Shooter videogame (*Call of Duty*, from Activision Blizzard) that are released regularly. Sports videogames are released yearly, and *Call of Duty* titles, although not necessarily yearly, are released with relatively high frequency. We can find eight *FIFA* titles, eight *PES* titles, and eight *Call of Duty* titles in our sample in ten years. The announcement event always brings new information to allow the market to understand what has been improved compared to previous versions, such as new and improved functions, improved performance, new campaigns, improved graphical quality and new graphic engines. However, due to the high frequency of the release of Esports, it is likely that the market slowly incorporates its expectation of a new title into the stock price, reducing the effect on the event day.

Our second research question, "announcement vs beta release vs general release: which event impacts the most investor's wealth?" seeks to find a reply to which event generates most of the returns per type of videogame.

Based on panel I of table 5, Traditional videogames generate positive returns in two out of the three moments, announcement and beta release. Therefore, the discussion around which event generates higher returns to investors is focused on those two events.

All post-event windows generate positive returns at a confidence level of at least 95% at the announcement date. Based on table 5, the highest CAR, which amounts to 2.09%, is reported in window [0;10], resulting in a 0.19% daily average abnormal return over the 11 days of the event window. This is the highest return achieved on any window of any event and type of videogame in our study. Based on this, we find that, from a CAR perspective, an investor would be taking the best decision by investing at the moment of the announcement and holding its investment for at least ten days. There are, however, other event windows that generate higher average daily returns. We also find that, although the CAR increases as the number of days in any post-event window increases, the daily ACAR decreases with that same number of days. This finding indicates that the market reacts with higher intensity right after the event. Although the positive reaction lasts for at least ten days, there is a gradual decrease in the reaction's intensity. Therefore, from a daily ACAR perspective and considering the event windows covered in this paper, an investor looking for the best moment to invest in an announcement of Traditional videogames would have the best results by investing on day 0 and selling its position at closing of that same day.

At the beta release date, we find, as mentioned before, a strong reaction on the event date itself, reaching a CAR and daily ACAR of 1.28% that then decreases to a CAR of 0.97% and a daily ACAR of 0.49% on the event window [0;1]. This reaction on the first day is the highest single-day return found in any event throughout our study. Based on this, an investor looking for a day-trade would make the most profit by investing in the beta release of a Traditional videogame to then sell the long position at closing of that same trading day. The decision to hold the investment until the day after would still yield a positive return, but less than the day-trade mentioned before on both a cumulative and average daily perspective.

The general release returns are negative and therefore influence investor's wealth in the same manner. Based on our results, investors who acquired stock in reaction to the general release would lose -0.63% in stock value on the event date.

For an investor looking to invest in Esports specifically, the decision would be easier due to the scarcity of positive returns that we find. The only option would be to invest in the event

window [0;1] related to the beta release date. By investing in this event, based on table 5, an investor would have a CAR of 0.77% over two days, earning a daily ACAR of 0.38%. Even so, unless an investor is looking to invest specifically in Esports, the best decision is to invest in Traditional videogames instead, due to returns from Esports-related events being consistently below the returns generated by the respective events and event windows in Traditional videogames.

The general release of Esports shows a similar tendency to the one verified in Traditional videogames, returning a negative result to investors. In this case, the CAR on the event window [0;10] reaches -2.82% at a daily ACAR of -0.26%.

5.4. Robustness test

We have implemented a robustness test, specifically a Model Variation test, to support the market model results. The decision to apply a robustness test comes with the notion that econometric models are only extremely simplified depictions of reality. In the current paper, given that we have used the market model as the basis for the computation of expected returns, we will use the CAPM for the same purpose. All the significance tests were then rerun on the results obtained from the CAPM. The results are displayed in table 6.

Table 6 – CAR and p-value of all events - CAPM

Event window	[-1;0]	[0;0]	[0;1]	[0;3]	[0;10]
			Panel I – Traditional videogames		
Announcement	0.34%	0.73%	1.12%	1.18%	2.33%
	(0.225)	(0.021)**	(0.005)***	(0.026)**	(0.022)**
Beta release	0.72%	1.29%	0.99%	0.77%	0.98%
	(0.196)	(0.007)***	(0.094)*	(0.191)	(0.283)
General release	-0.05%	-0.62%	-0.28%	-0.07%	-0.46%
	(0.459)	(0.035)**	(0.249)	(0.45)	(0.313)
All events grouped	-0.75%	0.74%	1.50%	1.76%	1.86%
	(0.45)	(0.387)	(0.158)	(0.206)	(0.502)
			Panel II – Esports		
Announcement	0.18%	0.26%	0.46%	0.55%	0.49%
	(0.284)	(0.15)	(0.114)	(0.142)	(0.211)
Beta release	0.69%	0.38%	0.87%	0.91%	-0.01%
	(0.071)*	(0.098)*	(0.042)**	(0.088)*	(0.498)
General release	0.25%	-0.47%	-0.34%	-1.10%	-2.52%
	(0.336)	(0.188)	(0.291)	(0.073)*	(0.004)***
All events grouped	1.11%	0.12%	1.02%	0.55%	-2.29%
	(0.219)	(0.868)	(0.339)	(0.681)	(0.152)

* Significance level of 10%; ** Significance level of 5%; *** Significance level of 1%

A comparison between tables 3 and 4 and table 6 shows that the two models used return overall consistent results.

The tests performed with the CAPM for Traditional videogames have usually shown slightly higher levels of confidence for the positive returns, being the opposite for the only significant negative abnormal return measured. Despite this, all results remain within the same interval

of significance (1%, 5% or 10%) under both models for all significant results in the market model, except for H8, related to the cumulation of Esports events.

Esports analysed under the CAPM, supported by Panel II of table 6, return a significantly higher number of results with statistical relevance, especially for research hypothesis H6 – *Esports videogames do not generate returns in the beta release*. Based on the CAPM, the windows [-1;0], [0;0] and [0;3] generate significant results at a 10% significance level, while the interval [0;1] returns an AR of 0.87% at a significance level of 5%. The abnormal returns are positive for all the event windows in both models, except for the event window [0;10], where the event window is negative in both cases.

Finally, for the tests performed in the grouped events of Traditional videogames and Esports, the results are consistent between the two models. The event windows that generate abnormal returns under the market model are the same that generate abnormal returns under the CAPM. The only significant difference relates to Esports in the event window [0;10], which is statistically significant at 5% under the market model and not significant under the CAPM.

6. Final remarks

Traditional videogames and Esports have shown impressive growth in their financial value and social relevance during the last decade. The success of videogames comes in large part from the increasing accessibility to more powerful and affordable hardware and faster internet connections. Both hardware and internet connections continue to improve in quality for the same prices, creating the conditions for videogames to continue their upwards trajectory.

The success of these industries has, as a consequence, drawn the attention of the scientific community. Due to the relatively short history of videogame and Esports, the amount of research available is scarce. Therefore, it is our purpose to contribute to the literature. To the best of our knowledge, no other paper has investigated the reaction from the market to the beta release of videogames yet.

Regarding the research on the announcement and general release of videogames, we have only found two papers, one for each event, Suh and Lee (2011) and Abramova (2013), respectively. This paper can also serve as a tool for more informed decision-making about investment in stocks of videogame publishers. We investigate how markets react to Traditional videogames' events and Esport's events and analyse which events generate the highest returns to investors. We also provide insight on the best investment options to maximize CAR or to maximize daily ACAR.

To perform this research, we adopt an event-study methodology over a sample of 198 events spread between July of 2009 to June of 2020. These events correspond to the three most important events of the software release cycle, namely: announcement, beta release and general release. The videogames studied are classified as either Traditional videogames or Esports and published by one out of the eight videogame publishers captured in our sample. For each event, we have used the daily closing stock prices to assess the market's reaction.

Table 7 presents a summary of our research hypothesis and the outcomes based on our research.

Table 7 – Null hypotheses rejection summary

#	Null hypotheses	Null hypothesis rejected/not rejected
H1	Traditional videogames do not generate returns in the announcement	Rejected*
H2	Traditional videogames do not generate returns in the beta release	Rejected*
H3	Traditional videogames do not generate returns in the general release	Rejected*
H4	Traditional videogames do not generate returns	Not rejected
H5	Esports videogames do not generate returns in the announcement	Not rejected
H6	Esports videogames do not generate returns in the beta release	Rejected*
H7	Esports videogames do not generate returns in the general release	Rejected*
H8	Esports videogames do not generate returns	Rejected*

* For some event windows

Table 7 presents the outcome regarding the rejection or non-rejection of the null hypothesis associated with each research hypothesis. The null hypotheses associated with Traditional videogames has been rejected for all the research hypotheses. Two out of four null hypotheses associated with Esports have been rejected. Hypothesis H5 – *Esports videogames do not generate returns in the announcement* has not been rejected on any event window due to the inexistence of any statistically significant results. Hypothesis H8 – *Esports videogames do not generate returns* has been rejected, based on the negative results that we find associated with the cumulation of the three Esports' events. The null hypothesis has been rejected for at least one event window for the remaining two research hypotheses.

For our first research question, which sought to understand if the market reacts differently towards Traditional videogames compared to Esports, we find that the reaction is different. According to our results, all the events are more profitable (or less loss-making) for Traditional videogames than for Esports. At announcement and beta release, we find that the returns are, for most post-event windows, positive for Traditional videogames and

indistinguishable from zero for Esports. We suggest that the difference in returns at the announcement date is related to the number of sequels in our sample and the time between each sequel's release. Both types of videogames generate negative returns at the general release date, being less negative for Traditional videogames.

Furthermore, we find that out of three types of Esports-related events, only the beta release generated positive returns, and also that these were more than offset by the negative returns generated by the general release. We hypothesize that this is caused mainly by the periodicity of the release of a large part of the Esports in our sample, which may lead the market to slowly incorporate in the stock price its expectations regarding the next version, resulting in a smaller reaction to the events studied. We conclude that the market's reaction is always more favourable (and often only favourable) to Traditional videogames.

Our second research question is focused on the returns generated by each event to understand which of the three yields the highest return to investors. We find that it is the announcement of Traditional videogames that generates the highest CAR. To achieve it, an investor should keep its investment over 11 days, between the event date and the tenth day after it. The CAR generated is 2.09%, at a daily ACAR of 0.19%. The best option for a day trade comes from investment on the beta release date, which would then be sold at the market's closing and would return an average profit of 1.28%. Investors should avoid investing on the general release date of any videogame, independently of being a Traditional videogame or an Esport. Doing so would yield negative returns in the short and long term (within the timeframe of our window), in line with the results presented in Abramova (2013).

A limitation of this research is the absence of some of the most relevant Esports and Traditional videogames. This absence is due to two reasons, the first being that some videogames are published by non-listed entities (e.g. *Rocket League* (2015), from Psyonix and *Counter-Strike: Global Offensive* (2012) from Valve). The second reason is that some videogames are published by multi-sector listed entities, which generate most of their revenue from non-gaming sectors, e.g. *Gears of War* (2011; 2016; 2019), from Microsoft and *Uncharted* (2009, 2011, 2016) from Sony. A second limitation is that videogame publishers regularly release information to the market during the software development cycle, not only on the three moments we have studied. We are confident that the three moments studied are indeed the most important moments of the development, but our research ignores other public

disclosures that may have an impact on stock prices, such as teasers, information leakages, gameplay demonstrations, among others.

As a suggestion for future research, it can be interesting to investigate the returns generated by videogames based on their revenue models, comparing a sample of paid videogames, a sample of hybrid videogames, and a sample of free videogames. Additionally, different price tiers can be considered, given that in today's market, it is common for videogame publishers to release videogames with hybrid pricing/revenue models with the expectation of generating revenue from both the sale of the videogame and in-game sales. Free videogames can be a risky investment to videogame publishers, but as recent cases (*Fortnite* (2017) is a good example) have shown, it is a case of high risk and high reward. The risk comes from the high unpredictability of the cash inflow, the reward from the abolition of price as an entry barrier. Investigating how the market sees each of the revenue models can generate interesting results.

Research can also focus on the genre of each videogame to understand which type of videogame the market prefers. Subdividing the study into several periods can help identify changes in the consumers' preferences throughout time.

We are confident that in the following years we will see a significant increase in the amount of scientific research around videogames to respond to the remarkable social relevance that this phenomenon has achieved. We strongly believe that our findings contribute to the existing research and can be helpful to investors and decision-makers within this industry, which is largely expected to have a bright future ahead.

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Annexes

List of Esports

Title	Videogame Publisher	Year of release
Call of Duty: Modern Warfare 3	Activision Blizzard	2011
Call of Duty: Black Ops 2	Activision Blizzard	2012
FIFA 13	Electronic Arts	2012
PES 2013	Konami	2012
Battlefield 4	Electronic Arts	2013
FIFA 14	Electronic Arts	2013
PES 2014	Konami	2013
TrackMania 2: Stadium	Ubisoft	2013
Call of Duty: Advanced Warfare	Activision Blizzard	2014
Hearthstone	Activision Blizzard	2014
Ultra Street Fighter IV	Capcom	2014
FIFA 15	Electronic Arts	2014
PES 2015	Konami	2014
Call of Duty: Black Ops III	Activision Blizzard	2015
Heroes of the Storm	Activision Blizzard	2015
FIFA 16	Electronic Arts	2015
PES 2016	Konami	2015
Rainbow Six Siege	Ubisoft	2015
Call of Duty: Infinite Warfare	Activision Blizzard	2016
Overwatch	Activision Blizzard	2016
Street Fighter V	Capcom	2016
FIFA 17	Electronic Arts	2016
PES 2017	Konami	2016
Call of Duty: World War II	Activision Blizzard	2017
FIFA 18	Electronic Arts	2017
PES 2018	Konami	2017
Call of Duty: Black Ops 4	Activision Blizzard	2018
FIFA 19	Electronic Arts	2018
PES 2019	Konami	2018
Call of Duty: Modern Warfare	Activision Blizzard	2019
FIFA 20	Electronic Arts	2019
PES 2020	Konami	2019

List of Traditional videogames

Title	Videogame Publisher	Year of release
Call of Duty: Black Ops	Activision Blizzard	2010
Civilization 5	Take-Two Interactive	2010
Resident Evil 6	Capcom	2012
Spec Ops: The Line	Take-Two Interactive	2012
Far Cry 3	Ubisoft	2012
Crysis 3	Electronic Arts	2013
Final Fantasy XIV: A Realm Reborn	Square Enix Holdings	2013
Grand Theft Auto 5	Take-Two Interactive	2013
Assassin's Creed Black Flag	Ubisoft	2013
Destiny	Activision Blizzard	2014
Dragon Age: Inquisition	Electronic Arts	2014
Watch Dogs 1	Ubisoft	2014
Far Cry 4	Ubisoft	2014
The Witcher 3	Bandai Namco Games	2015
Rise of the Tomb Raider	Square Enix Holdings	2015
Titanfall 2	Electronic Arts	2016
Battlefield 1	Electronic Arts	2016
Battleborn	Take-Two Interactive	2016
XCOM 2	Take-Two Interactive	2016
The Division	Ubisoft	2016
Watch Dogs 2	Ubisoft	2016
Destiny 2	Activision Blizzard	2017
Resident Evil 7	Capcom	2017
Star Wars: Battlefront 2	Electronic Arts	2017
Nier: Automata	Square Enix Holdings	2017
Ghost Recon Wildlands	Ubisoft	2017
Dragon Ball FighterZ	Bandai Namco Games	2018
Soulcalibur 6	Bandai Namco Games	2018
Monster Hunter: World	Capcom	2018
Battlefield V	Electronic Arts	2018
Metal Gear Survive	Konami	2018
Red Dead Redemption 2	Take-Two Interactive	2018
Far Cry 5	Ubisoft	2018
The Crew 2	Ubisoft	2018
Assassin's Creed Odyssey	Ubisoft	2018
Sekiro: Shadows die twice	Activision Blizzard	2019
Code Vein	Bandai Namco Games	2019
Devil May Cry 5	Capcom	2019
The Division 2	Ubisoft	2019
Final Fantasy VII Remake	Square Enix Holdings	2020

Esports observations

Video Game	Game Genre	Game publisher	Announcement	Adj. Announcement	Beta Release	Adj. Beta Release	General Release	Adj. General Release
Call of Duty: Black Ops 2	Shooter	Activision Blizzard	01/05/2012	04/05/2012			12/11/2012	12/11/2012
PES 2014	Sports	Konami	10/03/2013	11/03/2013	10/09/2013	10/09/2013	19/09/2013	19/09/2013
FIFA 20	Sports	Electronic Arts	08/06/2019	10/06/2019	27/07/2019	29/07/2019	27/09/2019	27/09/2019
Battlefield 4	Shooter	Electronic Arts	17/07/2012	17/07/2012	01/10/2013	01/10/2013	29/10/2013	29/10/2013
FIFA 16	Sports	Electronic Arts	28/05/2015	28/05/2015	13/08/2015	13/08/2015	22/09/2015	22/09/2015
Call of Duty: Modern Warfare 3	Shooter	Activision Blizzard	23/05/2011	23/05/2011	06/06/2011	06/06/2011	08/11/2011	08/11/2011
Call of Duty: Modern Warfare	Shooter	Activision Blizzard	30/05/2019	30/05/2019	12/09/2019	12/09/2019	25/10/2019	25/10/2019
Street Fighter V	Fighter	Capcom	06/12/2014	08/12/2014	23/07/2015	23/07/2015	16/02/2016	16/02/2016
PES 2018	Sports	Konami	17/05/2017	17/05/2017	20/07/2017	20/07/2017	12/09/2017	12/09/2017
Call of Duty: World War II	Shooter	Activision Blizzard	21/04/2017	21/04/2017	25/08/2017	25/08/2017	03/11/2017	03/11/2017
FIFA 13	Sports	Electronic Arts	15/05/2012	15/05/2012	11/09/2012	11/09/2012	25/09/2012	25/09/2012
Call of Duty: Advanced Warfare	Shooter	Activision Blizzard	02/05/2014	02/05/2014	17/10/2014	17/10/2014	04/11/2014	04/11/2014
FIFA 15	Sports	Electronic Arts	15/06/2014	16/06/2014	21/08/2014	21/08/2014	23/09/2014	23/09/2014
FIFA 18	Sports	Electronic Arts	05/06/2017	05/06/2017	02/08/2017	02/08/2017	29/09/2017	29/09/2017
PES 2019	Sports	Konami	09/05/2018	09/05/2018	08/08/2018	08/08/2018	28/08/2018	28/08/2018
FIFA 17	Sports	Electronic Arts	06/06/2016	06/06/2016	18/08/2016	18/08/2016	27/09/2016	27/09/2016
Rainbow Six Siege	Shooter	Ubisoft	10/06/2014	10/06/2014	26/11/2015	26/11/2015	01/12/2015	01/12/2015
Call of Duty: Black Ops III	Shooter	Activision Blizzard	09/04/2015	09/04/2015	18/08/2015	18/08/2015	06/11/2015	06/11/2015
Call of Duty: Infinite Warfare	Shooter	Activision Blizzard	02/05/2016	02/05/2016	14/10/2016	14/10/2016	04/11/2016	04/11/2016
PES 2017	Sports	Konami	25/05/2016	25/05/2016	23/08/2016	23/08/2016	13/09/2016	13/09/2016
FIFA 19	Sports	Electronic Arts	09/06/2018	11/06/2018	01/08/2018	01/08/2018	28/09/2018	28/09/2018
PES 2015	Sports	Konami	09/06/2014	09/06/2014	03/10/2014	03/10/2014	11/11/2014	11/11/2014
PES 2020	Sports	Konami	12/06/2019	12/06/2019	30/07/2019	30/07/2019	10/09/2019	10/09/2019
PES 2016	Sports	Konami	12/06/2015	12/06/2015	13/08/2015	13/08/2015	15/09/2015	15/09/2015
FIFA 14	Sports	Electronic Arts	06/06/2013	06/06/2013	10/09/2013	10/09/2013	23/09/2013	23/09/2013
Heroes of the Storm	MOBA	Activision Blizzard	17/10/2013	17/10/2013	13/01/2015	13/01/2015	02/06/2015	02/06/2015
Overwatch	Shooter	Activision Blizzard	07/11/2014	10/11/2014	27/10/2015	28/10/2015	24/05/2016	24/05/2016
TrackMania 2: Stadium	Racing	Ubisoft	02/11/2012	02/11/2012	27/02/2013	27/02/2013	20/06/2013	20/06/2013
Hearthstone	Card Game	Activision Blizzard	22/03/2013	22/03/2013	16/08/2013	16/08/2013	11/03/2014	11/03/2014
PES 2013	Sports	Konami	18/04/2012	18/04/2012	25/07/2012	25/07/2012	20/09/2012	20/09/2012
Ultra Street Fighter IV	Fighter	Capcom	15/07/2013	16/07/2013			03/06/2014	03/06/2014
Call of Duty: Black Ops 4	Shooter	Activision Blizzard	08/03/2018	08/03/2018	10/09/2018	10/09/2018	12/10/2018	12/10/2018

Traditional videogames observations

Video Game	Game Genre	Game publisher	Announcement	Adj. Announcement	Beta Release	Adj. Beta Release	General Release	Adj. General Release
Call of Duty: Black Ops	Shooter	Activision Blizzard	30/04/2010	30/04/2010			09/11/2010	09/11/2010
Destiny	Shooter	Activision Blizzard	13/02/2013	13/02/2013	17/07/2014	18/07/2014	09/09/2014	09/09/2014
Destiny 2	Shooter	Activision Blizzard	28/03/2017	28/03/2017	18/07/2017	18/07/2017	06/09/2017	06/09/2017
Sekiro: Shadows die twice	Action	Activision Blizzard	10/06/2018	11/06/2018			22/03/2019	22/03/2019
The Witcher 3	RPG	Bandai Namco Games	10/06/2013	10/06/2013			19/05/2015	19/05/2015
Code Vein	Action	Bandai Namco Games	20/04/2017	20/04/2017	31/05/2019	31/05/2019	27/09/2019	27/09/2019
Dragon Ball FighterZ	Fighter	Bandai Namco Games	09/06/2017	09/06/2017	14/01/2018	16/01/2018	26/01/2018	26/01/2018
Soulcalibur 6	Fighter	Bandai Namco Games	07/12/2017	07/12/2017	28/09/2018	28/09/2018	19/10/2018	19/10/2018
Resident Evil 6	Action	Capcom	19/01/2012	19/01/2012	18/09/2012	18/09/2012	02/10/2012	03/10/2012
Resident Evil 7	Action	Capcom	14/06/2016	14/06/2016	09/12/2016	09/12/2016	24/01/2017	24/01/2017
Monster Hunter: World	Action	Capcom	13/06/2017	13/06/2017	19/01/2018	19/01/2018	26/01/2018	26/01/2018
Devil May Cry 5	Action	Capcom	11/06/2018	11/06/2018	07/12/2018	07/12/2018	08/03/2019	08/03/2019
Crysis 3	Shooter	Electronic Arts	24/04/2012	24/04/2012	29/01/2013	29/01/2013	19/02/2013	19/02/2013
Dragon Age: Inquisition	RPG	Electronic Arts	17/09/2012	17/09/2012			18/11/2014	18/11/2014
Titanfall 2	Shooter	Electronic Arts	12/03/2015	12/03/2015	19/08/2016	19/08/2016	28/10/2016	28/10/2016
Battlefield 1	Shooter	Electronic Arts	06/05/2016	06/05/2016	31/08/2016	31/08/2016	21/10/2016	21/10/2016
Star Wars: Battlefront 2	Action	Electronic Arts	29/03/2017	29/03/2017	04/10/2017	04/10/2017	17/11/2017	17/11/2017
Battlefield V	Shooter	Electronic Arts	23/05/2018	23/05/2018	28/06/2018	28/06/2018	20/11/2018	20/11/2018
Metal Gear Survive	Action	Konami	17/08/2016	17/08/2016	18/01/2018	18/01/2018	20/02/2018	20/02/2018
Final Fantasy XIV: A Realm Reborn	RPG	Square Enix Holdings	26/07/2012	26/07/2012	25/02/2013	25/02/2013	27/08/2013	27/08/2013
Rise of the Tomb Raider	Action	Square Enix Holdings	09/06/2014	09/06/2014			13/11/2015	13/11/2015
Final Fantasy VII Remake	Action	Square Enix Holdings	15/06/2015	15/06/2015	02/03/2020	02/03/2020	10/04/2020	13/04/2020
Nier: Automata	Action	Square Enix Holdings	16/06/2015	16/06/2015			23/02/2017	23/02/2017
Spec Ops: The Line	Shooter	Take-Two Interactive	12/12/2009	14/12/2009	09/05/2012	10/05/2012	26/06/2012	26/06/2012
Civilization 5	Strategy	Take-Two Interactive	26/02/2010	26/02/2010			21/09/2010	21/09/2010
Grand Theft Auto 5	Action	Take-Two Interactive	25/10/2011	25/10/2011			17/09/2013	17/09/2013
Battleborn	Shooter	Take-Two Interactive	08/07/2014	08/07/2014	08/04/2016	08/04/2016	03/05/2016	03/05/2016
XCOM 2	Strategy	Take-Two Interactive	02/06/2015	02/06/2015			05/02/2016	05/02/2016
Red Dead Redemption 2	Action	Take-Two Interactive	16/10/2016	17/10/2016			26/10/2018	26/10/2018
Far Cry 3	Shooter	Ubisoft	06/06/2011	06/06/2011	22/05/2012	22/05/2012	29/11/2012	29/11/2012
Watch Dogs 1	Action	Ubisoft	05/06/2012	05/06/2012			27/05/2014	27/05/2014
Assassin's Creed Black Flag	Action	Ubisoft	04/03/2013	04/03/2013			29/10/2013	29/10/2013
The Division	Shooter	Ubisoft	10/06/2013	10/06/2013	18/02/2016	18/02/2016	08/03/2016	08/03/2016
Far Cry 4	Shooter	Ubisoft	15/05/2014	15/05/2014			18/11/2014	18/11/2014
Ghost Recon Wildlands	Shooter	Ubisoft	16/06/2015	16/06/2015	23/02/2017	23/02/2017	07/03/2017	07/03/2017
Watch Dogs 2	Action	Ubisoft	08/06/2016	08/06/2016			15/11/2016	15/11/2016
Far Cry 5	Shooter	Ubisoft	26/05/2017	26/05/2017			27/03/2018	27/03/2018
The Crew 2	Racing	Ubisoft	12/06/2017	12/06/2017	21/06/2018	21/06/2018	28/06/2018	28/06/2018
The Division 2	Shooter	Ubisoft	09/03/2018	09/03/2018	07/02/2019	07/02/2019	12/03/2019	12/03/2019
Assassin's Creed Odyssey	Action	Ubisoft	31/05/2018	31/05/2018			02/10/2018	02/10/2018

All event windows under market model and CAPM

Market Model

	-1 to 0	0 to 0	0 to 1	0 to 3	0 to 10	-5 to 10	-5 to 5	-5 to -1	-3 to 3	-1 to 1	0 to 5	1 to 5	1 to 10
H1	0.30%	0.71%	1.08%	1.10%	2.09%	1.78%	1.07%	-0.29%	0.32%	0.67%	1.37%	0.66%	1.38%
	0.254	0.024	0.006	0.037	0.039	0.101	0.174	0.317	0.341	0.094	0.057	0.198	0.108
H2	0.70%	1.28%	0.97%	0.73%	0.87%	-0.17%	0.04%	-1.02%	-0.14%	0.39%	1.07%	-0.21%	-0.41%
	0.202	0.008	0.099	0.204	0.307	0.471	0.491	0.111	0.455	0.364	0.182	0.403	0.391
H3	-0.08%	-0.63%	-0.30%	-0.13%	-0.62%	-0.77%	-0.15%	-0.14%	0.06%	0.25%	-0.01%	0.62%	0.01%
	0.437	0.032	0.230	0.415	0.263	0.241	0.422	0.395	0.466	0.311	0.494	0.122	0.497
H4	-0.87%	0.68%	1.37%	1.51%	1.15%	-0.90%	0.31%	-2.00%	-0.66%	-0.18%	2.34%	1.66%	0.47%
	0.383	0.428	0.196	0.283	0.688	0.785	0.889	0.081	0.699	0.879	0.195	0.216	0.858
H5	0.13%	0.23%	0.41%	0.45%	0.21%	0.38%	0.82%	0.19%	0.49%	0.31%	0.64%	0.41%	-0.02%
	0.341	0.175	0.143	0.195	0.380	0.321	0.127	0.299	0.188	0.240	0.168	0.267	0.487
H6	0.59%	0.33%	0.77%	0.72%	-0.55%	-1.01%	-0.03%	-0.44%	0.83%	1.02%	0.42%	0.08%	-0.89%
	0.104	0.130	0.062	0.145	0.308	0.211	0.489	0.209	0.157	0.052	0.293	0.453	0.199
H7	0.20%	-0.50%	-0.39%	-1.21%	-2.82%	-2.89%	-1.05%	-0.06%	-0.57%	0.31%	-0.98%	-0.48%	-2.32%
	0.369	0.175	0.262	0.057	0.002	0.004	0.107	0.463	0.256	0.332	0.101	0.199	0.008
H8	0.89%	0.01%	0.80%	0.11%	-3.52%	-3.83%	-0.21%	-0.26%	1.05%	1.67%	0.07%	0.07%	-3.53%
	0.326	0.987	0.454	0.933	0.043	0.063	0.894	0.788	0.478	0.170	0.961	0.957	0.027

CAPM

	-1 to 0	0 to 0	0 to 1	0 to 3	0 to 10	-5 to 10	-5 to 5	-5 to -1	-3 to 3	-1 to 1	0 to 5	1 to 5	1 to 10
H1	0.34%	0.73%	1.12%	1.18%	2.33%	2.14%	1.30%	-0.19%	0.46%	0.73%	1.49%	0.76%	1.60%
	0.225	0.021	0.005	0.026	0.022	0.055	0.119	0.377	0.268	0.073	0.041	0.160	0.072
H2	0.72%	1.29%	0.99%	0.77%	0.98%	-0.01%	0.14%	-0.98%	-0.08%	0.42%	1.12%	-0.16%	-0.31%
	0.196	0.007	0.094	0.191	0.283	0.499	0.466	0.119	0.476	0.354	0.168	0.423	0.415
H3	-0.05%	-0.62%	-0.28%	-0.07%	-0.46%	-0.53%	0.01%	-0.07%	0.16%	0.29%	0.08%	0.69%	0.15%
	0.459	0.035	0.249	0.450	0.313	0.305	0.496	0.447	0.407	0.281	0.452	0.093	0.433
H4	-0.75%	0.74%	1.50%	1.76%	1.86%	0.17%	1.02%	-1.69%	-0.21%	0.01%	2.72%	1.97%	1.12%
	0.450	0.387	0.158	0.206	0.502	0.957	0.626	0.000	0.897	0.996	0.127	0.133	0.663
H5	0.18%	0.26%	0.46%	0.55%	0.49%	0.80%	1.10%	0.31%	0.67%	0.38%	0.79%	0.53%	0.24%
	0.284	0.150	0.114	0.142	0.211	0.123	0.047	0.171	0.103	0.186	0.111	0.204	0.360
H6	0.69%	0.38%	0.87%	0.91%	-0.01%	-0.20%	0.52%	-0.19%	1.17%	1.17%	0.71%	0.33%	-0.39%
	0.071	0.098	0.042	0.088	0.498	0.433	0.292	0.358	0.074	0.032	0.173	0.317	0.350
H7	0.25%	-0.47%	-0.34%	-1.10%	-2.52%	-2.45%	-0.75%	0.07%	-0.38%	0.39%	-0.82%	-0.35%	-2.05%
	0.336	0.188	0.291	0.073	0.004	0.009	0.179	0.454	0.329	0.291	0.139	0.267	0.015
H8	1.11%	0.12%	1.02%	0.55%	-2.29%	-2.01%	1.02%	0.29%	1.83%	2.00%	0.74%	0.62%	-2.41%
	0.219	0.868	0.339	0.681	0.152	0.267	0.490	0.759	0.204	0.099	0.609	0.603	0.101

1% significance level 5% significance level 10% significance level