The influence of Twitch and sustainability on the stock returns of video game companies: Before and after COVID-19

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ARTICLE INFO	ABSTRACT
	The covid-19 pandemic has shocked society greatly, causing many changes in people's lives. One of these changes relates to leisure and how we relate to others. Videogames became one of the first entertainment options during the pandemic, making the video game industry and the pharmaceutical industry-one of the least affected by economic slowdown. This study analyzes how Twitch and sustainability jointly influence the stock returns of major videogame companies before and during Covid-19 using panel fsQCA analysis. The results show a positive relationship between Twitch, sustainability, and stock returns in video game companies, but this relationship differs yearly, being stronger during the Covid-19 period.

1. Introduction

Covid-19 has changed society in many ways: how we work, socialize, and even spend our leisure time. Overall, the economy suffered largely because of the slowdown in 2020. However, some sectors remained unaffected. These sectors include pharmaceuticals and the entertainment and videogame sectors. Videogames and their retransmission through live streaming platforms, such as Twitch, benefited from Covid-19, becoming one of the first entertainment options during confinement. In recent years, several studies have analyzed the effect of Covid-19 on the economy and business have appeared (Al-Omoush, et al., 2022; Galindo-Martín, et al., 2021; Dontu and Gustafsson, 2020; Xie et al., 2020; Zhang et al., 2020; Liu et al., 2020).

The videogame industry has undergone many changes and has evolved, always hand in hand with innovation (Gallagher and Park, 2002, Lantano et al., 2022) despite being highly uncertain (Alzamora-Ruiz, et al., 2021). This industry is currently dominated by three major console producers: Sony, Microsoft, and Nintendo. Another essential part of the sector is videogame developers, such as Activision, CD Projekt, and Take-Two. Nowadays, it is unthinkable to talk about gaming without mentioning live streaming platforms, particularly Twitch, the leading platform in the market. Live streaming platforms such as Twitch have increased their users before the pandemic, but they have grown significantly. For example, Twitch experienced a 98 % increase in

viewers from 2018 to 2020 (SullyGnome, 2022). Because of the large number of users of these platforms and streamers that are good prescribers of their products, gaming companies began using these platforms to promote themselves when launching new games and to keep live games that were in the later stages of their life cycle (Oh and Kim, 2022). Social media has been shown to impact businesses (Tortora, et al., 2021), so Twitch is also expected to have an impact. In this sense, Twitch can become a marketing tool that helps improve brand equity (Yoo, et al., 2000) through the brand loyalty generated among its users, something similar to what happens in sports (Mills, et al., 2022) and therefore has an impact on the accounting result and its stock market return. Despite Twitch's relevance in gaming, very few papers analyze its influence on videogame companies (Sjöblom and Hamari, 2017; Sjöblom, et al., 2017). In this sense, it has been proven that the type of content is more relevant than the genre of the streamed games (Sjöblom, et al., 2017), therefore in this paper, we focus on the type of content streamed and video games, not on genres.

Another important change that has recently occurred is the rise in sustainability concerns. Recent studies have shown that sustainability positively influences investors and the performance of sustainable companies (Ziegler et al., 2007; Zhang et al., 2018; Friede et al., 2015, Chiu et al., 2020) although some are dubious (Gillan et al., 2021; Larcker et al., 2022). However, very few studies have analyzed the sustainability of video game companies and their relationship with their returns.

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This study aims to analyze how Twitch and sustainability jointly influence the stock returns of major videogame companies before and during Covid-19. To this end, a panel analysis of fsQCA was carried out from 2018 to 2020 on video game companies that own at least one video game among the 100 most watched video games each year.

The results showed a positive relationship between twitch streaming, sustainability, and stock returns for video game companies. Moreover, this relationship differs depending on the year and is stronger in Covid-19 years. These findings contribute to the literature in several respects. First, it is one of the first studies to analyze the effect of Twitch on the stock returns of companies in the gaming sector in conjunction with sustainability. Second, the results demonstrated the positive impact of Covid-19 on this sector. Third, Twitch is relevant to the video game industry for various reasons. Not only is it a showcase that companies can use to promote their video games, but it is also a medium that lets you know how successful a game is. Finally, these results have practical implications for investors. On the one hand, Twitch is a relevant source of information for investing in the gaming sector; on the other hand, it has been shown that the social and environmental dimensions are more important to investors than the governance dimension.

The remainder of this paper is organized as follows. Section 2 describes the business context in which Twitch is inserted, presents a literature review, and states our hypotheses. Section 3 describes the research setting and methodology followed for the analysis. Section 4 discusses the empirical results, and Section 5 concludes the study and discusses its limitations and directions for future research.

2. Literature review

2.1. Videogames industry

A videogame is an electronic game in which the player uses some type of controller, such as a joystick, keyboard, or their own hands, to interact with the game (Aguzzoni et al. 2014). Video games are experiential goods, meaning they cannot be evaluated until they are acquired and consumed. In addition, the value of the video game generally decreases rapidly for the owner because he or she may become tired of playing or because he or she has finished the video game (Ishihara and Ching, 2019). Therefore, statistics from live streaming platforms, such as Facebook, YouTube, and Twitch, can help estimate the quality of a video game. For example, the fact that a game released years ago is still streamed by many streamers and with many viewers is a sign that the game is still alive and still generates profitability for the developer and distributor. Games like League of Legends (released in 2009), Grand Theft Auto V (released in 2013), and Minecraft (released in 2011) are still among the most-watched games every year.

The video game industry has several links within its supply chain. The gaming industry comprises console gamers, producers, computer gamers, and producers. A growing share of IT producers is developing a product line dedicated to gaming, such as HP with the Omen product line or Asus with the Rog product line. Some console manufacturers, such as Microsoft, Sony, and Nintendo, have also developed and distributed their videogames through their subsidiaries or by subcontracting developers. Video game developers who create games in collaboration with producers are also important players in this sector. Once the games have been developed, they are sold to distributors responsible for distributing them on different platforms. The videogame industry is, therefore, interdependent; that is, videogame developers and distributors depend on console compatibility, whereas producers depend on the availability of games (Dietl and Royer, 2003). Sometimes, a single company handles the whole process, like Microsoft. However, it is more common for the company to be both a developer and distributor, such as CD Projekt, Take-Two, or Activision.

The videogame industry has grown exponentially over the years, thanks in part to technological advances and innovations. An example of the importance of the video game sector is gamification and its relevance to the business world, as shown by Wünderlich et al. (2020). There are several significant milestones in the evolution of the industry. The first milestone corresponds to replacing the first arcade games installed on premises by consoles allowed to play at home, accompanied by an increase in the variety of games (Kent, 2010). From that moment on, several generations can be distinguished, marked by the introduction of technological changes and the competitive scenario (Landsman and Stremersh, 2011, Lantano et al., 2022). Gallagher and Park (2002) provide a detailed review of all generations, along with a description of each major milestone. The launch of digital video games characterizes the latest generation (2020-present) without physical support. Microsoft, Sony, and Nintendo have dominated the videogame console market since 2005 (Daim et al., 2014).

During the pandemic, this industry has grown significantly, as it has become one of the major recreational activities due to the lockdown. Specifically, according to (Morse et al., 2021), watching TV/streams/movies is the activity that has experienced the greatest increase and has emerged as a new leisure activity during COVID-19. The proof of this is the increased audience that live streaming platforms such as Twitch have experienced (López-Cabarcos et al., 2020).

2.2. Twitch and videogame companies' performance

Livestreaming is the transmission of live videos and audio over the internet. This mode of communication has become one of the main modes of entertainment, partly because of social networks, quickly gaining popularity in the 2010 s with the emergence of companies specifically dedicated to it, such as Twitch (Oh and Kim, 2022). According to Sjöblom and Hamari (2017), several factors, such as tension release and social integrative and affective motivations, cause people to watch more stream hours.

Video game companies have become aware of the success of live broadcast platforms in recent years and have begun to use them as a means of promotion. Electronic Arts only used streamers to promote its game Apex Legends, getting a million downloads on the first day and more than 50 million in the first month (Needleman, 2019). This is because viewers develop loyalty to streamers (Kim and Kim, 2022), who thus become the best video game prescriber (Oh and Kim, 2022).

Twitch was one of the first streaming platforms to have 30 million daily active users and 140 million monthly active users by 2022 (Earthweb, 2022). Although it was born as a platform primarily for video game streams, streamers currently broadcast varied content, such as music, talk shows, sports, food, and crafts. However, video games remain the main content streamed and watched. Although Twitch is the most widely used streaming platform, other platforms compete with it. The best known are Youtube, with its Youtube Gaming division, and Facebook Gaming. While Twitch bases its business model on live streams, YouTube mixes live streams and pre-recorded videos. Facebook Gaming is a live stream platform whose interaction with the audience is performed through the streamer's own page. In terms of numbers, according to the website cloutboost.com Cloutboost (2022), in 2021, Twitch captured more than 70 % of the game streaming market with a total of 5.79 billion total hours watched, while Facebook Gaming captured 15.7 % with a total of 1.29 billion total hours watched, and YouTube Gaming ranked third with 13.8 % with a total of 1.13 billion total hours watched. These data highlight the relevance of Twitch to the world of video games. This relevance is also because Twitch was born as a streaming platform, while YouTube started as a pre-recorded video platform that later incorporated live streams. Facebook Gaming is a division created from the Facebook social network.

To date, very few studies have addressed Twitch's influence on the performance of video game companies. Johnson and Woodcock (2019) analyzed the importance of twitch in the video game industry. They conclude that live streaming is a new force in the videogame industry, creating new links between developers and influencers that change our expectations of gameplay and game design. Oh and Kim (2022) analyze

how live-streaming viewership influences video game consumption. Specifically, they analyzed data from Twitch and Steam, the leading digital marketplace for video games. They found that the number of viewers during the prerelease of a new game is positively associated with the game's initial user base; that is, it contributes to the initial success of the new game. In addition, it is related to an increase in the likelihood of replaying the game during the decline stage of the product life cycle (Oh and Kim, 2022). Although no previous empirical study, to our knowledge, has examined the direct influence of Twitch on video-game companies, we propose the following hypothesis:

H1: Twitch statistics positively affect video game companies' returns.

Twitch's growth has been progressive over the years since its inception in 2012, but from April 2020 and the Covid pandemic, a new milestone has been reached. As with video games, the COVID-19 pandemic has also positively impacted streaming platforms, and they have all reached their maximum viewing points. For example, the average number of concurrent viewers on Twitch was 1.07 million in 2018, 1.26 million in 2019, and 2.12 in 2020, which was a 98 % increase from 2018 to 2020 (SullyGnome, 2022). This leads us to propose a complementary hypothesis for H1.

H2: Covid-19 had an impact on the relationship between Twitch statistics and video game companies' returns.

2.3. Sustainability and stock returns

A company is sustainable when its activities are carried out with the best interests of society and environment in mind (Caldera et al, 2018). In recent years, sustainability has become a necessity for companies wishing to be a market reference (Chien et al, 2021). A socially responsible company, in addition to improving its image in the market and society, is supposed to obtain rewards in terms of financial performance because it reduces its long-term risk, thereby leading to future profits that are larger and more sustainable (Larcker et al., 2022).

Many studies have demonstrated a positive relationship between sustainability and increased performance (Ziegler et al., 2007; Chiu et al., 2020, Lee and Suh, 2022; etc). Friede et al. (2015) conducted a *meta*-analysis of approximately 2200 empirical studies in various areas, accounting, economics, finance, and management, and stated that "the business case for ESG investing is empirically very well founded." "Roughly 90 % of studies find a nonnegative Environmental, Social and Governance (ESG) - Corporate Financial Performance (CFP) relation. More importantly, a large majority of studies report positive findings.".

Cheung (2011) shows that the inclusion or exclusion of a company in a sustainable index, in this case, the Dow Jones Sustainability World Index, positively or negatively affects stock returns, both in its variation (increase or decrease) and in its liquidity and systematic and idiosyncratic risk. Similarly, Zhang et al. (2018) demonstrate a positive relationship between sustainability engagement and stock returns; specifically, they show that the publication of sustainability news positively affects the volatility of a company's stock returns. Chiu et al. (2020) showed that companies that publish their corporate social responsibility (CSR) reports generating higher returns than those that do not.

However, the results are not always positive. Khan (2022), thanks to a *meta*-analysis, reports that ESG disclosure has a positive impact on financial performance, which is statistically insignificant but has a positive and statistically significant impact on market performance (measured by Tobin's Q). He also notices that "studies that reported a negative association between ESG and financial performance are from the Asian context, whereas EU and US-based studies reported a positive impact. This also points toward the role of institutional differences in shaping the effectiveness of non-financial disclosure." Accordingly, Gillan et al. (2021) survey the corporate finance literature and indicate that "the results from these corporate finance studies are more mixed than the overall conclusions of the Friede et al. (2015) study". This leads

Larcker et al. (2022) to state "In summary, we do not know the financial impact of ESG.".

Tsang et al. (2020) showed that in companies belonging to the Mainland China A-shares market, there is no relationship between sustainability and stock performance. However, Li et al. (2021) find that a socially responsible policy in the export industry leads to higher financial performance. La Torre et al. (2020) also find that companies in Eurostoxx50 are not rewarded for their efforts to be sustainable. We propose the following hypothesis:

H3: Sustainability has a positive effect on video game companies' returns.

H4: The combination of sustainability level and Twitch statistics positively affect video game companies' returns.

Sustainability can be measured in various ways, such as ESG scores, which separate scores into environmental (E), social (S), and governance (G) categories. Social ESG includes measures about the workforce, human rights, community, and product responsibility. The ESG environmental measures resource use, emissions, and innovation. ESG governance includes measures of management, stakeholders, and corporate social responsibility strategies. These measures allowed us to compare companies and identify better-positioned ones. Several authors have used this measure to analyze the relationship between different categories and stock returns. For example, Ziegler et al. (2007) examined how sustainability affects European companies' stock performance by considering two sustainability categories: environmental and social. They observed that environmental performance positively affects stock performance, contrary to social performance. Alsahlawi et al. (2021) find that environmental sustainability disclosure negatively affects stock returns in Saudi-listed firms. This leads us to propose a complementary hypothesis for H3.

H5: Sustainability dimensions (environmental, social, and governance) affect the returns of video game companies in different ways.

Another factor that can affect the relationship between sustainability and stock returns is financial crises or economic crises in general, such as those caused by the Covid-19 pandemic. Yoo et al. (2021) show that during the pandemic, ESG score E was related to higher returns and lower volatility and that CG scores were correlated with lower returns and higher volatility. They also find that the effect of E scores is larger for non-energy companies. Therefore, the last proposed hypothesis is as follows:

H6: Covid-19 had an impact on the relationship between sustainability and video game companies' returns.

Summarizing, the hypotheses proposed to be tested are:

H1: Twitch statistics positively affect video game companies' returns.

H2: Covid-19 had an impact on the relationship between Twitch statistics and video game companies' returns.

H3: Sustainability has a positive effect on video game companies' returns.

H4: The combination of sustainability level and Twitch statistics positively affect video game companies' returns.

H5: Sustainability dimensions (environmental, social, and governance) affect the returns of video game companies in different ways.

H6: Covid-19 had an impact on the relationship between sustainability and video game companies' returns.

3. Method

3.1. Panel data fsQCA

To analyze the joint effect exerted by Twitch and sustainability on the stock returns of video game companies, fsQCA was used. The fsQCA is a qualitative analysis method in which both the conditions and the outcome have a degree of membership in the set they represent, which is determined through calibration (Schmitt et al. 2017). Calibration is the first of the four steps to be carried out (Fig. 1): calibration, construction
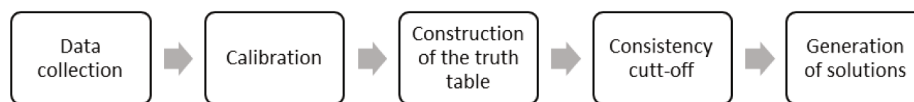
Source 1. Developed by the authors

Fig. 1. Steps to follow in fsQCA method, Source 1. Developed by the authors.

of the truth table, establishment of the consistency cut-off that allows us to distinguish the causal combinations that are part of the outcome from those that are not, and generation of the solutions (complex, parsimonious, and intermediate) (Ragin, 2008).

Usually, fsQCA uses data that do not incorporate temporal effects; however, recently, some fsQCA analyses have been carried out to incorporate these effects (Guedes et al, 2016; Beynon et al, 2020). This technique, developed by García-Castro and Ariño (2016), is known as panel data fsQCA and proposes new descriptive measures to evaluate consistency and coverage across cases and over time-based on the concepts established by Ragin (2008). García-Castro and Ariño (2016) proposed measures to evaluate the stability of consistency and coverage across cases (within) and over time (between). They proposed three types of consistency: pooled consistency (POCONS), between consistency (BECONS), and within consistency (WICONS). BECONS measures the cross-sectional consistency for each year, WICONS measures the consistency of the relations across time for each case, and POCONS measures the consistency of each causal combination. The last measure to be considered in the panel data fsQCA is distance. The distances between BECONS and POCONS indicate the stability of the consistency over time; therefore, the smaller the distance, the more stable the consistency. If it is high, it is necessary to evaluate the effects of time on the panel. Similarly, the distances between the WICONS and POCONS were calculated to evaluate how the WICONS varied across cases.

3.2. Sample and data

Two types of data were used for the analysis: financial data from companies and data from Twitch. Financial data were collected from several websites that provide financial data, namely Marketwatch (2021), MorningStar (2021), Macrotrends (2021), Ycharts (2021), and GuruFocus (2021). Twitch data were collected from the SullyGnome.com database (SullyGnome, 2021), which is a statistics and analytics service for Twitch that uses the Twitch API to collect information. As the aim is to analyze whether Twitch's influence on companies has changed during COVID-19, data were collected for the years 2018, 2019, and 2020, obtaining a three-year panel database and sorting according to the different videogame developers or distributor companies.

The following procedure was used to select companies included in the sample: First, we searched for videogames that were among the 100 most-viewed categories[1] of each year. Once the most-watched video games were detected, the developer company was sought, failing the distributor (they usually coincide). The video game industry comprises large developers and small or indie companies. Given the difficulty in obtaining data from unlisted individuals, we selected companies listed on the stock exchange. This resulted in an unbalanced panel of 17 companies (some companies had no video games in the top 100 most viewed in any given year).

3.3. Definition of the outcome and causal conditions

The outcome was the annual return of company *i* (RET). This variable indicates the annual return obtained by the company in the stock market, considering the distribution of dividends. These data were obtained directly from MorningStar.com. The interpretation of the outcome, given that all companies have returns, is that the presence of the outcome means that the annual return is high, and the absence means that it is low.

The causal conditions used were VIECH, SG, ESG, ESGS, ESGM, ESGG, and PER. VIECH is the average number of viewers per channel for all video games belonging to company *i*. To calculate this, the annual number of viewers per channel of each video game belonging to the company was taken, and the annual average was calculated.

SG is the number of streamers per videogame that streamed a company's set of videogames *i*. This variable was calculated as the annual average number of streamers who streamed at least one of the company's video games during the year.

These variables have been chosen as the most representative of Twitch since both the number of viewers and the number of streamers watching/playing a video game are an indication of the relevance of that game and will therefore have a direct impact on the company's results.

PER is the P/E ratio of the company, which measures its share price in relation to its earnings per share. A high P/E ratio could mean that investors are anticipating higher growth and profitability for a company in the future (Piñeiro-Chousa, et al., 2016), so a high P/E ratio would normally lead to an increase in stock returns.

ESG is the sustainability score awarded by Refinitiv (2021). It measures ten main topics (emissions, environmental innovation of products, human rights, shareholders, etc.) based on the information published by each company. This is an overall score, which can be divided into three categories: social (ESGS), environmental (ESGM), and governance (ESGG). It is an increasingly used metric to measure the performance of companies at the sustainability level (Starks, 2017; La Torre et al., 2020; Yoo et al., 2021; Nagy et al., 2013). A description and codification of the outcomes and conditions are provided in Table 1.

Considering the outcome and conditions, the first model proposed is as follows:

M1: RET = f(VIECH, SG, ESG, PER).

Because the ESG score can be decomposed into three categories, the

Table 1
Outcome and conditions.

Outcome and conditions	Description	Codification
RET	Annual stock return	Fuzzy value
VIECH	Average number of viewers per Twitch channel	Fuzzy value
SG	Average number of streamers per videogame	Fuzzy value
ESG	ESG score	Fuzzy value
ESGS	ESG score for the social category	Fuzzy value
ESGM	ESG score for the environmental category	Fuzzy value
ESGG	ESG score for the governance category	Fuzzy value
PER	P/E ratio	Fuzzy value

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[1] Twitch, as already mentioned, although it started out as a videogame streaming platform, today welcome topics such as just chatting, sports, crafts, etc.

following models are proposed:

M2: RET = f(VIECH, SG, ESGS, PER).
M3: RET = f(VIECH, SG, ESGM, PER).
M4: RET = f(VIECH, SG, ESGG, PER).

3.4. Calibration

As previously mentioned, fsQCA requires that both the outcome and the conditions are scaled in degrees of membership ranging from 0.0 to 1.0. To perform the calibration, it is necessary to establish thresholds for full membership (1), full non-membership (0), and crossover (0.5) (Ragin, 2008). Thus, the presence or absence of a condition or outcome is related to a score above or below the crossover, respectively (Romero-Castro et al, 2021). However, interpretation can be related to having a high or low score depending on the nature of the outcome or conditions. In this case, due to the nature of the outcome and the conditions, the most appropriate interpretation will be the latter; that is, when present, it will be associated with a high value, and when absent, it will be associated with a low value. For example, if PER is present in a causal combination, it is interpreted as high.

The outcomes and conditions are continuous variables; therefore, they must be calibrated. If possible, the calibration criteria should be based on the theory and structure of the dataset. In the absence of previous research, empirical calibration using percentile divisions of the sample is recommended (Crilly, 2010). In this case, the 10th and 90th percentiles were established as thresholds for full non-membership and full membership, respectively, while the 50th percentile was used as the crossover point, as described by Miranda et al. (2018), Olaya-Escobar et al. (2020), Castelló-Sirvent and Pinazo-Dallenbach (2021), and De Crescenzo et al. (2021), among others. Calibration was performed using the QCA package in R software (Thiem and Dusa, 2013). Table 2 shows the descriptive statistics for each condition and for the outcome, both on calibrated and uncalibrated scores and the calibration values.

Once the outcomes and conditions were calibrated, an asymmetry analysis of the conditions was performed. As seen in Table 3, no condition exceeds 80 %; therefore, there is no asymmetry. This means that no condition can simultaneously be a subset of the outcome (present and absent), indicating that they are inconsistent (Schneider and Wagemann, 2010).

Ambiguity analysis was also performed to check that no case was at the point of maximum ambiguity. If there were any cases at this point, the crossover point would have to be modified slightly, and calibration would have to be performed again. Some cases were found at the point of maximum ambiguity; therefore, the crossover point was slightly modified to solve it.

4. Results and discussion

4.1. Analysis of necessary conditions

In fsQCA analysis, the next step after calibration is the analysis of the

Table 3
Analysis of asymmetry.

	% cases greater than 0.5
VIECH	50
SG	50
ESG	50
PER	50
ESGS	50
ESGM	47.73
ESGG	45.45

necessary conditions. With this analysis, any condition that must occur to obtain the outcome can be detected. To be considered a necessary condition, the consistency must be greater than 0.9 (Schneider and Wagemann, 2012). The results of the analysis of necessary conditions for each model are presented in Table 4. As in this study, we are only interested in analyzing whether Twitch helps to increase the returns of video game companies; we have only performed the analysis for the presence of the outcome. None of the conditions has a consistency greater than 0.9 in any models, so there is no necessary condition.

4.2. Analysis of sufficient conditions

Once the necessary conditions were analyzed, sufficient conditions were analyzed. In this analysis, a truth table is constructed, in which all possible logical combinations of causal conditions that can lead to the outcome are shown. In this case, the total number of possible combinations in each proposed model was 16 (2^4, where four is the number of causal conditions used in each model). The truth table shows all possible logical combinations and cases that satisfy these combinations. Combinations containing no cases (logical reminders) were excluded from the analysis. The last step in performing the analysis is establishing the cut-off consistency, which in this case is 0.8 (Ragin, 2008; Fiss, 2011).

Tables 5- 8 present each model's intermediate solution of the fsQCA standard analysis. The solution consistency must be over 0.75; however, it is necessary to pay attention to the background, characteristics, and cases when selecting the consistency threshold (Schneider and Wagemann, 2006). So, the consistency threshold was set to 0.7. Since there is little prior literature to reference, particularly on Twitch, choosing the consistency threshold a lower (0.7) allows more possible combinations leading to the outcome to be included. All four models except model 4 have a consistency greater than the established threshold. In terms of coverage, a model is considered informative when it has a coverage between 0.25 and 0.65 (Ragin, 2008). All models meet this condition except model 4, which has a higher coverage (0.75).

Tables 5-8 also show the consistency of each configuration, the raw consistency, and the unique consistency. Configuration consistency measures the degree to which the configuration is a subset of the outcome, raw coverage explains the degree to which the configuration represents the outcome. Unique coverage indicates the proportion of membership in the outcome explained only by each individual

Table 2
Calibration values and statistics.

	Statistics						Calibration values				Fuzzy values descriptive			
	N	Mean	Std. Dev.	Min.	Max.		90 %	50 %	10 %		Mean	Std. Dev.	Min.	Max.
Outcome														
RET	44	23.35	34.52	−38.59	115.12		57.002	24.785	−20.368		0.503	0.35	0.016	0.9997
Conditions														
VIECH	44	36.49	16.78	10.08	78.56		57.96	33.19	20.57		0.478	0.348	0.005	0.9955
SG	44	194593.81	225342.85	8639	900006.5		444557.8	86.657.125	20281.72		0.479	0.36	0.030	0.9988
ESG	44	60.98	18.866	26	93		82	61.5	37.9		0.507	0.374	0.012	0.9893
PER	44	35.17	23.64	8.14	117.6		60.752	29.265	15.283		0.459	0.341	0.012	0.9997
ESGS	44	67.57	18.52	44	98		97	63.5	45		0.491	0.347	0.043	0.954
ESGM	44	47.18	28.18	0	86		78	48.1	2		0.54	0.361	0.044	0.9766
ESGG	44	62.81	20.32	25	96		94	66.1	28.6		0.486	0.296	0.038	0.9591

Table 4
Analysis of necessary conditions.

	Model 1			Model 2			Model 3			Model 4		
	Cons.Nec	Cov.Nec	RoN	Cons.Nec	Cov.Nec	RoN	Cons.Nec	Cov.Nec	RoN	Cons.Nec	Cov.Nec	RoN
FSVIECH	0.565	0.595	0.729	0.565	0.595	0.729	0.565	0.595	0.729	0.565	0.595	0.729
FSSG	0.596	0.626	0.744	0.596	0.626	0.744	0.596	0.626	0.744	0.596	0.626	0.744
FSPER	0.535	0.586	0.740	0.535	0.586	0.740	0.535	0.586	0.740	0.535	0.586	0.740
FSESG	0.614	0.608	0.712									
FSESGS				0.599	0.613	0.728						
FSESGM							0.668	0.622	0.693			
FSESGG										0.680	0.703	0.781
~FSVIECH	0.640	0.616	0.705	0.640	0.616	0.705	0.640	0.616	0.705	0.640	0.616	0.705
~FSSG	0.611	0.589	0.691	0.611	0.589	0.691	0.611	0.589	0.691	0.611	0.589	0.691
~FSPER	0.702	0.652	0.709	0.702	0.652	0.709	0.702	0.652	0.709	0.702	0.652	0.709
~FSESG	0.562	0.573	0.707									
~FSESGS				0.623	0.616	0.715						
~FSESGM							0.544	0.595	0.744			
~FSESGG										0.566	0.554	0.680

Table 5
Analysis of sufficient conditions. The intermediate solution. Model 1.

RET	1	2	3	4
VIECH			○	●
SG	●	●		
ESG	●		●	○
PER		○	○	○
Raw coverage	0.39	0.41	0.32	0.30
Unique coverage	0.10	0.06	0.05	0.03
Consistency	0.73	0.77	0.82	0.80
Solution coverage	0.62			
Solution consistency	0.72			

Note: ● = Core causal condition (present). ● = Peripheral causal condition (present). ○= Core causal condition (absent). ○= Peripheral causal condition (absent). Blank spaces indicate "do not care."

Table 6
Analysis of sufficient conditions. The intermediate solution. Model 2.

RET	1	2	3	4
VIECH			○	●
SG	●	●		
ESGS	●		●	○
PER		○	○	○
Raw coverage	0.41	0.41	0.29	0.34
Unique coverage	0.13	0.05	0.04	0.07
Consistency	0.74	0.77	0.82	0.82
Solution coverage	0.66			
Solution consistency	0.73			

Note: ● = Core causal condition (present). ● = Peripheral causal condition (present). ○= Core causal condition (absent). ○= Peripheral causal condition (absent). Blank spaces indicate "do not care."

configuration (De Crescenzo et al., 2021, p.584).

For Model 1 (Table 5), the four configurations had good consistency (greater than 0.7) and acceptable coverage (between 0.25 and 0.65). According to Configuration 1, which accounts for 39 % of the cases, a high ratio of streamers per game and a high ESG score lead to increased returns for video game companies. Configuration 2 (41 % of cases) indicates that even though companies have a low P/E ratio, returns increase if they have a high ratio of streamers per game. According to Configuration 3 (32 % of cases), having a high ESG score, a low number of viewers per channel, and a low P/E ratio leads to increased returns.

Finally, Configuration 4 (30 % of cases) indicates that a high number of viewers per channel, with a low ESG score and a low P/E ratio, leads to increased returns. What emerges from these four configurations is that investors consider Twitch statistics and the level of sustainability of videogame companies when deciding whether or not to invest in them, without considering fundamental variables such as the P/E ratio. These results confirm H1, H3, and H4 and are consistent with Johnson and Woodcock (2019), Kim and Kim (2022), and Oh and Kim (2022), as they highlight the relevance of Twitch for video game companies. Also agree with Cheung (2011), Friede et al. (2015), Zhang et al. (2018) and Chiu

Table 7
Analysis of sufficient conditions. The intermediate solution. Model 3.

RET	1	2	3	4
VIECH	●	●	○	○
SG	●	●	●	○
ESGM	●		○	●
PER		●	○	○
Raw coverage	0.26	0.24	0.24	0.24
Unique coverage	0.02	0.03	0.07	0.09
Consistency	0.83	0.87	0.87	0.83
Solution coverage	0.47			
Solution consistency	0.82			

Note: ● = Core causal condition (present). ● = Peripheral causal condition (present). ○ = Core causal condition (absent). ○ = Peripheral causal condition (absent). Blank spaces indicate "do not care."

Table 8
Analysis of sufficient conditions. The intermediate solution. Model 4.

RET	1	2	3
VIECH			○
SG		●	○
ESGG	●		
PER		○	●
Raw coverage	0.68	0.41	0.22
Unique coverage	0.27	0.04	0.03
Consistency	0.70	0.77	0.79
Solution coverage	0.75		
Solution consistency	0.69		

Note: ● = Core causal condition (present). ● = Peripheral causal condition (present). ○ = Core causal condition (absent). ○ = Peripheral causal condition (absent). Blank spaces indicate "do not care."

et al. (2020) among others on the existence of a positive influence of sustainability on stock returns, in this case, of video game companies.

Model 2 (Table 6) shows the four configurations that lead to increased yields. All four configurations have a consistency greater than 0.7 and a coverage between 0.25 and 0.65, so they can all be considered for the analysis. The four configurations are the same as in Model 1, with the difference that instead of the ESG score, the social ESG score (ESGS) is included in this case. The fact that the result is similar to that of the model using the overall ESG score may indicate that investors give the same importance to overall sustainability information as social. This is reasonable since this is where there is usually the most conflict and controversy within this sector.

For Model 3 (Table 7), four configurations had good consistency (greater than 0.7), but only one configuration with an acceptable coverage (between 0.25 and 0.65). Despite being the model with the highest consistency (0.82), three of the four configurations do not have sufficient coverage; therefore, the only relevant configuration in this model is Configuration 1. According to Configuration 1, which accounts for 26 % of the cases, a high ratio of viewers per channel and streamers per game and a high ESG score lead to an increase in the returns for video game companies. Again, you can see how relevant Twitch stats are to investors.

Although Model 4 does not meet the established level of consistency (0.7), it is relevant to note that one of its configurations has a consistency higher than 0.75 and a coverage higher than 0.25, as required by Ragin (2008). However, the configurations of this model were excluded from the analysis because of the consistency of the solution. The results obtained in Models 2–4 confirm H1, H3, H4, and H5 because not all three sustainability categories have the same influence. Unlike Ziegler et al. (2007), both environmental and social sustainability positively influence stock returns, with governance being the only category that has no effect.

The results of these four models have the following implications. First, having high statistics on Twitch means that the company's video games are successful, which positively impacts the company's share price. This means that some investors consider what happens on Twitch one of the variables to consider when deciding to invest in the company. Sustainability is another variable that has already been shown to be important to investors and impacts the company's share price. In this case, for the video game industry, investors consider the social and environmental dimensions; that is, a company with high social ESG and environmental ESG scores makes it more attractive to investors. Finally, it is worth noting that the combinations obtained indicate that investors consider Twitch and ESG when making their decisions.

4.3. Analysis of consistency and coverage distances

Tables 9-11 show the POCONS and BECONS and the distance measures for each configuration of the abovementioned models. Model 4 was excluded from this analysis as it was excluded from the fsQCA analysis. POCONS in all three models was above the threshold of 0.70, as in the fsQCA analysis.

The distances of BECONS were greater than those of WECONS in all three models. This indicates that time effects dominate cross-sectional

Table 9
Cluster consistencies and coverages for Model 1.

	1	2	3	4
Consistency				
Pooled	0.732	0.770	0.815	0.796
Between 2018	0.471	0.465	0.583	0.577
Between 2019	0.876	0.994	0.974	1.000
Between 2020	0.849	0.931	0.840	0.917
Coverage				
Pooled	0.385	0.407	0.324	0.299
Between 2018	0.499	0.574	0.420	0.570
Between 2019	0.328	0.380	0.336	0.281
Between 2020	0.405	0.365	0.266	0.200
Distances				
Between to Pooled	0.146	0.171	0.117	0.127
Within to Pooled	0.042	0.052	0.047	0.048

Table 10
Cluster consistencies and coverages for Model 2.

	1	2	3	4
Consistency				
Pooled	0.738	0.770	0.816	0.821
Between 2018	0.490	0.465	0.600	0.602
Between 2019	0.837	0.994	1.000	1.000
Between 2020	0.888	0.931	0.825	0.985
Coverage				
Pooled	0.412	0.407	0.287	0.343
Between 2018	0.555	0.574	0.409	0.670
Between 2019	0.332	0.380	0.283	0.298
Between 2020	0.446	0.365	0.239	0.254
Distances				
Between to Pooled	0.138	0.171	0.117	0.123
Within to Pooled	0.041	0.052	0.047	0.041

Table 11
Cluster consistencies and coverages for Model 3.

	1	2	3	4
Consistency				
Pooled	0.826	0.866	0.862	0.830
Between 2018	0.685	0.681	0.581	0.710
Between 2019	0.853	0.907	1.000	0.995
Between 2020	0.955	0.956	0.930	0.720
Coverage				
Pooled	0.256	0.238	0.243	0.243
Between 2018	0.449	0.295	0.267	0.441
Between 2019	0.190	0.207	0.236	0.265
Between 2020	0.250	0.251	0.240	0.130
Distances				
Between to Pooled	0.077	0.082	0.126	0.094
Within to Pooled	0.033	0.030	0.032	0.046

effects (García-Castro and Ariño, 2016). Hence, only the consistency and coverage between years were analyzed for the configurations of each model. Analysis of the BECONS shows that they have not had a stable evolution over time but that there is a considerable difference between 2018 and the other two years (2019 and 2020). These results show evidence of time effects, which may be due first to the growth that Twitch (2019) had and the confinement during COVID (2020), which caused an exponential increase in both viewers and streamers on the platform. The fact that the consistencies are higher during the last two years means that Twitch statistics have been more relevant for investors and, thus, have contributed to the increased returns of video game companies. Investor awareness of sustainability has also increased in recent years. An increasing number of investors are paying attention to measures such as ESG when making decisions, which is also reflected in these results. The BECOV (between-coverage) analysis also shows variations between years, again highlighting the time effect's existence. These results confirm H2 and H6, as it is clear how Covid-19 has influenced the

relationship between Twitch and returns and sustainability and returns. It should be noted that in this case, it has been shown that the environmental and social scores during Covid-19 positively influenced returns, unlike Yoo et al. (2021), who only found this positive influence on the environmental score. Therefore, although Covid-19 has been a problem for many sectors, the video game industry has not been as affected by it, partly due to the increase in viewers on streaming platforms (Morse et al., 2021) and, specifically, on Twitch, as reflected in the analysis of the temporal effect.

5. Conclusion

This study analyzes the relationship between Twitch, sustainability, and stock returns of major video game companies, distinguishing between different sustainability scores (E, S, and G) before and during Covid-19. The results confirm the positive relationship between twitch, stock returns, and sustainability. Specifically, the G score is insignificant if sustainability is broken down into three categories. Regarding the effect of Covid-19 on this relationship, it is observed that the relationship is indeed more pronounced during the pandemic years, confirming that Covid-19 has had a positive effect on the gaming sector.

The results of this study have several practical implications. First, the results indicate that certain types of investors prioritize Twitch statistics and the company's level of sustainability over more accounting-based information, such as the P/E ratio, in making their investment decisions. In addition, within the information on sustainability, the most relevant for investors are environmental and social; that is, regarding emissions, innovation (E), and workers and human rights (S). This means that if any gaming companies have a scandal about these two categories, investors will surely take it into account, and there will be a decrease in the stock return.

This study is one of the first to use a method such as the fsQCA panel in the financial field. It is the first to analyze the relationship between Twitch and sustainability and stock returns in the gaming sector. In terms of contribution, it has been shown that Covid-19 has not been detrimental to this sector. Twitch and sustainability, particularly the social and environmental dimensions, are variables that investors consider when making decisions. This study has certain limitations. First, the gaming sector is an industry that has many companies, mostly small- and medium-sized and indie, which makes it very complicated to collect information. Therefore, the sample for the analysis was reduced to companies that had their games among the top 100 most-viewed games on Twitch each year and listed on the stock exchange to access the information. Another limitation, derived from a previous study, is the limited number of cases to be analyzed. To mitigate this limitation, the fsQCA methodology was used, which allows analysis with a reduced number of observations. This is the first step that opens up many future research directions. The next step could be to analyze a larger number of years or perform a quantitative analysis using daily data and include another series of variables that may be of interest, such as Tobin's Q or performance.

curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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