# How Review Ratings Influence Sales on Steam

## A study in the Video Game Industry


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# Abstract

The video game industry has grown immensely. Additionally, there has been a surge of online reviews and consumers that consult online reviews in decision making. Due to this, it is important to understand the influence that online reviews have on the sale of video games. Although several studies have examined the effect of online reviews on the sale of video games, all of these studies were focused on the effect of expert- or user review ratings on console game sales. Therefore, this study investigates a new context, namely the effect of expert- and user review ratings on the sale of PC games. In addition, this study develops hypotheses on how these effects may be moderated by video game characteristics.

This research is applied on Steam, which is a platform through which video games for PC can be purchased. The number of downloads for a given game is used as the dependent variable, and expert- and user review rating are used as independent variables. Furthermore, the moderating variables are game mode (i.e. multi-player or single-player) and publisher (i.e. major publisher or minor publisher). In order to conduct this research, data on video games was collected from multiple online sources. After collection, the data was processed resulting in a clean and rich dataset of 1,203 video games. To test the hypotheses, the clean dataset was regressed using an OLS regression.

The results show that expert- and user review rating both have a positive effect on the number of downloads on Steam. However, the effect of expert review ratings is larger than that of user review ratings. Therefore, expert review ratings carry more importance for video game downloads than user review ratings. Moreover, game mode has been found to moderate the effect of user review rating on the number of downloads. If a video game has multi-player functionalities, the effect of user review rating on the number of downloads increases. Furthermore, publisher has been found to moderate the effect of expert review rating on the number of downloads. If a video game is published by a major publisher, the effect of expert review rating on the number of downloads increases.

The findings suggest that video game publishers releasing PC games should take both expert- and user review ratings into account, due to their significant effect on sales related outcomes. In addition, managers of major publishers should pay attention to practices that may improve expert ratings. This is due to the fact that effect of expert ratings on sales is strengthened when a game is released by a major publisher. Also, publishers that release multi-player games should lay emphasis on the improvement of user ratings. This is because the effect of user ratings on sales is strengthened when a game is multi-player.

# Preface

Before you lies the thesis “How Review Ratings Influence Sales on Steam: A study in the video game industry”. This thesis has been written to fulfil the graduation requirements of the Master Marketing Analytics program at Tilburg University. I was engaged in researching and writing this thesis from August to December 2021.

First, I would like to thank my supervisor, Bobbie Krijger, for her guidance and support during the process. Second, I would like to thank Max Veerhoek for helping me with fine tuning the code used to collect a part of the data necessary to conduct this analysis. Third, I would like to thank Raul Kleinherenbrink for proofreading my thesis, and providing me with mental support. If I ever lost interest or motivation, he helped me constructively, and rebuilt my interest and motivation to write my thesis.

I hope you enjoy reading my thesis.

Yours sincerely,

Marc Lefebvre

Rotterdam, December 26th, 2021

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# 1. Introduction

The video game industry has experienced meteoric growth. The initial forecast for the video game market revenue in 2020 was $159.3 billion (Newzoo, 2020). However, due to the increase in time spent at home amidst the COVID-19 pandemic, the global video game market generated a baffling $177.8 billion in 2020 (Newzoo, 2021). In addition to a spike in revenues, the market has also seen an increase in time spent playing video games. A survey conducted in the US reported that gamers spent 45% more time playing video games amid the quarantine (Bloomberg, 2020). Moreover, one of the leading online video game retailers, Steam, hit a peak of 20.3 million concurrent players which is 11% above their previous high (The Economist, 2020). In addition to an increase in playing time, the amount of people playing video games, also known as gamers, has increased. According to the Global Games Market Report by Newzoo, the amount of gamers has already grown by 5.4% from 2020 to 2021. Of the total 3 billion gamers worldwide, 1.4 billion are active on a personal computer (PC) and 0.9 billion on a console (e.g. ps4, Wii, Xbox) (Newzoo, 2021). According to a survey conducted by brightlocal, 83% of consumers in the entertainment industry look at online reviews before making a decision (brightlocal, 2020). Also, McKinsey & Company found that there was a surge in volume of online ratings and reviews, which were 87% higher in December 2020 than in December 2019 (McKinsey, 2021). The growth of the video game industry, the surge of online reviews and the importance of online reviews in consumer decision making emphasizes the significance of understanding the influence that online reviews have on video games. Against this background, this study sets out to assess the effect of online review rating on the number of PC game downloads on Steam, and to what extent video game characteristics influence this effect.

A body of prior literature that is related to the effect of online reviews on sales has been identified, and is presented in Table 1. There are three streams of literature that relate to this study. The first stream of literature investigates the effect of expert reviews on sales related outcomes in different contexts. For instance, Basuroy et al. (2003) conducted research in the movie industry and found that positive and negative expert reviews influence box office performance. A research conducted by Cox (2014) in the video game industry had similar results, whose findings show that video games with higher expert ratings are more likely to sell a larger number of units.

The second stream of literature examines the effect of user reviews on sales related

**Table 1: Prior research related to Expert- and User Reviews and their respective effect on sales related outcomes in different contexts**

| Article | Context | Expert | User | Expert vs. User | Dependent variable | Key findings | Method |
|---|---|---|---|---|---|---|---|
| (Chevalier & Mayzlin, 2006) | Books | – | ✓ | – | Book sales | Improvement in reviews leads to increase in relative sales | Differences-in-Differences |
| (Ho-Dac et al., 2013) | Blu-ray & DVD | – | ✓ | – | Blu-ray & DVD sales | Positive reviews increase sales of weak brands, no significant impact on strong brands | OLS regression |
| (Öğüt & Onur Taş, 2012) | Hotels | – | – | ✓ | Hotel room sales | A higher user rating significantly increases online sales, no significant impact of expert (star) rating | Log-linear regression |
| (Ye et al., 2009) | Hotels | – | ✓ | – | Hotel rooms bookings | Significant relationship between online reviews and hotel room sales | Fixed log-linear regression |
| (Chintagunta et al., 2010) | Movies | – | ✓ | – | Box office earnings | Valence* has a significant and positive impact on box office earnings | OLS regression |
| (Basuroy et al., 2003) | Movies | ✓ | – | – | Box office performance | Positive and negative expert reviews predict and influence box office performance. Furthermore, there is evidence of negativity bias | Time-series cross-section regression |
| (Tsao, 2014) | Movies | – | – | ✓ | Movie evaluations | Greater importance is attached to user reviews than expert reviews | Between-subject factorial design |
| (Zhu & Zhang, 2010) | Video Games | ✓ | – | – | Video game sales on console | Online reviews are more influential for less popular games, and if gamers have greater internet experience | Differences-in-Differences |
| (Zhu & Zhang, 2006) | Video Games | – | ✓ | – | Video game sales on console | Online consumer reviews have a significant influence on the sale of video games | Differences-in-Differences |
| (Cox, 2014) | Video Games | ✓ | – | – | Video game sales on console | Games with higher expert ratings are significantly more likely to sell a greater number of units | OLS regression |

**Valence: Mean user rating*

outcomes in an array of different contexts, such as the hotel- (Ye et al., 2009), movie- (Chintagunta et al., 2010), and video game industry (Zhu & Zhang, 2006). In addition, research has been conducted on the sale of books and DVDs. For instance, Chevalier & Mayzlin (2006) found that the improvement of online book reviews leads to an increase in sales. Furthermore, research by Ho-Dac et al. (2013) on the sale of DVDs found that positive user review ratings increase sales of weak brands. However, user review ratings do not have a significant effect on strong brands.

The third stream of literature is concerned with the difference between effect of expert- and user ratings on sales related outcomes in different contexts. For example, Tsao (2014) found that greater importance is attached to user reviews than expert reviews in the movie industry. Furthermore, research conducted in the hotel industry by Ögüt & Onur Tas (2012) found that a higher user rating significantly increases online sales, whilst expert rating has no significant influence.

The main focus of this study is positioned in the third stream of literature. In addition, the distinct effects of expert- and user reviews, which are the first and second stream of literature, are included. Furthermore, and contrary to prior research in the video game industry, this study is focused on PC games instead of console games. In order to further discuss the relevance of this study, it is necessary to clarify and elaborate on the difference between PC and console gamer audiences. First, the differences in hardware (PC vs. console) will be discussed. Second, the different types of gamers will be described.

PC is notorious for its superiority in terms of computing power, which improves the graphics and speed of video gameplay. The hardware can continually be upgraded by the owner of a PC in order to keep it up-to-date. However, installing hardware upgrades requires additional investment and knowledge of the PC. Also, the initial investment for a new PC is significantly higher than a new console. Although the initial investment for a console is relatively low, games have been found to be more expensive. Furthermore, consoles are mainly built for usability. Additionally, no prior knowledge of the system is necessary due to the fact that hardware upgrades are not an option. An upgrade of console hardware only happens when a new console is released (Pakhrani et al., 2020; Johnson, 2021).

According to market research conducted by Clairfield International, gamers can be categorized into three different groups; hardcore gamers, casual gamers, and mass market gamers. Hardcore gamers are mainly categorized by their hefty investments in state-of-the-art gaming equipment, and the large amount of time they spend playing video games. Casual gamers play games regularly, but not as much as hardcore gamers. Moreover, casual gamers

have been known to be far more price-sensitive than hardcore gamers. Mass market gamers do not spend a lot of time playing video games (Clairfield International, 2018). Although all three categories can be spread across PC and console, the amount of hardcore gamers is still skewed towards PC. According to the CEO of anzu.io (a sophisticated in-game advertising company), the PC gaming usually attracts gamers with a hardcore streak. Therefore, PC may serve as a proxy for hardcore gamers who spend more time and money on gaming. In addition, as game review ratings are most often presented on websites and PC gamers are already active on their PCs, it may be that the threshold to view review ratings on PC is lower than on console. Moreover, user review ratings on the Steam platform are readily presented, which further lowers the threshold for this segment. Also, when taking the price-sensitivity of casual gamers into consideration, it can be said that casual gamers may prefer a console over a PC. All the beforementioned reasons likely indicate a difference in the consumer segment for PC and console gamers, and thus make the PC audience an interesting and relevant consumer group to investigate.

This study has multiple contributions to existing literature. First, the main aim is to research the difference of effect, and thus the relative importance, of expert- and user reviews on sales related outcomes in the video game industry. Prior research has investigated the difference in importance between expert- and user reviews. However, this research was focused on the movie- and hotel industry (Öğüt & Onur Taş, 2012; Tsao, 2014). This entails that this study will present new insights into the relative importance of expert- and user reviews in the video game industry.

Second, this study examines the effect of expert reviews on sales related outcomes for PC games. As discussed before, it can be argued that there is a difference between PC and console gamers. Prior studies on the influence of expert reviews in the video game industry were explicitly focused on console games (Cox, 2014; Zhu & Zhang, 2010). Therefore, this study contributes to the existing literature on the effect of expert reviews in the video game industry by adding a new dimension, namely PC games.

Third, this study focuses on the effect of user reviews on sales related outcomes for PC games. Prior research has been conducted for this effect on the sale of books (Chevalier & Mayzlin, 2006), DVDs (Ho-Dac et al., 2013), and movies (Basuroy et al., 2003; Chintagunta et al., 2010). In terms of video games, only Zhu & Zhang (2006) researched the effect of user reviews on console game sales. Therefore, this research contributes to the existing literature by concentrating on PC games as a new dimension.

In summary, this study investigates what the effect of expert- and user review ratings is on sales related outcomes for PC games in the video game industry. To be more specific, the sales related outcome that will be used in the analysis is the number of downloads a game has on the Steam platform. In addition to the distinctive effects, the relative importance of expert- and user reviews will be examined. Furthermore, video game characteristics will be included as moderators. The video game characteristics that will be included are publisher (i.e. major- or minor publisher) and game mode (i.e. single- or multiplayer).

The findings of this research may yield practical implications for the video game industry. First, managers and marketers of video game publishers may gain insight into the distinct importance of expert- and user review ratings on sales of their games. In addition, it may become clear which review type carries more weight and deserves priority when deciding a publishing strategy for a PC video game. Second, publishers of single-player and/or multi-player games may gain awareness of which review type yields the most value for their video games in terms of sales. Third, minor- and major publishers may gain an understanding of which review rating holds the highest relative importance for sales.

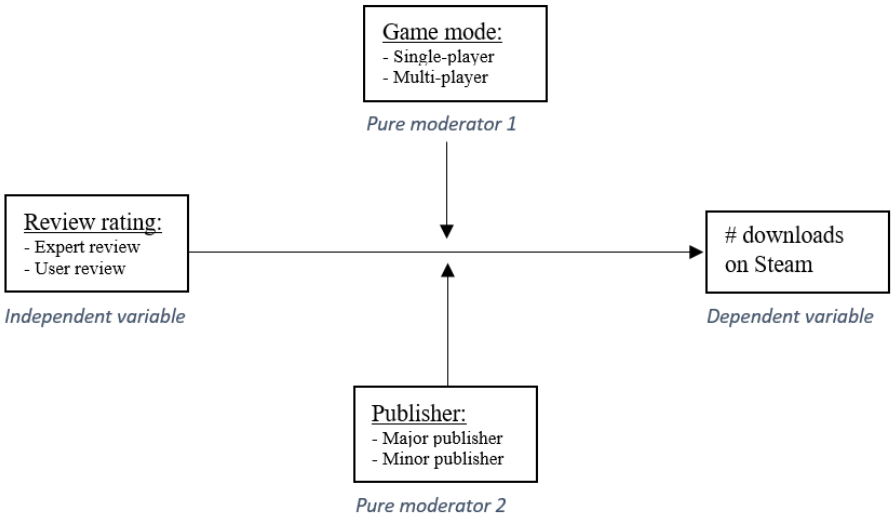
This thesis is structured as follows. First, the theoretical framework will be introduced. In this chapter, the conceptual model will be presented followed by the justification of all relevant hypotheses. Second, the methods used in this research will be elaborated on. This chapter will encompass the data collection, processing, and description, followed by the statistical analysis that will be used to test the data. Third, the results of the statistical analysis will be discussed. This chapter will initially delve into the model fit, followed by a thorough elaboration on all relevant findings. Fourth, conclusions and recommendations will be given based on the findings. This is the concluding chapter of this thesis and will, in addition to elaborating on the theoretical and managerial implications, present insight into the limitations of this research and what further research may be interesting.

# 2. Theoretical framework

## 2.1 Conceptual framework

The conceptual framework for this research is presented in Figure 1. The framework consists of the main effect of expert- and user reviews on number of downloads on Steam. In addition, the main effect is moderated by video game characteristics (i.e. game mode and publisher).

**Figure 1 - Conceptual Framework**




## 2.2 Hypotheses

### 2.2.1 The main effect of expert reviews on Nr. of downloads on Steam

In order to understand the conceptual model, it is necessary to define the variables included. Review rating is separated in two distinct variables, namely Expert review (i.e. ratings by experts, critics or professionals in a respective industry; Cox, 2014; Chen et al., 2011) and User review (i.e. rating by a user or consumer assessing the quality of a product or service; Ho-Dac et al., 2013). Furthermore, the number of downloads on Steam (written as: # of downloads on Steam) represents the number of downloads for a particular game on the Steam platform.

As mentioned before, a basis of extant literature exists on the effect of expert reviews on sales related outcomes. In the movie industry, Basuroy et al. (2003) found that positive (and negative) critic reviews influence and predict box office revenue. A study conducted in the movie industry presents similar results, indicating that higher expert ratings significantly impact returns (Chen et al., 2011). In terms of the video game industry, studies by both Cox (2014) and Zhu & Zhang (2010) support these findings, offering evidence that suggest that the purchasing decision of consumers in the video games market is significantly influenced

by expert review scores. In addition, Zhu & Zhang (2010) propose that expert reviews are more influential for less popular games. The findings of the beforementioned studies indicate a clear direction regarding the influence of expert reviews on sales related outcomes. This study argues that this holds for PC games. The reasoning behind this is twofold. First, the movie- and video game industry are both entertainment based industries and this study may yield similar results. Second, despite the dissimilarities between PC and console gamers, the general effect of expert reviews will be similar as it is still centred around video games. This leads to the following hypothesis:

$H_1$: Expert reviews positively influence the number of downloads on Steam.

### 2.2.2 The main effect of user reviews on Nr. of downloads on Steam

There is an extensive basis of literature available on the effect of user reviews on sales related outcomes. A multitude of studies in different contexts have presented similar results. For instance, studies concerning the sale of books (Chevalier & Mayzlin, 2006), new products (Cui et al., 2012), mobile phones (Decker & Trusov, 2010), and rooms in hotels (Jenq, 2019; Ye et al., 2009) all found significant relationships with user reviews. More importantly, studies conducted in entertainment based industries such as the movie industry suggest similar results. For example, Chintagunta et al. (2010) found that the mean user rating is one of the main drivers of box office performance. However, a study by Liu (2006) contradicts this stating that instead of the mean user rating, the volume of user reviews offers explanatory power for box office performance. Although volume might carry more explanatory power, Duan et al. (2014) suggests that the mean user rating significantly influences the volume of user reviews, which subsequently influences box office performance. In addition to the movie industry, findings from a study by Zhu & Zhang (2006) suggests that user reviews have a significant influence on the sale of video games. The findings of the video game- and movie industry, which are both entertainment based industries, combined with the general consensus of other contexts that user reviews influence sales related outcomes leads to the following hypothesis:

$H_2$: User reviews positively influence the number of downloads on Steam

### 2.2.3 The difference in effect of user- and expert reviews on Nr. of downloads on Steam

Although there is a scarce amount of extant literature regarding the difference in effect of expert- and user reviews on sales related outcomes in the video game industry, there is an array of literature from other industries available. Prior research from the hotel industry

found that consumers relate more to opinions of peers, rather than those of professionals (De Langhe et al., 2016). Ögüt & Tas (2012) had similar findings, suggesting that a higher user rating for hotels significantly increases online sales whilst an expert defined star rating does not. A study from the movie industry supports these findings, stating that potential moviegoers attach greater importance to consumer reviews than to critic reviews (Tsao, 2014). However, this is contradicted by two recent studies. These studies suggest that expert ratings are more influential for moviegoing decisions than user ratings. This is due to the fact that experts are critical, more consistent, and that expert reviews have a larger influence on the movie industry as a whole (Basuroy et al., 2020; Souza et al., 2019). Research on the video game industry builds upon these findings, proposing that user reviews are often highly polarized, whilst expert reviews are more balanced over time (Santos et al., 2019). The beforementioned literature leads to the impression that expert reviews are valued more, relative to user reviews in an entertainment oriented industry due to their consistency and reliability. Furthermore, research in the movie industry suggests that infrequent moviegoers are influenced to a greater extent by user reviews, whilst frequent moviegoers are influenced to a greater extent by expert reviews (Chakravarty & Mazumdar, 2016). As mentioned in the introduction, PC gamers are often more invested in the act of playing video games relative to console gamers. Therefore, this study argues that PC gamers may be similarly classified as frequent moviegoers, thus placing more emphasis on the importance of expert reviews. This leads to the following hypothesis:

$H_3$: Expert reviews positively influence the number of downloads on Steam more than user reviews.

### 2.2.4 The moderating effect of game mode

The first moderator is game mode. Game mode is the manner in which a video game can be played. This can be multi-player, which means the video game can be played (online) by more than one player. Conversely, single-player means the video game can be played by one player (Situmeang et al., 2014; Cole & Griffiths, 2007).There is a limited amount of extant literature on the influence of game mode on the relationship between expert- and user reviews and sales related outcomes. Cox (2014) found a significant effect concerning the number of players that were able to play a video game. The more players were able to play, the more games were sold (Cox, 2014). Moreover, prior research about video games has found that mode of play predicts the time spent playing, and that there is a positive relationship between the social aspects of playing video games and time spent playing (Cole

& Griffiths, 2007; Johnson et al., 2016). Furthermore, Zhu & Zhang (2010) suggest that user reviews are more important for games that are played online. Although time, as mentioned by Cole & Griffiths (2007) and Johnson et al. (2016), is not a perfect indication of preference in terms of game mode, it does give an idea towards the social aspects of gaming. When taking the social aspects and the findings of Cox (2014) into consideration, it can be said that the single-player (and thus less social) games are more focused on the quality of the game (expert opinions) than the opinion of other players. Therefore, this study formulates the following hypothesis:

$H_4$: The positive effect of expert reviews on the number of downloads on Steam is stronger (weaker) when game mode is single-player (multi-player)

Furthermore, based on the literature, this study argues that multi-player (online) games are more likely to have a stronger influence on the relationship between user reviews and the number of downloads on Steam than single-player games. The reasoning behind this is twofold. First, multi-player games are played by a large community of gamers and thus user (gamer) opinions are regarded highly. Second, user reviews have been found to have a significant impact on the performance of games that are played online (Zhu & Zhang, 2010). This leads to the following hypotheses:

$H_5$: The positive effect of user reviews on the number of downloads on Steam is stronger (weaker) when game mode is multi-player (single-player)

### 2.2.5 The moderating effect of publisher

The second and final moderator is publisher. A publisher is the company that publishes a video game to the market for sale to the general public (Cox, 2014). In context of this study, a major publisher is a company with an annual revenue above $50 million and a minor publisher is a company with an annual revenue below $50 million. This cut-off points was determined by examining publisher revenues online, and creating a clear divide between high and low grossing publishers. Once again, a limited amount of extant research on the video game industry is available. Prior research conducted on the movie industry found that movie stars and budgets moderated the impact of expert reviews on movies (Basuroy et al., 2003). Moreover, Souza et al. (2019) found that the influence of expert reviews on blockbusters is null, whilst the influence on small release films is large. The findings in these academic sources lead to the following hypothesis:

$H_6$: The positive effect of expert reviews on the number of downloads on Steam is stronger (weaker) when the game is released by a minor publisher (major publisher).

Furthermore, a study conducted by Zhu & Zhang (2010) found that online user reviews were more influential for less popular games. In addition, Ho-Dac et al. (2013) supports this stating that online user reviews increases the sale of brands with low brand equity. The beforementioned findings lead to the following hypothesis:

$H_7$: The positive effect of user reviews on the number of downloads on Steam is stronger (weaker) when the game is released by a minor publisher (major publisher).

# 3. Method

In this chapter the data collection, processing, description and statistical method will be discussed. The goal of this research is to assess what the effect of expert- and user review rating is on the number of PC game downloads on Steam, and to what extent video game characteristics influence this effect. In order to assess this effect, data on expert- and user ratings, video game characteristics (publisher and game mode), and control variables (release date and price) has to be collected. The method that will be used to assess this effect is OLS regression. All files that are mentioned in this chapter can be found in this study's respective GitHub repository (See Appendix A).

## 3.1 Data collection

To test the conceptual framework, data for all included variables has to be collected. A detailed description of all variables is provided in Table 2. There are three sources from which the data is collected, each source will be discussed in the following paragraphs.

First, data is collected from Kaggle.com, which is a website that offers its users the ability to share and collaborate on datasets. From this website a rich Steam store dataset is downloaded. The dataset is named *Steam Store Games (Clean dataset)*, and is developed and shared by Nik Davis. The dataset contains data from 27,075 game titles released between 1998 and 2019. Data on user reviews (x2), game mode (m1), publisher (m2), release date (c1, c2), and price (c3) is available in this dataset.

Second, expert review (x1) data is collected from steamspy.com, which is a Steam stats service which automatically gathers data from Steam user profiles using a Web API. To collect data from steamspy, a web scraper is developed. This web scraper uses the game IDs provided in the Kaggle dataset to create a list of unique URLs which are used to scrape all necessary web pages.

Third, the number of downloads per game on Steam (y) is collected from SteamDB, which is a third-party website that gives insight into the Steam platform and its database. Similar to the last steamspy scraper, the collection method for SteamDB will involve a web scraper. However, in order to correctly scrape this website, the web scraper detects a temporary ban and waits until it is able to continue scraping in addition to using the game IDs to create unique URLs.

**Table 2: Detailed description of variables**

| Variable | Measurement | Description | Data source |
|---|---|---|---|
| # Downloads on Steam (y) | Ratio | Number of game owners on Steam | SteamDB |
| Expert review (x1) | Ratio | Average expert review rating per game | steamspy |
| User review (x2) | Ratio | Average user review rating per game | Kaggle |
| Game mode (m1) | Nominal | Dummy variable: 0 for multi-player, 1 for single-player | Kaggle |
| Publisher (m2) | Nominal | Dummy variable: 0 for minor publisher, 1 for major publisher | Kaggle |
| Release date old (c1) | Nominal | Dummy variable: 0 for > 2010, 1 for <=2010 | Kaggle |
| Release date mid (c2) | Nominal | Dummy variable: 0 for < 2011 & 2016 <, 1 for >=2011 & <= 2016 | Kaggle |
| Price (c3) | Nominal | Dummy variable: 0 for paid, 1 for free | Kaggle |

## 3.2 Data processing

Before the collected data can be analysed, it is necessary to process the data with the goal of creating one final, clean dataset consisting of all the variables in the conceptual framework. The data cleaning process can be broken down into three succinct phases. These phases will be elaborated on further in the following paragraphs.

Phase one is aimed at cleaning the readily available Kaggle dataset. After the dataset is loaded, the first course of action is to remove all games with no playing time. This step reduces the total number of observations from 27,075 to 6,170. After this is done, the total amount of negative and positive user reviews are summed in a new column. All games with less than 1000 total user reviews are removed. The reasoning behind this is that as user review rating is a percentage, a game with a low amount of total reviews may skew the results. This further reduces the total amount of observations to 2,366. Next, any unnecessary columns are removed. Finally, all game IDs of the remaining observations are extracted. These IDs are used in the steamspy and SteamDB web scraper.

Phase two is focused on importing, merging and cleaning the steamspy web scraper results. After the necessary datasets are loaded and imported, all datasets are merged. Next, all expert review rows with NA values are removed, reducing the total number of observations to 1,203. This is followed by the removal of all unnecessary columns and

categories. After this, the expert rating variable is changed to a percentage, and both expert rating and user rating are rounded to two decimals in order to match in terms of notation. Finally, a dummy variable is created for game mode (m1).

Phase three seeks to import, merge and clean the SteamDB web scraper results. In addition, a dummy variable for publisher (m2) is created. The first course of action is to create a dataset of all unique publishers. This dataset can subsequently be used to code the dummy variable by systematically searching for the annual revenue per publisher online[1]. When this is completed, the months and days of release date are removed in order to merely depict the year of release. This is followed by the creation of dummy variables for the control variables release date (c1, c2) and price (c3). The dummy variables for release date are computed as follows: c1 covers all games prior to 2011, and c2 covers all games from 2011 to 2016. A dummy for all games released after 2016 is not included due to collinearity issues. The dummy variable for price is computed to determine if a game is offered for free or not. Finally, publisher and the SteamDB results are merged into one final, clean dataset.

## 3.3 Data description

After the data is processed, the final dataset consists of 1,203 video game titles. When observing the descriptive statistics in Table 3, the data suggests that the mean of both expert- and user reviews are high. Past research has found similar patterns in review ratings for video games on Xbox and PS2 (Zhu & Zhang, 2010) and book reviews on Amazon.com (Chevalier & Mayzlin, 2006). In terms of the moderators, there is a significantly higher amount of

**Table 3: Descriptive Statistics**

| Variable | N | 0 | 1 | Min | Max | Mean | SD |
|---|---|---|---|---|---|---|---|
| **Dependent variable** | | | | | | | |
| # Downloads on Steam (y) | 1203 | | | 140000 | 80500000 | 3030000 | 3990000 |
| **Independent variables** | | | | | | | |
| Expert review (x1) | 1203 | | | 0.23 | 0.96 | 0.762 | 0.0966 |
| User review (x2) | 1203 | | | 0.13 | 0.99 | 0.829 | 0.126 |
| **Moderators** | | | | | | | |
| Game mode (m1) | 1203 | 502 | 701 | 0 | 1 | 0.583 | 0.493 |
| Publisher (m2) | 1203 | 701 | 502 | 0 | 1 | 0.417 | 0.493 |
| **Control variables** | | | | | | | |
| Release date old (c1) | 1203 | 986 | 217 | 0 | 1 | 0.180 | 0.385 |
| Release date mid (c2) | 1203 | 468 | 735 | 0 | 1 | 0.611 | 0.488 |
| Price (c3) | 1203 | 1120 | 83 | 0 | 1 | 0.069 | 0.254 |

[1] Websites: zoominfo.com, owler.com, growjo.com, games-stats.com, dnb.com, rocketreach.co, vginsights.com.

single-player games present in the dataset than multi-player games. Furthermore, there is a higher amount of minor publishers in the dataset than major publishers. When taking a closer look at the descriptive statistics for game mode presented in Table 4, it is notable that the mean user review rating for single-player games is significantly higher than multi-player games. In addition, single-player games have a lower mean when it comes to downloads in comparison to multi-player games. The summary statistics of publisher also present notable insights. The data suggests that minor publishers receive a significantly higher mean user review rating than major publishers. However, major publishers receive significantly higher mean expert review ratings than minor publishers. Intuitively, this may be explained by the origin of the games. Minor publishers may release niche, indie games with a lower production value that are enjoyed by a relatively small audience and thus receive most of their attention from users (gamers). On the contrary, there are many eyeballs aimed at the production of games that stem from major publishers. These publishers have a large amount of resources. Therefore, their games would have a higher production value resulting in an increased probability that a game is of high quality.

**Table 4: Descriptive Statistics Dummy Variables**

| **A: Summary Statistics for dummy variable game mode** | | |
|---|---|---|
| **Variable** | **Multi-player (0)** | **Single-player (1)** |
| **# Downloads on Steam (y)** | | |
| Mean (SD) | 359000 (5560000) | 2620000 (2190000) |
| **Expert review (x1)** | | |
| Mean (SD) | 0.762 (0.0981) | 0.762 (0.0957) |
| **User review (x2)** | | |
| Mean (SD) | 0.797 (0.141) | 0.852 (0.110) |
| **B: Summary statistics for dummy variable publisher** | | |
| **Variable** | **Minor publisher (0)** | **Major publisher (1)** |
| **# Downloads on Steam (y)** | | |
| Mean (SD) | 2580000 (2300000) | 3650000 (5480000) |
| **Expert review (x1)** | | |
| Mean (SD) | 0.748 (0.0967) | 0.781 (0.0933) |
| **User review (x2)** | | |
| Mean (SD) | 0.843 (0.119) | 0.810 (0.134) |

## 3.4 Model

The statistical analysis that will be performed in this research is an OLS regression. The regression analysis includes a number of variables that could theoretically explain variation in the number of downloads on Steam. This is due to the fact that these variables are largely consistent or comparable with variables included in the analysis of, for instance, the

sale of console video games in the US (Cox, 2014), and the impact of reviews on movie revenues (Basuroy et al., 2020; Chintagunta et al., 2010). However, the main difference is that the beforementioned studies account for time (longitudinal data) whilst this study does not (cross-sectional data). Since the main aim of this study is to explain the variation of the y-variable as robustly as possible with the variation of the x-variables, only one model will be developed in order to capture as much variation as possible. In this model, the dependent variable will be taken as a logarithm in order to respond to skewness caused by the large size of the dependent variable. In addition, the independent variables are mean-centered in order to improve interpretation. By mean-centering, the main effects in the model can be interpreted distinctively from the moderating effects. However, mean-centering does not change the computational accuracy, sampling accuracy of main effects, moderating effects, nor the R2 (Echambadi & Hess, 2007). The functional form of the model developed for this study is as follows:

$$Log(NrDownloadsSteam_i) = \beta_0 + \beta_1 Expert_i + \beta_2 User_i + \beta_3 Expert * 1GameMode_i + \beta_4 User * 1GameMode_i + \beta_5 Expert * 1Publisher_i + \beta_6 User * 1Publisher_i + \delta_7 GameMode_i + \delta_8 Publisher_i + \delta_9 ReleaseOld_i + \delta_{10} ReleaseMid_i + \delta_{11} Price_i + \varepsilon_i$$

The unit of analysis is a video game (i). The number of downloads on Steam for a video game i in this model is depicted on the left-side of the equation. All relevant coefficients and variables are depicted on the right side of the equation. As discussed earlier in this chapter, there are: two independent variables ($\beta_1 Expert_i$ & $\beta_2 User_i$), two moderators which are represented as four variables in the equation due to their interaction with each independent variable ($\beta_3 Expert * GameMode_i$, $\beta_4 User * GameMode_i$, $\beta_5 Expert * Publisher_i$ & $\beta_6 User * Publisher_i$), and five control variables when including the two moderators distinctively as additional control variables ($\delta_7 GameMode_i$, $\delta_8 Publisher_i$, $\delta_9 ReleaseOld_i$, $\delta_{10} ReleaseMid_i$, $\delta_{11} ReleaseNew_i$, $\delta_{12} Price_i$).

# 4. Results

In this chapter the results of the beforementioned model will be discussed. First, the model will be tested for heteroskedasticity and multicollinearity, followed by a paragraph concerning the model fit. Second, the main effects and the corresponding hypotheses for

these effects will be analysed. Third, the moderating effects will be discussed in addition to their corresponding hypotheses.

## 4.1 Assumptions of the OLS regression and model fit

### 4.1.1 Heteroskedasticity

The statistical analysis used to test the conceptual framework is an OLS regression. The analysis assumes that the variance of the error term is constant and unrelated to the independent variables, also known as homoskedasticity. If the error term is heteroskedastic, the results might have incorrect standard errors. In this analysis, it is expected that the error term might be heteroskedastic due to the high variance in errors of expert- and user review ratings. This entails that the majority of the ratings will be clustered at one side of the graph, which means that the variance grows if the review is higher. In order to check for heteroskedasticity, White's test is performed. As predicted, heteroskedasticity is present in the model as the p-value of White's test falls below the critical value of 0.05. In order to correct this, Huber-White robust standard errors are used. These are standard errors that are heteroskedasticity-robust, and enable the correct interpretation of the results.

### 4.1.2 Multicollinearity

Moreover, the analysis also assumes that there is no correlation between independent variables in the OLS regression model. If there is correlation, the independent variables are not independent which can cause problems for the model fit and interpretation of results. In order to identify if there is multicollinearity present in the model, the variance inflation factor (VIF) is calculated for each variable (See Table 5). All of the variables have a VIF close to 1, which indicates that there is hardly any case of multicollinearity present in this model.

**Table 5: VIF values per variable**

| Variable | VIF |
|---|---|
| Expert review (x1) | 1.55 |
| User review (x2) | 1.59 |
| Game mode (m1) | 1.13 |
| Publisher (m2) | 1.20 |
| Release date old (c1) | 1.63 |
| Release date mid (c2) | 1.56 |
| Price (c3) | 1.07 |

4.1.3 Model fit

Two statistics are used to evaluate model fit, namely R2 and the F-statistic (See Table 6). There are differing opinions regarding what is an acceptable R2. A study from 1992 recommends that an R2 value should be equal to or greater than 0.10 in order for the variance explained of a particular construct to be deemed adequate (Falk & Miller, 1992). A study from 1998 recommends a higher R2, arguing that an R2 of 0.19 is the lowest acceptable level (Chin, 1998). Finally, a book on market research states that values between 0.10 and 0.30 are most common in cross-sectional study designs focused on research on marketing (Mooi, Sarstedt, & Mooi-Reci, 2017). The OLS regression in this study has an R2 of 0.197, which is acceptable according to all three sources. Furthermore, if the F-test has an F-statistic of at least 3.95 or higher the model stands a mere 1% chance of being wrong (Archdeacon, 1994). The OLS regression in this study has a F-statistic of 26.61 which is well over 3.95 and thus acceptable. Therefore, the model in this study can be deemed a well-fitted regression model capable of predicting values close to the observed data values.

**Table 6: OLS regression output**

| **OLS** | **β** | **P** | **SE** |
|---|---|---|---|
| *Independent variables* | | | |
| Expert rating | 0.154*** | (0.000) | 0.026 |
| User rating | 0.124*** | (0.000) | 0.030 |
| *Moderating variables* | | | |
| User rating x Game mode | -0.066* | (0.023) | 0.029 |
| Expert rating x Game mode | 0.034 | (0.169) | 0.025 |
| User rating x Publisher | 0.025 | (0.381) | 0.028 |
| Expert rating x Publisher | 0.070** | (0.008) | 0.027 |
| *Control variables* | | | |
| Publisher | 0.080** | (0.001) | 0.024 |
| Game mode | 0.081*** | (0.001) | 0.023 |
| Release old | 0.172*** | (0.000) | 0.027 |
| Release mid | 0.233*** | (0.000) | 0.029 |
| Price | 0.095*** | (0.000) | 0.025 |
| Num. Obs. | 1203 | | |
| F-statistic | 26.61 | | |
| R2 | 0.197 | | |
| R2 Adj. | 0.190 | | |
| Std. Errors. | Heteroskedasticity-robust | | |

+ p < 0.1, * p < 0.05, ** < 0.01, *** p < 0.001

## 4.2 Main effects

### 4.2.1 The main effect of expert reviews

Before elaborating on the effects, it is important to mention how the coefficients in an OLS regression table with a logarithmic dependent variable are interpreted. To illustrate, the first main effect will be used as an example. In order to get the percentage change in the dependent variable (number of downloads on Steam), the exponent of the β of expert rating is taken: exp(0.154) = 1.166461. This means that when expert rating increases by one unit, the number of downloads on Steam increases by 16.65%, ceteris paribus. In support of $H_1$, this shows that expert ratings positively affect the number of downloads on Steam (β = 0.154, p = 0.000). This aligns with literature from the movie- (Basuroy et al., 2003; Chen et al., 2011) and video game industry (Cox, 2014; Zhu & Zhang, 2010), which also found that box office revenues and the sale of video games on console are significantly impacted by expert ratings. These findings show that there are similarities between the console and PC gamer audience regarding the effects of expert reviews. There are no clear-cut contradictions of these findings in literature from reputable journals.

### 4.2.2 The main effect of user reviews

In line with $H_2$, the results show that user rating positively affects the number of downloads on Steam (β = 0.124, p = 0.000). This means that when user rating increases by one unit, the number of downloads on Steam increases by 13.20%, ceteris paribus. This effect confirms findings in existing literature, which ascertained that the sale of books (Chevalier & Mayzlin, 2006), movies (Chintagunta et al., 2010) and video games on console (Zhu & Zhang, 2006) found a significant positive relationship with user reviews. In similar fashion to the findings for expert ratings, these findings confirm that there is a similarity between the console and PC game audience when regarding the effect of user ratings. Contradicting $H_2$ is Liu (2006), who found that volume has significant explanatory power for box office revenues whilst valence does not.

### 4.2.3 The difference in effect of expert- and user reviews

In order to determine if there is a difference between the effect of expert- and user, a t-test is performed. With the t-test both variables are tested on whether the true difference between the group means is, or is not, different from 0. According to the results of the t-test, the true difference between expert- and user reviews is different from 0 ($p < 0.05$). This means that there is a significant difference between the two variables, and that the difference likely did not happen by chance. Now, when interpreting the coefficients from the table it is

evident that expert reviews have a larger effect on the number of downloads on Steam than user reviews. These results are in accordance with $H_3$, and fall in line with literature from the movie industry (Basuroy et al., 2020; Souza et al., 2019) which found that expert ratings were valued more trustworthy in comparison to user reviews. Contradictory literature regarding this hypothesized relationship is present for the hotel (De Langhe et al., 2016; Öğüt & Onur Taş, 2012) and movie industry (Tsao, 2014), which found that consumers relate more to peers than professionals.

## 4.3 Moderating effects

### 4.3.1 The moderating effect of game mode

$H_4$ is not supported, as the moderation of game mode on the effect of expert rating on the number of downloads on Steam is insignificant (β = 0.034, p = 0.169). The reasoning behind the insignificance may be that the effect of an expert rating does not depend on game mode. For instance, as mentioned in the paragraph about $H_5$, a gamer values user ratings more for multi-player games than user ratings for single-player games as the rating is posted by other gamers from the community that play that specific multi-player game. However, an expert is playing the game in order to judge it on certain parameters that they dub as important or essential. Therefore, an expert review might be viewed as a more global rating that does not depend on game mode but more on the experts knowledge and intuition about video game quality.

$H_5$ is supported, as the positive effect of user rating on the number of downloads on Steam is stronger when a game is multi-player (β = -0.066, p = 0.023). The results show that the slope decreases if a game is single-player (dummy = 1) and the user rating increases by one unit, vice versa. The distinct moderating effect shows that when a game is single-player and the user rating increases by one unit, the number of downloads on Steam decreases by 6.39%, ceteris paribus. However, the total effect of the moderator is computed by the summation of the main- and moderating effect β. Doing so shows that the initial 13.20% increase per one unit of user rating, decreases to an increase of 5.97% per one unit if the game is single-player. There is no concrete literature in line with these findings. The main intuition was built upon the assumption that a large community of gamers play multi-player games together, and thus value each others opinions highly.

### 4.3.2 The moderating effect of publisher

The results show contradictory findings for $H_6$. The positive effect of expert ratings on the number of downloads on Steam is stronger when the game is released by a major

publisher (β = 0.070, p = 0.008). This shows that the slope increases when a game is released by a major publisher (dummy = 1) and the expert rating increases by one unit, vice versa. When observing the distinct moderating effect, it is apparent that when the expert rating increases by one unit for a game released by a major publisher, the number of downloads on Steam increases by 7.25%, ceteris paribus. However, when observing the total effect of the moderator it shows that the initial 16.65% increase per one unit of expert rating increases to 25.11% if the game is released by a major publisher. Literature from the movie industry contradicts these findings, stating that the influence of expert reviews on blockbusters is not significant (Basuroy et al., 2003; Souza et al., 2019). This leads to the belief that there is an observable difference between the movie- and video game industry regarding the release of movies and games from producers with well-renowned brands and a high production budget. Furthermore, this could also be a reason why an expert review would be more favourable when rating a game released by a major publisher, as an expert may have a bias towards a high production value.

The results from the regression analysis do not support $H_7$. This is due to the fact that the moderation of publisher on the relationship between user ratings and the number of downloads on Steam is insignificant (β = 0.025, p = 0.381). This may have to do with the fact that gamers (users) do not value a game on the same parameters that experts due. Rather, gamers may value games based on overall enjoyment and thus lay less emphasis on the publisher and production value of the game.

## 4.4 Control variables

The control variables that are presented in the regression output table enhance the internal validity of the analysis. By attaching more variables that have influence on the dependent variable, the R2 increases and limits the influence of other extraneous variables. Since all the control variables are significant (P < 0.05), it is evident that they improve the model.

# 5. Conclusions and implications

## 5.1 Conclusion

This study investigates the effect of expert- and user review ratings on the number of downloads on Steam, and to what extent video game characteristics influence this effect. The beforementioned main- and moderating effects are formulated in seven distinct hypotheses (See Table 7). In order to test the hypotheses, data on 1,203 video games was collected from multiple online sources and regressed using an OLS regression. Of the seven hypothesized relationships, four are supported, one ($H_6$) found contradictory results, and two ($H_4$, $H_7$) are not supported due to insignificance of results. The main effect findings show that both expert- and user review ratings positively influence the number of downloads on the Steam platform. However, expert review ratings have a larger effect and thus carry more importance when regarding the number of downloads on Steam than user review ratings. Furthermore, the moderating variables, game mode and publisher, also yield interesting results. First, the results show that the effect of user reviews on the amount of downloads on Steam increases when the game has multi-player functionalities, instead of mere single-player functionalities. This may be due to the community feeling gamers have playing a game together (multi-player), which may result in gamers that are part, or want to be part of the community, to take user review ratings in higher regard than expert review ratings. Second, the effect of expert reviews on the number of downloads on Steam increases when the game is released by a major publisher, rather than a minor publisher. This is contradictory to the literature, which states that major publishers are most often not overly effected by review ratings.

**Table 7: Hypotheses outcomes**

| **Hypotheses** | **Outcome** |
|---|---|
| $H_1$: Expert reviews positively influence the number of downloads on Steam. | Supported |
| $H_2$: User reviews positively influence the number of downloads on Steam | Supported |
| $H_3$: Expert reviews positively influence number of downloads on Steam more than user reviews | Supported |
| $H_4$: The positive effect of expert reviews on the number of downloads on Steam is stronger (weaker) when game mode is single-player (multi-player) | Not supported |
| $H_5$: The positive effect of user reviews on the number of downloads on Steam is stronger (weaker) when game mode is multi-player (single-player) | Supported |
| $H_6$: The positive effect of expert reviews on the number of downloads on Steam is stronger (weaker) when the game is released by a minor publisher (major publisher) | Not supported |
| $H_7$: The positive effect of user reviews on the number of downloads on Steam is stronger (weaker) when the game is released by a minor publisher (major publisher) | Not supported |

## 5.2 Implications

### 5.2.1 Theoretical

This study holds multiple theoretical implications. First, in terms of expert reviews the findings of this research extend congruence of literature. Previous research from the video game industry found that expert reviews have a significant impact on the sale of video games (Cox, 2014; Zhu & Zhang, 2010). Since prior research was focused solely on the sale of console games, this study extends this stream of literature by adding PC as a new dimension.

Second, the findings of this study also enrich previous literature on user reviews. Prior research from similar industries (e.g., movie industry) presented mostly contradicting results, with the significant explanatory power of user reviews varying between its valence and volume (Chevalier & Mayzlin, 2006; Chintagunta et al., 2010; Liu, 2006). The only previous literature on user reviews from the video game industry is in line with this study, stating that user rating has a significant influence on the sale of video games for consoles (Zhu & Zhang, 2006). Thus, this study extends the existing stream of literature of user reviews in the video game industry by including the PC dimension.

Third, in terms of the difference of effect between expert- and user reviews, this study adds to a previously unbeknown stream of literature in the video game industry. Prior research has been conducted in several similar industries (e.g., movie- and hotel industry). These studies found contradicting results, with half of the literature swaying towards the greater importance of expert reviews (Basuroy et al., 2020; Souza et al., 2019), and the other half swaying towards the importance of user reviews (De Langhe et al., 2016; Öğüt & Onur Taş, 2012). This study found that expert reviews carry more importance in the video game industry, and has uniquely positioned itself as the first to research this difference for this context. Hence, this study extends the field of video game literature with this new insight.

Fourth, literature in the video game industry is reinforced with findings regarding game mode. There is no prior literature that researches the moderating effect of game mode on the relationship between user reviews and sales related outcomes. Therefore, this study adds a new insight, namely that the effect of user reviews on sales related outcomes is strengthened (weakened) when a game is multi-player (single-player). This finding, and any future findings relating to game mode, are an interesting addition to the literature base for the video game industry. This is due to the fact that game mode presents a clear distinction between the type of experience a gamer is seeking, which can in turn influence decision making and the difference in importance of different factors of judgement.

Fifth, the base of literature for the video game industry is improved with a new insight regarding publishers. Although there is no existing literature for the video game industry, prior research is available for the movie industry. In the movie industry, it was found that the box office revenues of movies with larger budgets and releases are less affected by expert reviews than small release films (Basuroy et al., 2003; Souza et al., 2019). This study found contradicting results for the video game industry, namely that when a game is released by a major publisher the impact of expert reviews on downloads is strengthened. This contradictory finding shows that publishers influence the relationships between expert review ratings and sales related outcomes differently in the video game industry than in the movie industry. Intuitively, in terms of video games, it can be argued that video games are a more time-intensive investment when compared to movies. This may influence the way in which a video game is purchased, regardless of the popularity of a publisher.

### 5.2.2 Managerial

The findings of this study also have practical implications for the video game industry. Managers of major publishers should pay attention to practices that may improve expert ratings, due to the strengthening effect that expert ratings have on sales related outcomes. When taking the movie industry as an example, there are multiple possibilities in order to accomplish an improvement of expert ratings. First, major publishers can organise a test screening for a group of experts in the industry in order to hear their judgement. A test screening will most often be organised when the video game is not in the latter stages of development yet. This can gauge what experts currently think of the game, and furthermore give insight into whether they believe it requires necessary adjustments in order to be considered worthy of a higher rating (Jolliffe & Zinnes, 2006). Second, preview screenings can be organised when the video game is in the latter stages of development. During these screenings, publishers invite experts and marketing professionals that they prequalify to determine if they are a fit for the game that will be screened. The preview screening may serve to ascertain whether there are final finishing touches necessary for the game itself, or if the marketing strategy needs adjustment (Kerrigan, 2009).

Furthermore, video game publishers that release multi-player games should be wary of the effect of user ratings on sales related outcomes. This is due to the fact that an improvement of user ratings for multi-player games has an effect on the amount of times a game is downloaded. At the moment, there are already certain strategies that are implemented in the video game industry in order to develop a relationship with gamers and improve the

game simultaneously. First, a game can use alpha and beta testing. Alpha testing is most often performed before release, on-site (where the game is developed), and by employees who are under contract of the developing company. The goal is to identify bugs in order to correct them. However, it is possible for publishers to invite loyal gamers (customers) of previous games to the alpha testing phase in order to give them a sneak preview and elicit their feedback and opinions. Besides receiving a relevant outsider opinion, the sneak preview of the game may create traction if positive insights are shared within the gaming community. Beta testing is most often performed by real gamers from the comfort of their homes. During this phase, the game is in the final stages of development which means that gamers can experience an almost finished product. Therefore, gamers can voice their opinions and feedback to the publisher in order to improve the game. Furthermore, positive responses from the gamer audience in this phase can instigate further traction for the game before its official release (Bates, 2004). Second, Valve (the creators of Steam) have developed an on-platform tool called Steam Early Access through which developers of PC games can publish their unfinished, yet playable games to the public. This tool enables the development of games in congruence with the community, thus building a fanbase and tailoring to their specific demands whilst simultaneously earning revenue by selling the unfinished product for a prepurchase fee. By developing a game in congruence with gamers, video game developers and publishers can continually adjust and tailor their game, increasing the probability of satisfaction from the gamer community (Valve, 2021).

## 5.3 Limitations and future research

Despite the beforementioned insights, this study has some limitations. First, the data used for the number of downloads (owners) on Steam is an estimation. This means that the data is not a one-on-one accurate representation of the actual download data, and therefore the findings cannot concretely represent the effects on sales of games on Steam. A possible improvement for this limitation may be to replicate this study using actual sales data from other similar platforms and publishers that sell PC games online and that share their video game sales data publicly. Examples of other video game platforms are GOG, Itch.io, and Origin. Second, as argued in the introduction, there is a difference between the console and PC gamer segment. However, this difference is ascertained by recognizing connections between different sources and not based on concrete segmentation. Therefore, the findings in this research are not generalizable for the PC gamers segment. A possible improvement for this limitation may be to replicate this study with video games that are only available on PC,

and to investigate if the results of that future research are in-line with the findings of this study. Moreover, the specific difference between the console and PC gamer segment can be researched in order to establish proof of concrete segmentation. In order to do so, data on games that are available for both PC and console will be necessary, including relevant and accurate sales data of both platforms for these games. Third, the model in this research has a low R2. This is due to the fact that there are many additional variables that could have been added. However, there was no data collected for these variables. A possible improvement of this limitation may be to add additional variables to the model. For instance, variables that have been used in other studies related to video games such as genre, video game perspective, volume of reviews, and age rating can be included (Cox, 2014; Zhu & Zhang, 2010). Fourth, expert- and user review ratings may be a proxy of quality. If so, this would entail that a game with a higher rating automatically receives more downloads, as the inherent quality is high relative to other games. A possible solution to test this is to collect data on pre-release ratings and measure the amount of sales that a game has over a predefined period following the release of the game.

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# Appendices

## A. GitHub repository

Overview of the of the directory structure and files:

```
├── README.md
├── makefile
├──.gitignore
├── data
│   ├── d_publishers.csv
│   ├── df_merged2.csv
│   ├── game_id.csv
│   ├── game_url.csv
│   ├── metascore.csv
│   ├── publishers.csv
│   ├── results.csv
│   └── steam.csv
├── gen
│   ├── analysis
│   │   └── output
│   │       └── regression_table.png
│   └── data-preparation
│       └── output
│           └── df_clean.csv
└── src
    ├── collect
    │   ├── SteamDB.ipynb
    │   ├── kaggle.R
    │   └── steamspy.ipynb
    ├── preparation
    │   ├── summary_stats.R
    │   ├── clean_1.R
    │   ├── clean_2.R
    │   └── clean_3.R
    ├── analysis
    │   └── regression.R
    └── .DS_Store
```