



# FROM FREE TO FEE: THE CAUSAL EFFECT OF FREE TRIALS ON ONLINE VIDEO GAME SALES

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## Abstract

A wide range of companies in the digital industry, Netflix and Spotify among others, apply free trials for customer acquisition. There exists abundant research on the economic effectiveness of free trials for analog products and services. However, for digital products and services this topic has not sufficiently been researched. Using real-world observational data from the digital video game distribution company Steam, this study scrutinizes the causal effect of the company's free trial scheme "Free Weekend" on customer purchases and streaming viewership. Further, factors moderating the effect of free trials on customer purchases are analyzed. Fixed effects regression models are employed to identify the proposed causal effects. This study finds that the presence of a free trial increases customer purchases in the subsequent week by 10.8% ( $p < .10$ ). This effect disappears after the week subsequent to the free trial. None of the proposed factors moderating this relationship, game price and rating, are significant. Further, this study finds that the presence of a free trial increases the streaming viewership of a game on the streaming platform "Twitch" by 150.4% ( $p < .01$ ) during the free trial and by 82.0% ( $p < .05$ ) in the subsequent week. Again, this effect disappears after the week subsequent to the free trial. A conducted robustness check indicates limited robustness of the results obtained from the main fixed effects analysis of this study. This study underlines the importance of revalidating scientific findings and customary marketing knowledge stemming from past analog environments for digital products and services.

**Keywords:** Free trials, product sales, marketing effectiveness, causal effect, panel data, digital content, digital products, video games

## Resumo

Uma grande variedade de empresas na indústria digital, Netflix e Spotify, entre outras, utilizam amostras gratuitas para adquirir clientes. Existe uma abundante pesquisa sobre a efetividade econômica de amostras gratuitas para produtos e serviços semelhantes. No entanto, para produtos e serviços digitais, este tópico não foi suficientemente pesquisado. Usando dados observacionais reais da empresa de distribuição de videogames digitais Steam, este estudo examina o efeito causal das promoções de teste gratuito da empresa, "Free Weekend" nas compras de clientes e na visualização de streams. Adicionalmente, fatores moderadores do efeito de amostras gratuitas em compras de clientes são analisados. Modelos de regressão de "fixed effects" são executados para identificar os efeitos causais propostos. Este estudo descobriu que a presença de uma amostra gratuita aumenta as compras de clientes na semana seguinte em 10,8% ( $p < .10$ ). Este efeito desaparece depois da semana subsequente à amostra gratuita. Nenhum dos fatores propostos que moderam essa relação, preço do jogo e classificação, é significativo. Adicionalmente, este estudo descobriu que a presença de uma amostra gratuita aumenta a audiência de streaming de um jogo na plataforma de streaming "Twitch" em 150,4% ( $p < .01$ ) durante o período da amostra gratuita em 82,0% ( $p < .05$ ) na semana seguinte. Novamente, o efeito desaparece depois da semana subsequente à amostra gratuita. Uma verificação de robustez indica robustez limitada dos resultados obtidos a partir da análise principal deste estudo de "fixed effects". Este estudo salienta a importância da revalidação de descobertas científicas, válidas em ambientes passados, em produtos e serviços digitais.

**Palavras-chave:** Amostras gratuitas, venda de produtos, efetividade do marketing, efeitos causais, dados painéis, conteúdo digital, produtos digitais, videogames

## Contents

Acknowledgements.....	i
Abstract.....	ii
List of Abbreviations .....	iv
List of Tables .....	v
List of Figures.....	vi
1 Introduction.....	1
1.1 Topic and Relevance.....	1
1.2 Aim and Scientific Method.....	2
1.3 Structure and Chapter Overview.....	2
2 Literature Review.....	3
2.1 Free Trials as a Customer Acquisition Tool .....	3
2.2 The Effect of Free Trials on Customer Purchases and other Economic Performance Measures.....	5
2.3 Moderating Factors .....	6
3 Conceptual Framework and Hypotheses .....	7
4 Dataset and Methods.....	13
4.1 Empirical Context .....	13
4.2 Population and Sample .....	14
4.3 Dataset.....	14
4.4 Empirical Strategy .....	16
4.5 Models.....	18
5 Descriptive Statistics and Results .....	20
5.1 Descriptive Statistics.....	20
5.2 Graphical Analysis.....	22
5.3 Regression Analysis.....	23
5.4 Robustness Check .....	26
5.5 Synopsis of Results.....	30
6 General Discussion .....	31
6.1 Scientific Implications .....	32
6.2 Managerial Implications .....	32
6.3 Limitations and Future Research .....	33
7 Bibliography .....	36
Appendix.....	40

## List of Abbreviations

CAGR	Compound annual growth rate
df	Degrees of freedom
et al.	Et alii
exp	Exponential function
FW	Week with “Free Weekend” promotion
FW1	Week one week after “Free Weekend” promotion
FW2	Week two weeks after “Free Weekend” promotion
FW3	Week three weeks after “Free Weekend” promotion
FW4	Week four weeks after “Free Weekend” promotion
LM	Lagrange multiplier statistic
log	Natural logarithmic transformation
M	Mean
Max	Maximum
Min	Minimum
N	Number of subjects
p.	Page
$p$	p-Value
PCP	Peak concurrent players
PERC2WK	Proportion of owners that played a game in the past two weeks
$R^2$	R squared: goodness of fit measure
SD	Standard deviation
t	T-test statistic
TW	Twitch
USD	United States dollar
$u_{it}$	Idiosyncratic error
$\chi^2$	Chi-square
YT	Youtube

## List of Tables

Table 1: Overview of Existing Studies on the Effectiveness of Free Trials.....	6
Table 2: Factors Determining the Effect of Free Trials in the Digital Context.....	11
Table 3: Relevant Variables of this Study .....	16
Table 4: Descriptive Statistics .....	21
Table 5: Descriptive Statistics for Games with and without “Free Weekend” .....	22
Table 6: Regression Models concerning the “Free Weekend” Main Effect.....	25
Table 7: Results of Differences-in-Differences Models after Matching .....	30
Table 8: Ramifications for Proposed Hypotheses.....	31

## List of Figures

Figure 1: Overview of the Research Model .....	13
Figure 2: Graphical Overview of the “Free Weekend” Effect.....	23
Figure 3: Overview of the Matching Approach.....	28
Figure 4: Overview of the Covariate Balance.....	29

## 1 Introduction

### 1.1 Topic and Relevance

Companies in the digital industry, Netflix, Amazon Prime Video and Spotify among others, incur limited variable costs relative to profits realized when selling additional products or services. Consequently, these companies deploy heavy sales promotion schemes to increase customer purchases. Among the most prominent promotion tools utilized in the digital industry are free trials (Datta, Foubert and Van Heerde, 2015; Rietveld, 2018). Free trials describe a tool of sales promotion “that enables consumers to start using a service without a financial obligation and to revise their initial adoption decision if they are not satisfied” (Datta et al., 2015, p. 218).

There exists no scientific consensus on the effect of free trials on customer purchases and other economic performance measures. While some authors have found a positive effect of free trials (Bawa & Shoemaker, 2004 among others) others have pointed to detrimental effects (Datta et al., 2015 among others). Particularly for digital products and services there exists a limited number of scientific studies scrutinizing the effect of free trials (apart from studies focusing on interactive digital television).

This study will investigate the question: *Are free trial schemes for digital products and services effective in generating additional customer purchases?*

To this purpose this study will analyze the economic effectiveness of the free trial scheme “Free Weekend” of the digital video game distribution company Steam.

Video game development and distribution has been growing into a globalized multibillion-dollar industry (Newzoo, 2018). The global video game market accounted for 137.9 billion USD in sales in 2018. Sales are expected to grow to 180.1 billion USD in 2021, which would reflect a Compound Annual Growth Rate [CAGR] of 9.3% (Newzoo, 2018, p. 14).

In the context of the recent success of the video game industry new distribution channels for video games have been tapped into. The strong preference of video gamers for digital video game software rather than physical software explains the rise of digital distribution platforms for video games such as Steam (Nielsen, 2018). Steam has been developed by the software company Valve Corporation for purchasing and playing video games digitally on the personal computer. Steam offers users the installation and automatic updating of games online and provides cloud saving, social networking and community opportunities, in-game chat options and video streaming (Steam, n.d.). In 2017 Steam achieved sales of 4.3 billion USD, corresponding to 18% of global PC game sales (Bailey, 2018). Steam had over 150

million registered users, 90 million monthly active users and 47 million daily active users in 2018 (Taylor, 2018).

Steam frequently offers free trials through its “Free Weekends” with the opportunity to play one selected game with all its functionalities for free for a limited time period, normally during the weekend.

### **1.2 Aim and Scientific Method**

This study contributes to the scientific research regarding the economic effectiveness of free trials for digital products and services. Further, and in more specific terms, this study provides valuable findings for digital video game distribution companies as it examines the effectiveness of a sales promotion tool customarily applied in this market.

This study analyzes a large observational panel dataset obtained from the digital video game distribution company Steam focusing on game related performance measures. With the aim to determine the causal effect of free trials on customer purchases and streaming viewership and to analyze two proposed factors moderating the effect of free trials on customer purchases – game price and rating – a twofold scientific approach is followed: first, fixed effects regression models are employed and second, the robustness of obtained results is substantiated with differences-in-differences models calculated after applying an alteration of the propensity score matching approach.

### **1.3 Structure and Chapter Overview**

Following, the second chapter will address the theoretical background of free trials and will review relevant literature in the area. The third chapter identifies a research gap based upon the literature review and defines hypotheses, which guide the following analysis. Chapter four illustrates the dataset and methodology utilized. Subsequently, chapter five presents the results of the main study carried out. These results are discussed in chapter six by relating findings to the existing literature on free trials and by developing scientific as well as managerial implications. Finally, limitations of this study are discussed and pathways for future research illustrated.

## **2 Literature Review**

The following chapter provides an overview of free trials for both analog and digital products and services in order to identify an existing gap in scientific research this study will explore. The chapter starts by illustrating the general concept of free trials and then examines the effect of free trials on consumer purchases and other economic performance measures.

### **2.1 Free Trials as a Customer Acquisition Tool**

Free trials of products and services have traditionally been a prominent marketing and sales tool applied in various industries and sectors. In the pharmaceutical industry drug sampling to doctors is the most important customer acquisition tool. In 2005 in the United States alone 18.4 billion USD worth of free drug samples were distributed to doctors (Ascarza et al., 2014). Similarly, in the consumer products sector free product samples are frequently distributed to enhance product popularity and adoption during product introduction (Bawa & Shoemaker, 2004).

The importance of free trials as an integral part of the customer acquisition process has been substantiated by the rise of the digital economy. Today, free trials are commonly utilized to promote digital products, such as software solutions or video games, to customers. Steam, for example, provides the opportunity to play selected games for free for a limited time period on so called “Free Weekends” (Li & Kanan, 2018; Steam, n.d.; Cheng & Liu, 2010; Li & Kanan, 2018). Marketing of digital content, such as books, videos, and music is in most cases supported by free product trials. The digital video streaming on demand platform Netflix and the digital music streaming on demand platform Spotify both offer a 30-day free trial period of their product (Netflix, n.d.; Spotify, n.d.).

A systematic effect of free trials on customer purchases and other economic performance measures can be presumed when considering relevant scientific theory and research. According to buyer-seller relationship theory, the specific conditions that lead to customer acquisition result in differences in customer behavior (Reinartz, Thomas, & Kumar, 2005). Verhoef & Donkers (2005), for instance, show that customer acquisition through the Internet leads to increased retention rates when compared with email or direct response marketing.

When extrapolating buyer-seller relationship theory to a free trial context, it is plausible that free trials lead to systematic differences in customer purchases and other economic performance measures.

Bawa and Shoemaker (2004) theoretically substantiate the impact of free trials by identifying three potential forms of effects. First, there exists an acceleration effect, where customers adopt a product or service sooner than they would have without the trial. Second, there exists a cannibalization effect, whereby consumers that would have bought the product or service in absence of the trial refrain from doing so because of their trial experiences. And third, there exists an expansion effect, which relates to product or service purchases by consumers that would not consider buying without the trial.

Further, Bawa and Shoemaker (2004) identify three common customer segments in a free trial context. First, the “prior triers segment” that have purchased the product or service before the free trial promotion. Second, the “likely triers segment” composed of customers that have not purchased the product or service before but have a positive purchase probability in presence of a free trial. And third, the “nontriers segment” that has not purchased the product or service before and is likely to continue to refrain from doing so after a free trial. Acceleration and cannibalization effects prevail in the “likely triers segment” while the expansion effect is related to the “likely triers segment” and, to a small extent, to the “nontriers segment”.

Bawa and Shoemaker (2004) propose that the effect of free trials on customer purchases and other economic performance measures depends significantly on the relative size of the three customer segments and their purchase probabilities that translate into the magnitude of the acceleration, cannibalization and expansion effects in a given context. Consequently, the effect of free trials on customer purchases and other economic performance measures will vary in its direction and extent depending on the specific context in which free trials are applied.

This dualistic understanding of the effect of free trials on customer purchases and other economic performance measures constitutes the existing diversity of scientific findings regarding the effect’s existence, direction and extent.

In the following section scientific findings regarding the effect of free trials on customer purchases and other economic performance measures will be presented to serve as the foundation for developing a unique research question for this work.

## **2.2 The Effect of Free Trials on Customer Purchases and other Economic Performance Measures**

So far there exists no scientific consensus on the effect of free trials on customer purchases and other economic performance measures. The direction of the effect and its magnitude vary between scientific studies. Scott (1976), for instance, finds that after a two-week trial period of a newspaper 4% of customers were willing to sign a six-month subscription contract for that newspaper compared to a 9% subscription rate in the control group. Datta et al. (2015) show that free-trial customers have a higher churn rate and a 59% lower customer lifetime value than regular customers. Gilbert and Ebert (2002) find that customers that can evaluate a product or service before purchase are more critical concerning the product or service after purchase.

On the contrary, numerous scientific studies have pointed to a positive effect of free trials on customer purchases and other economic performance measures. Lammers (1991) finds that customers that have received a free sample increase their purchases, however, not for the sampled product but for products from the same category and for cheaper rather than more expensive products. Similarly, Bawa and Shoemaker (2004) find a positive effect of product sampling on long-term customer retention. Customers that were provided with a consumer product sample increased their purchases by 18%. Measureable effects lasted as long as 12 months after the promotion. Gedank and Neslin (1999) find that sampling of mineral water products increases purchasing probabilities after the promotion. Foubert & Gijsbrechts (2016) show that customers that have benefitted from a free trial have a higher propensity to start using interactive digital television. Moreover, prior research has shown that free trials have a positive effect on brand perception (Bettinger, Dawson, & Wales, 1979) and the level of interpersonal communication about a brand (Holmes & Lett, 1977).

Table 1 provides an overview of studies conducted on the effect of free trials on customer purchases and other economic performance measures.

**Table 1:** Overview of Existing Studies on the Effectiveness of Free Trials*Description of relevant studies and findings*

Authors	Year	Effect	Context	Experimental Setting	Findings
Scott	1976	Negative	Analog	Treatment group receives newspaper trial	4% conversion rate for treatment group, 9% conversion rate for control group
Gilbert & Ebert	2002	Negative	Analog	Selecting photo prints. Treatment group was allowed to reevaluate their selection decision	The option to reevaluate the selection decision leads to decreased satisfaction
Datta et al.	2015	Negative	Digital	Free trial for interactive digital television	Free trial customers have a higher churn rate and 59% lower customer lifetime value
Lammers	1991	Positive	Analog	Sampling of chocolate in a well-established shop	Purchases of sample customers increased by 43%. Purchases focused on cheaper products in the same category
Gedenk & Neslin	1999	Positive	Analog	Sampling of mineral water in a test supermarket	Sampling increases purchasing probabilities
Bawa & Shoemaker	2004	Positive	Analog	Consumer product sample distributed via newspaper	Purchases of sample customers increased by 18%. Effects lasted for 12 months after treatment
Foubert & Gijsbrechts	2016	Positive	Digital	Free trial for interactive digital television	Free trial customers have a higher propensity to subscribe to the service

### 2.3 Moderating Factors

Various authors have pointed to factors that moderate the effect of free trials on customer purchases and other economic performance measures.

Pauwels and Weiss (2008) state that free trials can reduce the reference price of customers. In this sense, the customers' willingness to pay for a product or service decreases as these have become accustomed to owning or experiencing the product or service for free during the free trial period. Consequently, the effect of a free trial depends on the consistency of customers' reference prices in a free trial context.

Halbheer et al. (2004) show that the effectiveness of a free trial depends on the trial's potential of affecting quality beliefs associated with the trial product or service. Free trials offer the opportunity to gain reliable information on a product's or service's quality through own experience. Depending on if the product or service experience is sufficient or not sufficient to match product or service quality expectations this will have a positive or negative effect on product or service quality beliefs and thereby on customer purchases (Liu, Au, and Choi, 2014; Sriram, Chintagunta, & Manchanda, 2015). Hence, the experienced quality of a product or service relative to prior quality expectations moderates the effectiveness of a free trial. In this context it is worth noting that quality beliefs based on own experience tend to be more favorable than those based solely on external quality indications such as advertising and direct marketing, which could constitute a generalized positive effect of free trials on customer purchases (Mehta, Chen, & Narasimhan, 2008).

Moreover, customers will likely share their free trial quality experience with others. Consequently, the effectiveness of a free trial depends on its capacity to induce positive or respectively not induce negative word of mouth effects (Foubert & Gijsbrechts, 2016; Ghose & Han, 2011).

Foubert and Gijsbrechts (2016) find that usage intensity during a free trial positively affects customer purchases. Datta et al. (2015) theoretically substantiate this claim by arguing that in retrospect customers' usage intensity signals them the personal value they attach to a product or service. Consequently, usage intensity will affect product or service evaluations, which determine a free trial's effectiveness. The positive influence of usage intensity on the effect of free trials is substantiated by studies from Bolton and Lemon (1999) and Prins, Verhoef, and Franses (2009).

Datta et al. (2015) further find that free trial customers are more responsive to marketing communication. Thus, the positive effect of a free trial depends on the level of marketing actions aimed at free trial customers.

### **3 Conceptual Framework and Hypotheses**

There exists no scientific consensus on the effect of free trials on customer purchases and other economic performance measures. Further, existing scientific studies in this domain have mainly focused on consumer products or information services. The extent of research scrutinizing the economic effectiveness of free trials for digital products and services is limited (Foubert et al., 2016).

This is particularly surprising considering that free trials are a popular sales promotion tool in the digital industry. Companies in the digital industry, Netflix, Amazon Prime Video or Spotify among others, incur limited variable costs relative to profits realized with each additional product or service sold. Consequently, these companies deploy heavy sales promotion schemes to increase customer purchases. Free trials are among the most frequently used sales promotion tools by companies in the digital industry (Datta, Foubert and Van Heerde, 2015; Rietveld, 2018).

However, although free trials are frequently applied in the digital industry, their economic effectiveness in a digital context is still under-researched.

This study purposes to explore this research gap by investigating the question: *Are free trial schemes for digital products and services effective in generating additional customer purchases?*

In order to investigate this question, this study will analyze the economic effectiveness of the free trial scheme “Free Weekend” of the digital video game distribution company Steam. “Free Weekends” at Steam comprise the opportunity to play one selected game with all its functionalities for free for a limited time period.

Previously identified general factors that determine the direction and extent of the effect of free trials on customer purchases and other economic performance measures are likely to constitute a positive free trial effect for digital products and services.

Product evaluations based on own experience have shown to be more favorable than those based solely on external quality indications (Mehta, Chen, & Narasimhan, 2008). This could particularly be true for free trials for digital products and services, which, unlike consumer products, are often consumed repeatedly and not only at one instance. Consequently, a free trial for digital products and services in itself is likely to constitute a positive effect on customer purchases.

Further, digital products and services are frequently accompanied by social networking and community opportunities. Customers often discuss their product or service quality experiences or post ratings of the free trial product or service after the promotion period. Hence, it is likely that the direct positive effect of beneficial product evaluations on customer purchases for digital products and services will be complemented and accelerated by positive word of mouth effects (Foubert & Gijbrecchts, 2016).

Moreover, free trials for digital products and services are frequently and prominently promoted. Free trial customers have been shown to be particularly prone to marketing communications so that the heavy promotion of free trials for digital products and services

will presumably constitute a positive free trial effect on customer purchases (Datta et al., 2015).

A factor limiting the positive effect of free trials on customer purchases for digital products and services is likely to be the higher proneness of customers for reference price reductions induced by the free trial. Numerous digital products and services are offered for free (Facebook or Google Maps for instance). Customers are accustomed to owning or experiencing digital products and services without charge. Consequently, it can be presumed that for digital products and services customers are more likely to be prone to a reduction of their reference price induced by the free trial period (Pauwels & Weiss, 2008). The higher proneness of customers of digital products and services for reference price reductions could limit the positive free trial effect on customer purchases.

Apart from previously identified general factors determining the effect of free trials for digital products and services, there exist factors specific to free trials for video games that are likely to further substantiate a positive effect of the “Free Weekend” at Steam on customer purchases.

Video games frequently comprise elements of storytelling. Players occupy the role of a character that masters tasks and obstacles in order to proceed in a fictional story. The “Free Weekend” at Steam offers customers the opportunity to take a first step in that story. It is unlikely that a player will finish a game’s story during the time-limited “Free Weekend”. Moreover, it can be presumed that customers that have taken a first step in a game’s story are likely to want to finish the game in its entirety. This lock-in effect of customers through unfinished storytelling is likely to constitute a positive effect of the “Free Weekend” at Steam on customer purchases.

Further, and also related to in-game storytelling, customers that play part of a game’s story during the “Free Weekend” are likely to develop positive emotional attachment to that game and its characters. Throughout the story of a game a player interacts with other fictional characters she emotionally bonds with. In the game *Fallout*, for instance, the player is accompanied by the German Shepherd “Dogmeat” with which many players have emotionally engaged (Fiegel, 2009; Good, 2013). The above-mentioned lock-in effect is consequently presumably also based on the emotional attachment players develop towards a game and its characters. Again, this lock-in effect is likely to constitute a positive effect of the “Free Weekend” at Steam on customer purchases.

Moreover, many video games include online multiplayer game modes in which players can play with others jointly via the Internet. In these online multiplayer game modes players

master tasks and obstacles together or fight jointly as a team against others. Often, relationships between players within an online multiplayer game develop (Ducheneaut et al., 2007). It can be presumed that players of online multiplayer game modes exert social pressure on other players they have an in-game relationship with to continue playing the game. This social pressure amongst online multiplayer gamers is likely to substantiate a positive effect of the “Free Weekend” at Steam on customer purchases.

Adding, in the context of the “Free Weekend” at Steam the psychological mechanism of escalating commitment is likely to be relevant. Escalating commitment describes a process in which “negative consequences may actually cause decision makers to increase the commitment of resources and undergo the risk of further negative consequences” (Staw, 1976, p. 27). Applied to the “Free Weekend” at Steam it can be presumed that many customers will have spent significant hours playing the game at offer at the end of the trial period. Escalating commitment could in this instance mean that players that have committed personal resources, in this case time, to the free trial game already, will not hesitate to commit further, now financial, resources by purchasing the game. Moreover, according to escalating commitment theory, customers will be prone to escalate their commitment independent from their evaluation of the game at offer.

Table 2 provides an overview of factors determining the effect of free trials on customer purchases for digital products and services in general and video games in particular.

**Table 2:** Factors Determining the Effect of Free Trials in the Digital Context

*Overview of relevant factors, their effect, and applicability*

Factor	Effect	Applicability
More favorable evaluations based on repeated own experience during free trial	Positive	Digital products and services
Strong positive word of mouth effects	Positive	Digital products and services
High promotion levels	Positive	Digital products and services
High proneness to reference price reductions	Negative	Digital products and services
Lock-in of players through unfinished storytelling	Positive	Video games
Lock-in of players through emotional attachment	Positive	Video games
Social pressure by other players in online multiplayer game modes	Positive	Video games
Escalating commitment	Positive	Video games

Concluding, there are numerous factors that are likely to constitute a positive effect of free trials on customer purchases for digital products and services in general and for video games in particular. Only the higher proneness of free trial customers in a digital context for reference price reductions could limit the positive effect of free trials. Nevertheless, this factor is presumed to be negligible in the case of the “Free Weekend” at Steam considering the limited length of the free trial period.

As a result of the above reasoning it is hypothesized that the “Free Weekend” at Steam will have a positive effect on customer purchases of the video game at offer after the free trial period.

**H1:** The “Free Weekend” at Steam will have a positive effect on customer purchases of the video game at offer after the free trial period.

Furthermore, product or service quality has been proven to be an important moderating factor influencing the effect of free trials (Liu et al., 2014; Sriram et al., 2015). In the context of this study, today’s rating of a video game by Steam users will serve as a proxy variable for video

game quality. A stronger positive effect of the “Free Weekend” on customer purchases for video games with good ratings is hypothesized.

**H2:** Quality ratings of a game will positively moderate the positive effect of the “Free Weekend” on customer purchases.

Adding, it can be assumed that the pricing category in which a game is offered influences the effect of free trials. Lammers (1991) has shown that free trials tend to generate additional customer purchases for cheaper products. Thus, a stronger positive effect of the “Free Weekend” on customer purchases for low-priced games is hypothesized.

**H3:** Game prices will negatively moderate the positive effect of the “Free Weekend” on customer purchases.

The rise of the video game industry has boosted live streaming of video game content. Live streaming means that gamers “broadcast streams, [and] share live video content of their gameplay composited with a video feed of themselves in real life” (Hamilton, Garretson, & Kerne, 2014, p.1). The most popular video game live streaming platforms are Twitch with 9.4 billion viewing hours in 2018 and Youtube Live with 2.3 billion viewing hours in the same year. The third biggest competitor Microsoft Mixer reached only 0.2 billion viewing hours in 2018 and is therefore disregarded in the following analysis due to lacking market relevance (Perez, 2018; Yosilewitz, 2019).

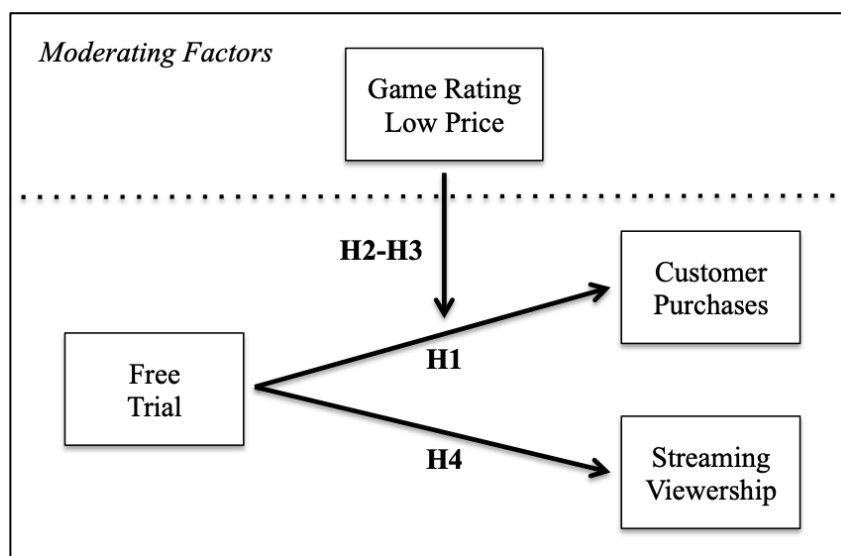
In the context of this study it can be assumed that streamers on Twitch or Youtube Live could pick up the occasion of the “Free Weekend” on Steam and stream about the video game currently offered. Hence, it is hypothesized that the number of views on Twitch and Youtube Live of the game offered during a “Free Weekend” increases during and shortly after the trial period. If an increase in viewership on Twitch and Youtube Live occurred, this could offer marketing opportunities for Steam, particularly considering the higher responsiveness of free trial customers to marketing communications (Datta et al., 2015).

**H4:** The number of views on Twitch and Youtube Live of the game offered during a “Free Weekend” increases during the free trial period.

Figure 1 provides an overview of the research model utilized in this study including the defined hypotheses.

**Figure 1:** Overview of the Research Model

*Relevant components of the research model based upon the defined hypotheses*



## 4 Dataset and Methods

### 4.1 Empirical Context

With the “Free Weekend” Steam offers users the opportunity to play selected games for free for a limited time period. In most cases “Free Weekends” start on Thursday and last four days until Sunday. There are some instances for which “Free Weekends” start on Friday and last only three days until Sunday. The starting time of “Free Weekends” varies. Almost all “Free Weekends” terminate at 1pm Pacific Time on Sunday. “Free Weekends” can occur repeatedly for individual games. Nevertheless, there tends to exist an extensive time period between each “Free Weekend” incident for each individual game. During the “Free Weekend” there are no content limits imposed on the game at offer. Users can play the game in its entirety. After the “Free Weekend” users lose the ability to play the game for free. However, the ownership of the game at offer does not extend automatically to a for-pay version. Users have to opt-in to buy the game at offer after the “Free Weekend” has terminated. In almost all cases “Free Weekends” are promoted in the “News” section of Steam’s website. An example of a “Free Weekend” announcement on Steam is provided in Appendix A. Similarly, “Free Weekends” are almost always advertised prominently on the

initial screen of the downloadable Steam computer application. This being said, for some low-selling niche games developers might decide independently of Steam to offer a “Free Weekend”. In this case, the “Free Weekend” is mostly advertised through posts of the game’s developers in relevant sections of Steam’s “User Forum”. “Free Weekends” are advertised to all of Steam’s global customers. “Free Weekends” are in most cases accompanied by price discounts for the game at offer. Price discounts vary in their extent and are jointly advertised with the “Free Weekend”.

### **4.2 Population and Sample**

The relevant population for this study is for-pay downloaded PC video games. According to some estimations, Steam controls 50%-70% of the market for downloaded PC video games (Chiang, 2011). This study scrutinizes a sample of all for-pay video games offered by Steam between the years 2015 and 2018. It is likely that this sample is representative of the identified relevant population so that the generalizability of results is justified.

### **4.3 Dataset**

The observational data analyzed in this study is obtained from the digital video game distribution company Steam. We gained access to a large panel dataset through the third party data provider Steam Spy that focuses on data scrapping in the video game industry.

The dataset comprises 1,306 video games, which correspond, to the best knowledge of the author, to all for-pay video games offered on Steam that had achieved any sales until the end of the observational period.

The observational period reaches from 2015/04/01 to 2018/07/17 comprising 175 consecutive weeks.

The panel dataset is unbalanced. While some games are present throughout the entirety of the observational period, some are introduced later than 2015/04/01 and some are dropped from Steam before 2018/07/17.

The data includes, among other variables, weekly information on how many people owned a game. This variable will be considered an operationalization of customer purchases and will be the dependent variable in the analysis of this study. A detailed description of the meaning of game ownership on Steam can be found in Appendix B.

Additionally, the dataset comprises a variable that corresponds to the content of the “News” section on Steam and to related posts in Steam’s “User Forum” concerning each video game in a given week. This information was utilized to code an identifying variable that shows if a

“Free Weekend” took place for a game in a given week. The information of the “News” and “User Forum” posts was analyzed automatically looking for a string containing the phrase “Free Weekend”. Further, this automatic analysis was substantiated by a manual qualitative check in order to ensure that an identified relevant Steam “News” or “User Forum” post actually corresponded with a “Free Weekend”. The variable indicating if a “Free Weekend” took place for a game in a given week will be the main independent variable in the analysis of this study.

Moreover, the dataset contains weekly information on the peak number of Twitch viewers and the number of Youtube views of a game. These variables will be utilized as dependent variables to check the effect of “Free Weekends” on streaming viewership.

Adding, the dataset includes information on the rating of a game by Steam users and weekly information on the price of a game in USD. These variables will be utilized to check the proposed moderation of the “Free Weekend” effect on customer purchases by game rating and game price.

Further, the dataset comprises weekly information on the number of peak concurrent players of a game and on the percentage of owners that played a game in the past two weeks. These variables will be utilized as control variables in this study as they indicate the popularity of a game and the potential of a game to induce player loyalty, which could both affect customer purchases.

Moreover, most “Free Weekends” are accompanied by price promotions. The mentioned variable indicating the weekly price of a game will be utilized to control for the effect of price promotions on customer purchases. Further, a variable is coded that indicates if a price promotion for a game was announced in a Steam “News” or “User Forum” post in a given week. This variable will be used to control for the effect of the advertisement of the price decrease.

The following table provides an overview of the variables utilized in the analysis of this study and of important factors of the research model they correspond with.

**Table 3:** Relevant Variables of this Study*Overview of relevant variables and corresponding constructs from the research model*

Name in Analysis	Content	Construct	Related Hypothesis
Owners	Weekly number of owners of a game	Customer purchases	H1-H3
FW	Indicator if “Free Weekend” took place	Occurrence of “Free Weekend”	H1-H4
TW Viewers	Weekly peak number of Twitch viewers of a game	Live stream viewership	H4
YT Views	Weekly Youtube views of a game	Live stream viewership	H4
Rating	Rating of a game by Steam users	Game rating	H2
Price	Weekly price of a game in USD	Game Price	H3
PCP	Weekly number of peak concurrent players of a game	Popularity of a game	Not applicable
PERC2WK	Percentage of game owners that played a game in the last two weeks	Potential to induce customer loyalty	Not applicable

Further, there exist missing observations for the variables peak number of Twitch viewers, Youtube views, weekly number of peak concurrent players, the percentage of owners that played in the past two weeks, and rating of a game. For some games all values for one of the mentioned variables are missing. Overall, 6% of observations are missing. 67% of games are affected by missing data. For 37% of games all values for at least one variable are missing. An overview of missing observations is provided in Appendix C. It is not clear if observations of the mentioned variables are missing at random or not. This is a limitation to this study that will be discussed in the concluding paragraphs of the paper. Nevertheless, variables with missing values will be included in the analysis of this study.

#### 4.4 Empirical Strategy

In the case of observational non-experimental data, the identification of causality is likely to be hampered by selection bias due to self-selection into treatment (Heckman, 1979). Authors like Datta et al. (2015) have pointed to the importance of addressing selection bias appropriately when analyzing the causal effect of free trials.

In this study there could exist significant self-selection bias concerning the games offered via a “Free Weekend”. Games could for instance be assigned a “Free Weekend” because of constant characteristics they entail. It could be the case that only games with a specific genre or from certain developers are eligible for a “Free Weekend”. Further, self-selection of “Free Weekend” games could be caused by time-changing characteristics. It is imaginable that games with a decreasing proportion of owners that have played the game recently are more likely to be assigned a “Free Weekend”.

To control for selection bias caused by constant characteristics of a game I will leverage on the time dimension of the panel dataset and employ fixed effects regression models.

Fixed effects regression has been called “especially useful in the context of causal inference” and should “be standard in the toolkit of modern social research” (Brüderl & Ludwig, 2015, p. 327). Particularly for the analysis of events, such as the “Free Weekend” in this study, fixed effects regression appears “to be one of the most promising statistical methods for analyzing nonexperimental panel data” (Allison, 1994, p. 196).

Compared with pooled ordinary least squares regression models, fixed effects regression models allow controlling for all time constant unobserved confounding variables and in this way improve causal inference for panel data. In other words, fixed effects estimates are unbiased even in the presence of constant unobserved confounding variables (Brüderl & Ludwig, 2015).

Nevertheless, fixed effects regression models require the assumption of strict exogeneity on the explanatory variables to produce unbiased estimators. Strict exogeneity means that the idiosyncratic error ( $u_{it}$ ) should be “uncorrelated with each explanatory variable across all time periods” (Wooldridge, 2013, p. 485). In many fixed effects models a control group of untreated observational units is utilized to control for an overall time trend. In this context strict exogeneity means that the trajectory of the outcome variable of treated and control observational units ought to have been parallel in absence of the treatment (Brüderl & Ludwig, 2015). Fixed effects estimates will be biased if between treated and control observational units unobserved time-changing confounding variables cause heterogeneity in the trajectory of the outcome variable (Brüderl & Ludwig, 2015; Allison, 1994).

In order to optimally conform with the strict exogeneity assumption of fixed effects regression, time-changing and potentially confounding variables are included in the regression models of this study. These variables were selected based on economic reasoning and on identified relationships between potential confounders and the dependent variables of this study.

### 4.5 Models

In the central fixed effects model of this study, subsequently called Model 1, the natural logarithm of the number of owners will be used as the dependent variable because the distribution of this variable is skewed to the right. Further, before the natural logarithm of the number of owners is taken, the constant 1 will be added to account for the fact that there exist observations of games with 0 owners. Adding a small constant before taking the natural logarithm does not affect result interpretation of the analysis as according to Wooldridge (2012, p. 193), in this case “percentage change interpretations are often closely preserved”. A histogram showing the distribution of the number of owners before and after the described transformation is provided in Appendix D.

The main independent variable of this study is a dummy variable indicating if during a week a “Free Weekend” took place for a game or not. In order to represent the time path of the causal effect of “Free Weekends” on the number of owners of a game, a separate dummy variable is coded for every week after the “Free Weekend”. Altogether four additional dummy variables are coded indicating the first four weeks after a “Free Weekend”. The “Free Weekend” indicator variables are subsequently called FW, FW1, FW2, FW3, and FW4. The effect of the „Free Weekend“ at Steam is assumed to be uniform for repeated occurrences. The „Free Weekend“ dummy variables in the fixed effects models of this study represent the uniform effect of each additional „Free Weekend“ for a game.

The variables weekly number of peak concurrent players and percentage of owners that played a game in the past two weeks are included in the model to control for a game’s popularity and its potential to induce player loyalty.

The variables peak number of Twitch viewers and number of Youtube views of a game are not included in the model as both variables contain a great abundance of missing values. Including them would limit the number of game-weeks the model calculation is based on.

The variable weekly price of a game and the variable identifying if a price promotion was advertised are included in the model to control for the effect of price promotions.

In a similar sense dummy variables indicating if a patch respective an update for a game were promoted on Steam are included in the model.

Dummy variables for each week in the dataset are included to control for an overall time trend. Further, dummy variables for each season of the year are included to control for seasonality.

All models in this study use game-fixed effects.

Model 1 is presented in equation (1).

$$\begin{aligned} \log(Y_{it} + 1) = & \beta_1 F\ddot{W}_{it} + \beta_2 F\ddot{W}1_{it} + \beta_3 F\ddot{W}2_{it} + \beta_4 F\ddot{W}3_{it} + \beta_5 F\ddot{W}4_{it} + \beta_6 PC\ddot{C}CU_{it} + \\ & \beta_7 PERC\ddot{2}WK_{it} + \beta_8 Pr\ddot{i}ce_{it} + \beta_9 Pr\ddot{i}ce\ddot{P}romo_{it} + \beta_{10} P\ddot{a}tch_{it} + \beta_{11} U\ddot{p}date_{it} + \\ & \beta_{12} Se\ddot{a}son_{it} + \beta_{13} W\ddot{e}ek_{it} + \ddot{u}_{it}, t = 1, 2, \dots, T, \end{aligned} \quad (1)$$

In order to test the proposed moderation of the “Free Weekend” effect on customer purchases, interaction terms of the variables video game rating and weekly price with each of the “Free Weekend” indicators are included in a separate model, subsequently called Model 2.

Model 2 is presented in equation (2).

$$\begin{aligned} \log(Y_{it} + 1) = & \beta_1 F\ddot{W}_{it} + \beta_2 F\ddot{W}1_{it} + \beta_3 F\ddot{W}2_{it} + \beta_4 F\ddot{W}3_{it} + \beta_5 F\ddot{W}4_{it} + \beta_6 Pr\ddot{i}ce_{it} + \\ & \beta_7 PC\ddot{C}CU_{it} + \mathbf{Interaction\ Terms} + \beta_{15} PERC\ddot{2}WK_{it} + \beta_{16} Pr\ddot{i}ce\ddot{P}romo_{it} + \\ & \beta_{17} P\ddot{a}tch_{it} + \beta_{18} U\ddot{p}date_{it} + \beta_{19} Se\ddot{a}son_{it} + \beta_{20} W\ddot{e}ek_{it} + \ddot{u}_{it}, t = 1, 2, \dots, T, \end{aligned} \quad (2)$$

In order to present Model 2 in a readable manner not all interaction terms are included in equation (2) but only the generic notion “Interaction Terms”. In this case “Interaction Terms” means that the following interactions are calculated for each “Free Weekend” indicator FW, FW1, FW2, FW3, and FW4.

$$\beta_8 F\ddot{W}_{it} \times Rating_i + \beta_9 F\ddot{W}_{it} \times Price_{it}$$

In order to test the effect of “Free Weekends” on streaming viewership two more fixed effects models are calculated with Twitch and Youtube streaming viewership as the dependent variables. These are subsequently called Model 3 and Model 4.

Again, the natural logarithm is taken of each dependent variable after adding the constant 1 as their distribution is skewed to the right and both include observations of games with 0 streaming viewership. Histograms showing the distribution of Twitch and Youtube streaming viewership before and after the described transformation are provided in Appendix D. The set of control variables utilized in Model 3 and Model 4 is equivalent to the control variables in Model 1. Additionally, the number of owners of a game is included as a control variable in both models.

Model 3 and Model 4 correspond to the functional form of equation (3).

$$\begin{aligned} \log(\ddot{Y}_{it} + 1) = & \beta_1 \ddot{F}\ddot{W}_{it} + \beta_2 \ddot{F}\ddot{W}1_{it} + \beta_3 \ddot{F}\ddot{W}2_{it} + \beta_4 \ddot{F}\ddot{W}3_{it} + \beta_5 \ddot{F}\ddot{W}4_{it} + \beta_6 \ddot{P}\ddot{C}\ddot{C}\ddot{C}U_{it} + \\ & \beta_7 \ddot{P}\ddot{E}\ddot{R}\ddot{C}\ddot{2}\ddot{W}K_{it} + \beta_8 \ddot{O}\ddot{w}\ddot{n}\ddot{e}\ddot{r}\ddot{s}_{it} + \beta_9 \ddot{P}\ddot{r}\ddot{i}\ddot{c}\ddot{e}_{it} + \beta_{10} \ddot{P}\ddot{r}\ddot{i}\ddot{c}\ddot{e}\ddot{P}\ddot{r}\ddot{o}\ddot{m}\ddot{o}_{it} + \beta_{11} \ddot{P}\ddot{a}\ddot{t}\ddot{c}\ddot{h}_{it} + \\ & \beta_{12} \ddot{U}\ddot{p}\ddot{d}\ddot{a}\ddot{t}\ddot{e}_{it} + \beta_{13} \ddot{S}\ddot{e}\ddot{a}\ddot{s}\ddot{o}\ddot{n}_{it} + \beta_{14} \ddot{W}\ddot{e}\ddot{e}\ddot{k}_{it} + \ddot{u}_{it}, t = 1, 2, \dots, T, \end{aligned} \quad (3)$$

## 5 Descriptive Statistics and Results

This chapter presents the findings of this study in order to investigate the proposed research question. The analysis of this study was carried out using the statistical computation software “R”.

### 5.1 Descriptive Statistics

The main descriptive statistics for relevant variables of the dataset can be observed in Table 4. The average number of owners of a game is 640,193.40 with a relatively large standard deviation of 1,810,253.00 and a range from 0.00 to 56,153,000.00 owners. Games have on average 1,390.29 weekly peak concurrent viewers on Twitch (SD = 13,428.62) with a range from 0.00 to 1,137,953.00 viewers. Further, games receive on average 184,729.00 weekly views on Youtube (SD = 1,372,524.00). The number of weekly views on Youtube ranges from 0.00 to 114,483,120.00. For all three dependent variables the standard deviation is larger than the average, which points to the skewedness of the distribution of the variables.

On average games are priced at 12.85 USD (SD = 13.06). Some games are priced at 0.00 USD for some week. The most expensive game in the dataset has a price of 99.00 USD for some week. The average rating of games by users on Steam is 75.24 (SD = 18.35) with a possible maximum rating of 100.00. Games have on average 2,242.34 weekly peak concurrent players (SD = 43,563.14). The game with most weekly peak concurrent players reaches 3,080,310.00 during some week. The distribution of the variable weekly peak concurrent players is also skewed. On average, games are played by 6.31 percent of owners in the last two weeks (SD = 11.17). Some games are not played by any of their owners (Min = 0.00) and some by all of their owners (Max = 100.00) in the past two weeks for some week. An overview of descriptive statistics only with cases without missing data is provided in Appendix E.

**Table 4:** Descriptive Statistics*Overview of descriptive statistics for relevant variables*

Statistic	N	Mean	SD	Min	Max
Owners	172,886	640,193.40	1,810,253.00	0.00	56,153,000.00
TW Viewers	119,958	1,390.29	13,428.62	0.00	1,137,953.00
YT Views	169,141	184,729.00	1,372,524.00	0.00	114,483,120.00
Price	172,886	12.85	13.06	0.00	99.99
Rating	170,041	75.24	18.35	8.00	100.00
PCP	170,515	2,242.34	43,563.14	0.00	3,080,310.00
PERC2WK	164,832	6.31	11.17	0.00	100.00

There are 63 occurrences of the “Free Weekend” throughout the observational period. “Free Weekends” are applied to 41 unique games. The maximum count of “Free Weekends” per game is six and can be observed for the game “Tom Clancy's Rainbow Six Siege”.

A comparison between descriptive statistics of games with and without “Free Weekend” is shown in Table 5. It is noticeable that compared with games for which no “Free Weekend” occurred during the observational period, games with a “Free Weekend” have significantly more owners ( $p < 0.01$ ), weekly peak concurrent viewers on Twitch ( $p < 0.01$ ) and weekly views on Youtube ( $p < 0.01$ ). Similarly, games with a “Free Weekend” have a higher weekly price ( $p < 0.01$ ), a higher rating ( $p < 0.01$ ), more weekly peak concurrent players ( $p < 0.01$ ) and a higher percentage of owners that played the game in the past two weeks ( $p < 0.01$ ). This preliminary finding indicates that selection bias into treatment could exist in the context of “Free Weekends” at Steam. “Free Weekends” seem to be offered primarily for highly priced and high-selling blockbuster games. This finding further justifies the choice of fixed effects regression models in this study to control for selection bias induced by constant characteristics of a game and the decision to utilize time-changing control variables in these fixed effects regression models.

**Table 5:** Descriptive Statistics for Games with and without “Free Weekend”*Overview of descriptive statistics for relevant variables*

Statistic	Games with “Free Weekend”		Games without “Free Weekend”	
	Mean	SD	Mean	SD
Owners	973,918.40	1,341,039.00	629,157.80	1,822,668.00
TW Viewers	3,154.04	11,818.10	1,320.91	13,483.38
YT Views	613,209.30	1,677,757.00	170,235.70	1,358,649.00
Price	30.30	18.81	12.27	12.42
Rating	76.40	12.82	75.20	18.50
PCP	6,555.66	18,467.19	2,097.66	44,151.12
PERC2WK	13.68	15.93	6.06	10.88

## 5.2 Graphical Analysis

The following graphs of Figure 2 provide a preliminary overview of the effect of “Free Weekends”. The graphs show the development of the variables weekly number of peak concurrent players, number of owners, peak number of Twitch viewers and Youtube views for games that incur a “Free Weekend” and for a random sample of games that do not incur a “Free Weekend”. The number of games included in the random sample is equivalent to the number of “Free Weekend” incidents. The time period displayed starts one week before a “Free Weekend” incident and ends 4 weeks after.

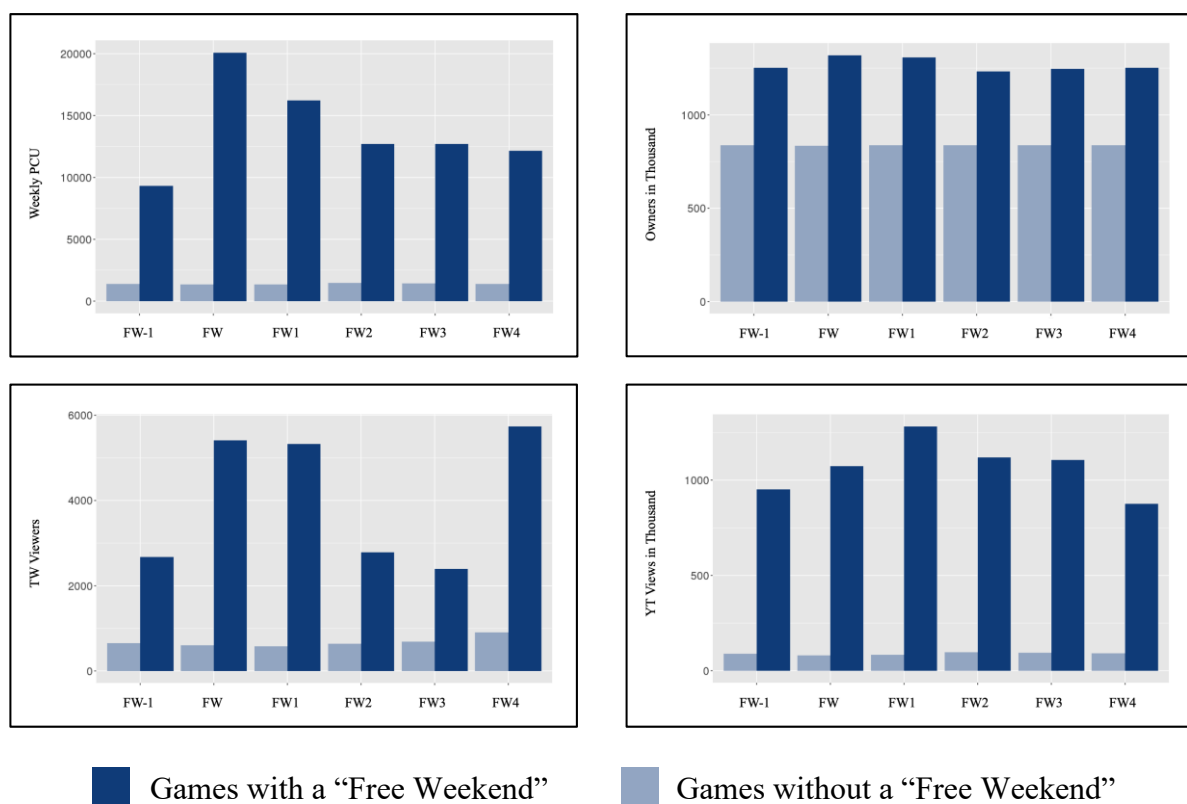
On a preliminary basis it can be observed that for games with a “Free Weekend” the number of weekly peak concurrent players increases during the “Free Weekend” but drops again once the “Free Weekend” is finished. For games without a “Free Weekend” the number of weekly peak concurrent players stays at a stable level throughout the inspected time period. During “Free Weekends” more users play the game at offer.

Similarly, for games with a “Free Weekend” the number of owners increases in the week of a “Free Weekend” but slightly drops two weeks after the “Free Weekend” is finished. Again, for games without a “Free Weekend” the number of owners stays at a stable level throughout the examined time period. This could indicate that although people are tempted to buy a game during “Free Weekends”, they cannot be converted into long-term players and consequently delete the game from their Steam account soon after the “Free Weekend”.

Considering the streaming viewership of games, it can be noted that for games with a “Free Weekend” the peak number of Twitch viewers and Youtube views increase during and in the week subsequent to “Free Weekends” but drop again two weeks after the “Free Weekend” is finished. For games without a “Free Weekend” the streaming viewership stays at a stable level throughout the examined time period. During “Free Weekends” the streaming viewership of the game at offer increases.

**Figure 2:** Graphical Overview of the “Free Weekend” Effect

*Development of relevant variables over time for games with a “Free Weekend”*



### 5.3 Regression Analysis

Following, the previous preliminary graphical analysis of the “Free Weekend” effect will be substantiated by calculating fixed effects regression models.

In all regression models the variable weekly peak concurrent players is included in units of thousand to ease interpretation. Similarly, the number of owners is included in units of million in Model 3 and Model 4.

Standard errors displayed throughout all models are clustered at game-level as proposed by Arellano (1987) to account for heteroskedasticity and cross-sectional serial correlation.<sup>1 2</sup>

Two further prerequisites for fixed effects regression models were reviewed. As indicated by Q-Q Plots in Appendix F, residuals in all models were approximately normally distributed. Adding, it was confirmed that all three dependent variables are stationary and do not have a unit root.<sup>3</sup>

Table 6 presents the main fixed effects regression models of this study.

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<sup>1</sup> Breusch-Pagan tests for each model indicate the presence of heteroskedasticity. BP = 15,516, in a  $X^2$  distribution with 191 *df* this yields,  $p < 0.01$  for Model 1. BP = 29,160, in a  $X^2$  distribution with 231 *df* this yields,  $p < 0.01$  for Model 2. BP = 3,390, in a  $X^2$  distribution with 186 *df* this yields,  $p < 0.01$  for Model 3. BP = 12,189, in a  $X^2$  distribution with 186 *df* this yields,  $p < 0.01$  for Model 4.

<sup>2</sup> Breusch-Godfrey/Wooldridge tests for first-order serial correlation for each model indicate the presence of serial correlation.  $LM = 93,789$ , in a  $X^2$  distribution with 6 *df* this yields  $p < 0.01$  for Model 1.  $LM = 132,010$ , in a  $X^2$  distribution with 2 *df* this yields  $p < 0.01$  for Model 2.  $LM = 66,145$ , in a  $X^2$  distribution with 6 *df* this yields  $p < 0.01$  for Model 3.  $LM = 38,267$ , in a  $X^2$  distribution with 6 *df* this yields  $p < 0.01$  for Model 4.

<sup>3</sup> Augmented Dickey-Fuller tests with lag order 2 for each dependent variable indicate that these variables are stationary.  $t = -63.636$ ,  $p < 0.01$  for the log of the number of owners.  $t = -87.631$ ,  $p < 0.01$  for the log of the peak number of Twitch viewers.  $t = -101.310$ ,  $p < 0.01$  for the log of the number of Youtube views.

**Table 6:** Regression Models concerning the “Free Weekend” Main Effect

*Results of Model 1, Model 2, Model 3, and Model 4*

	<i>Dependent Variables</i>			
	<i>log(Owners+1)</i>	<i>log(Owners+1)</i>	<i>log(TW Viewers+1)</i>	<i>log(YT Views+1)</i>
	(Model 1)	(Model 2)	(Model 3)	(Model 4)
FW	.064 (.057)	-.106 (.499)	.918 (.286)***	.330 (.261)
FW1	.103 (.058)*	.097 (.482)	.599 (.268)**	.299 (.237)
FW2	.087 (.058)	.034 (.498)	.068 (.222)	-.069 (.246)
FW3	.014 (.054)	-.138 (.459)	.035 (.222)	.291 (.234)
FW4	-.010 (.050)	.030 (.378)	.295 (.263)	-.075 (.232)
PCP	.001 (.000)***	.001 (.000)***	-.001 (.001)	.000 (.000)
PERC2WK	-.024 (.001)***	-.024 (.001)***	.027 (.002)***	.033 (.002)***
Price	.005 (.002)**	.005 (.002)***	.003 (.005)	.012 (.005)**
Price Promo	.029 (.018)	.029 (.018)	.482 (.065)***	.457 (.063)***
Patch	.098 (.042)**	.098 (.042)	.276 (.091)***	.312 (.091)***
Update	-.026 (.021)	-.026 (.021)	.069 (.064)	.142 (.056)**
Owners			.152 (.000)***	.040 (.046)
FW × Rating		.001 (.005)		
FW × Price		.004 (.006)		
FW1 × Rating		.000 (.005)		
FW1 × Price		.000 (.005)		
FW2 × Rating		.001 (.005)		
FW2 × Price		.000 (.005)		
FW3 × Rating		.002 (.004)		
FW3 × Price		.000 (.004)		
FW4 × Rating		.001 (.004)		
FW4 × Price		-.003 (.004)		
Season Dummy	Yes	Yes	Yes	Yes
Week Dummy	Yes	Yes	Yes	Yes
Within R <sup>2</sup>	.485	.484	.205	.105
Games	1,227	1,227	830	1,210
Game-Weeks	160,739	160,739	114,642	159,501

Significance levels are based on panel-robust standard errors.

\* p < .10. \*\* p < .05. \*\*\* p < .01.

In Model 1 with the number of owners of a game as the dependent variable none of the “Free Weekend” indicator variables are significant apart from FW1. Interestingly, a “Free Weekend” only has an effect one week after its occurrence. The presence of a “Free Weekend” causes a 10.8%  $[(\exp(.103)-1)*100\%]$  ( $p < .10$ ) increase in the number of owners in the subsequent week. Model 1 explains 48.5% of the variation in ownership of a game over time.

In Model 2 none of the interaction coefficients of the “Free Weekend” indicator variables with video game rating or video game price were significant. Model 2 explains 48.4% of the variation in ownership of a game over time.

In Model 3 with the peak number of Twitch viewers as the dependent variable the “Free Weekend” indicator variables FW and FW1 are significant. The presence of a “Free Weekend” causes a 150.4%  $[(\exp(.918)-1)*100\%]$  ( $p < .01$ ) increase in the peak number of Twitch viewers during the week of its occurrence. Further, in the week subsequent to a “Free Weekend”, the presence of the “Free Weekend” causes a 82.0%  $[(\exp(.599)-1)*100\%]$  ( $p < .05$ ) increase in the peak number of Twitch viewers. Model 3 explains 20,5% of the variation in the peak number of Twitch viewers of a game over time.

In Model 4 with the number of Youtube views as the dependent variable none of the “Free Weekend” indicator variables is significant, not even at a 10% level against a two-sided alternative. Model 4 explains 10.5% of the variation in Youtube views of a game over time. There seem to be various factors that change over time that are not included in Model 4 producing the remaining 89.5% in variation.

It must be noted that in neither of the models discussed the entirety of games in the dataset was included. While there are 1,306 games in the dataset, Model 1 and Model 2 include 1,227, Model 3 830 and Model 4 1,210 games. Games that missed all values of an independent or dependent variable were dropped when calculating each model.

Appendix G illustrates that the results of Model 1, Model 2, Model 3 and Model 4 indicate largely consistent findings when calculated with balanced panel data.

### **5.4 Robustness Check**

Fixed effects regression models require the assumption of strict exogeneity on the explanatory variables to produce unbiased estimators. Strict exogeneity means that the idiosyncratic error ( $u_{it}$ ) should be “uncorrelated with each explanatory variable across all time periods” (Wooldridge, 2013, p. 485). In the fixed effects models of this study a control group of untreated observational units is utilized to control for an overall time trend. In this

context strict exogeneity means that the trajectory of the outcome variable of treated and control observational units ought to have been parallel in absence of the treatment (Brüderl & Ludwig, 2015).

There exist three potential sources of endogeneity: first, time-varying confounding variables that affect both, the probability of treatment and the outcome variable. Second, simultaneity or reverse causality, in which developments in the outcome variables affect the probability of treatment. And third, measurement error in the treatment indicator.

In this study a wide range of control variables were included in the fixed effects models to limit the potential of time-varying confounding variables to cause endogeneity. Nevertheless, after all, Model 1 for instance, only succeeds in explaining 48.5% of the variation in ownership of a game over time. Hence, there must exist unobserved time-changing variables that explain the remaining 51.5% of the variation in ownership of a game over time. If these affect both the probability of a game being subject to a “Free Weekend” and the number of owners of a game, endogeneity would be the outcome. Further, it is conceivable that the number of owners has some effect on the probability of a game being subject to a “Free Weekend”. For instance, it could be the case that games with a decreasing number of owners are more likely to be assigned a “Free Weekend”. Measurement error in the treatment indicator, however, is unlikely to cause endogeneity in the context of this study as the “Free Weekend” indicator variable was created based on a thorough quantitative as well as qualitative check.

In order to further substantiate the results of this study, particularly in the context of a possible breach of the assumption of strict exogeneity of fixed effects regression models, a complementary robustness check was carried out.

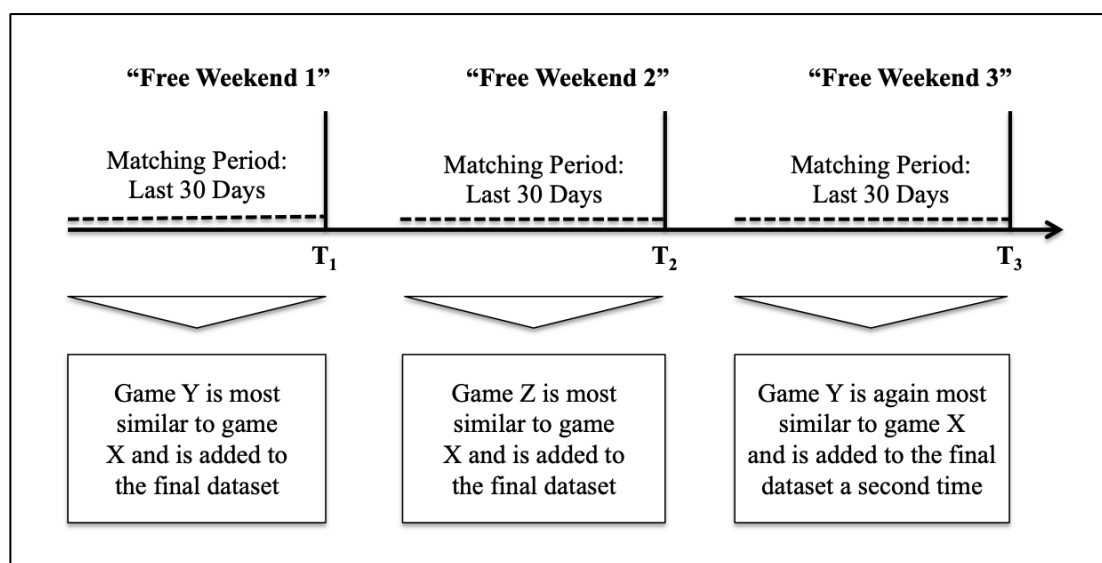
In this robustness check, selection bias was, similar to Datta et al. (2015), tackled by applying a matching approach before calculating differences-in-differences models. Matching treated observational units with similar control observational units regarding relevant covariates allows analyzing observational non-experimental data in a way that it mimics the characteristics of a randomized controlled experiment (Austin, 2011; Caliendo & Kopeinig, 2008). By controlling the influence of confounding variables before the treatment takes place matching is a suitable approach for confronting selection bias, reducing model dependence and thereby improving causal inference (Iacus, King, & Porro, 2012).

In this study matching will be carried out via one-to-one exact matching for each game for each instance of the “Free Weekend”. The time period considered for matching will be the month before the “Free Weekend”. This means that video game X, which is promoted

through a “Free Weekend” starting at time  $T$ , will be matched with video game  $Y$  that is most similar to video game  $X$  in the 30 days before  $T$ . For each “Free Weekend” instance this matching approach will be applied. As a result of matching a dataset will be compiled comprising all games with a “Free Weekend”. For each “Free Weekend” instance there will exist a similar matched control game in the dataset. Figure 3 presents the matching approach of this study graphically.

**Figure 3:** Overview of the Matching Approach

*Exemplary presentation of the matching approach for video game  $X$  with recurring treatment*



For the robustness check the propensity score matching approach will be applied as it has been shown to lead to imbalance reduction between treated and control observational units (Austin, 2011; Caliendo & Kopeinig, 2008).

The propensity score is a balance score that is calculated by regressing treatment status on selected baseline characteristics using a logistic regression model. The propensity score corresponds to the probability to be among the treated observational units as predicted by selected baseline characteristics. With propensity score matching, each treated observational unit is matched to a control observational unit with a similar propensity score (Austin, 2011; Caliendo & Kopeinig, 2008).

In this study propensity score matching will be performed via nearest neighbor matching. With nearest neighbor matching one-to-one pairs of treated and control observational units with similar propensity score values are formed. Further, matching will be performed with

replacement of already matched control observational units. In this way control observational units can be matched multiple times.

After matching, differences-in-differences models are calculated for each “Free Weekend” incident. The relevant time periods for these differences-in-differences models are the week prior and the week subsequent to a “Free Weekend”. A new dataset will be compiled comprising only the week prior and the week subsequent to a “Free Weekend” of the game that is promoted and its best matching counterpart. This means that for treated game X, which is promoted through a “Free Weekend” that starts at time T, and for control game Y which is the best match for game X for this “Free Weekend” incident, only the week prior and subsequent to this “Free Weekend” incident will be considered when compiling the new dataset. Each “Free Weekend” incident will be treated in a similar manner.

Following, differences-in-differences models will be calculated similar to the functional forms in equation (1) to (4), however, without a dummy variable indicating each week.

Figure 4 shows the standardized difference between treated and control observational units before and after matching. For calculating the standardized difference only the month before each “Free Weekend” incident is considered. The covariate balance significantly improved through the applied matching approach.

**Figure 4:** Overview of the Covariate Balance

*Presentation of the standardized difference between treated and control observational units before and after matching*

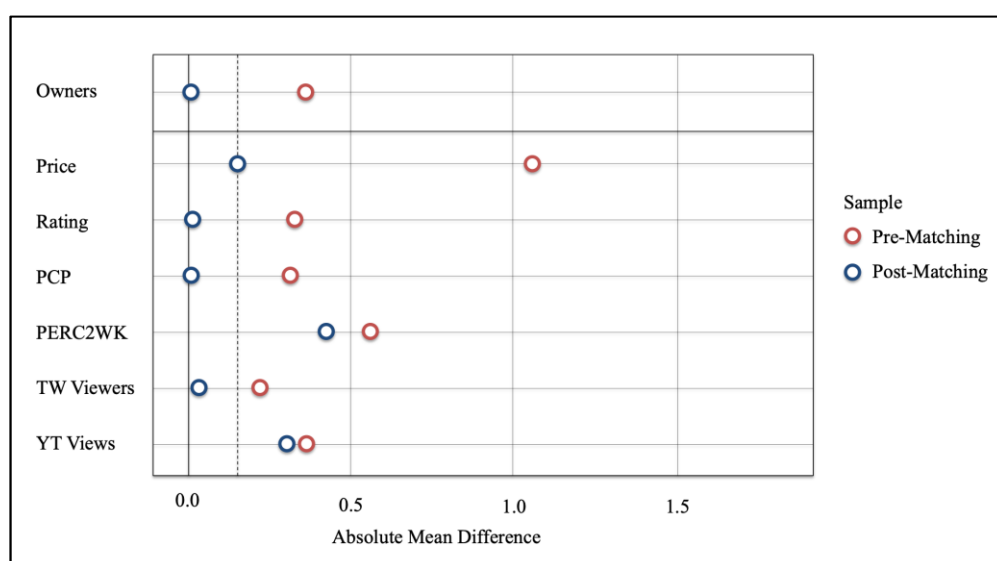


Table 7 shows the results of the calculated differences-in-differences models. The full set of control variables in these models is equivalent to the ones utilized in the fixed effects models 1 to 4. The dummy variable indicating each week is not included.

**Table 7:** Results of Differences-in-Differences Models after Matching

*Results of Model 5, Model 6, and Model 7*

	<i>Dependent Variable</i>		
	<i>log(Owners+1)</i>	<i>log(YT Views+1)</i>	<i>log(TW Viewers+1)</i>
	(Model 5)	(Model 6)	(Model 7)
Constant	11.246 (.576)***	1.840 (2.000)	-1.788 (2.486)
After	-.021 (.215)	-.274 (.737)	.405 (.958)
FW	1.008 (.421)**	3.269 (1.403)**	1.535 (1.628)
After × FW	.014 (.254)	.291 (.828)	.035 (1.023)
Control Variables	Full Set	Full Set	Full Set
R <sup>2</sup>	.428***	.278***	.169***
Observations	195	195	159

Significance levels are based on panel-robust standard errors.

\* p < .10. \*\* p < .05. \*\*\* p < .01.

The results of Model 5, Model 6, and Model 7 do not show any statistically significant effect of the presence of a “Free Weekend” neither on the number of owners nor on the streaming viewership of a game. However, the direction and relative magnitude of the “Free Weekend” effect in these models is consistent with the findings from the main fixed effects regression models of this study. The lacking significance of the “Free Weekend” effect in these models could be caused by the decrease in sample size resulting from the application of the matching approach.

Concluding, the calculated differences-in-differences models after employing propensity score matching do not substantiate the robustness of the results of the main fixed effects regression analysis of this study.

## 5.5 Synopsis of Results

The results of this study show that “Free Weekends” are successful in generating additional customer purchases in the week subsequent to their occurrence. However, this effect is short-

lived as it disappears after the week subsequent to the “Free Weekend”. Further, this study does not find that the “Free Weekend” effect on the number of owners of a game is moderated by a game’s rating or price.

Finally, the results of this study indicate that “Free Weekends” are successful in generating additional streaming viewership of a game during and in the week subsequent to their occurrence. This effect is limited to the streaming platform Twitch and cannot be observed for Youtube Live.

A robustness check based upon differences-in-differences models calculated after employing propensity score matching indicates limited robustness of the results of the main fixed effects regression models of this study.

Table 8 provides an overview of the ramifications of the results of this study for the hypotheses proposed in the research model.

**Table 8:** Ramifications for Proposed Hypotheses

*Overview of the ramifications of the results of this study for the proposed hypotheses*

Hypothesis		Result
H1	The “Free Weekend” at Steam will have a positive effect on customer purchases of the video game at offer after the free trial period.	Partially supported
H2	Quality ratings of a game will positively moderate the positive free trial effect on customer purchases.	No evidence
H3	Game prices will negatively moderate the positive free trial effect on customer purchases.	No evidence
H4	The number of views on Twitch and Youtube Live of the game offered on a “Free Weekend” increases during the free trial period.	Partially supported

## 6 General Discussion

As outlined earlier in this study there exists limited knowledge on the effectiveness of free trials in a digital context. Exactly this was the research gap this study purposed to explore. Filling this research gap is particularly important considering that numerous leading companies in the digital industry, Amazon Prime, Netflix, and Spotify among other, apply free trials as a major tool of sales promotion.

This study finds indications that free trials can be an effective tool in the digital context. The presence of a “Free Weekend” increases the number of owners of a video game on Steam in the subsequent week by 10.8% ( $p < .10$ ). However, this effect is short-lived as it disappears after the week subsequent to the free trial.

Further, in this study the proposed factors moderating the positive effect of free trials in a digital context rating by users and pricing category were not found to be significant.

Finally, this study finds indications that free trials for video games increase streaming viewership by 150.4% ( $p < .01$ ) during the promotion period and by 82.0% ( $p < .05$ ) in the subsequent week. However, this effect is limited to the streaming platform Twitch and does not include Youtube Live.

The positive effect of the presence of a free trial on the number of owners and on the streaming viewership of a game on the platform Twitch obtained from the main fixed effects regression models of this study need to be interpreted with caution as a conducted robustness check indicates limited robustness of these results.

### **6.1 Scientific Implications**

This study adds to the field of free trial research by establishing a better understanding of the effect of free trials in a digital context. The theoretical contributions of this study to the field of free trial research are threefold:

First, this study is, to the best knowledge of the authors, among the first to show that free trials can be an effective tool for generating additional customer purchases for digital products and services. Second, this study provides a better understanding of the time-path of the free trial effect on customer purchases in a digital context. And third, with the analysis of the free trial effect on streaming viewership of a game this study shows the positive effect of free trials on non-sales-related performance measures that are relevant in the digital industry and that have been disregarded in prior research.

### **6.2 Managerial Implications**

Free trials are frequently applied by companies in the digital industry. This study supports leaders of these companies in their decision for or against utilizing free trials in a given context and provides guidance for choosing the right free trial configuration.

Subsequently, the practical implications of this study for leaders in the digital industry in general will be discussed first. Second, practical implications for digital video game distribution companies will be illustrated.

Based on the results of this study leaders in the digital industry are advised to apply free trial promotion schemes in order to increase sales. Particularly in situations in which a short-term increase in the number of owners of a product or service is desirable, utilizing a free trial promotion scheme is indicated. For instance, for products or services that are subject to network externalities, meaning that product or service utility is bounded by the size of the user base, free trials can represent an effective tool to quickly gain market share during a product's or service's introduction phase.

Adding, the rating by users and pricing category of a digital product or service can be disregarded when choosing the optimal product or service to put on a free trial promotion.

For leaders of digital video game distribution companies, such as Steam, this study further implicates that when designing a free trial promotion scheme the free trial should be configured in a way to leverage upon the increased streaming viewership on Twitch of the free trial game. For example, Steam could engage popular streamers on Twitch during the free trial promotion to not only stream the game on free trial but to promote it popularly at the same time. Streamers could be provided with promotion codes for their viewer base with an additional discount for purchase or for unlocking special game features during and shortly after the free trial period. Through these means the time horizon of the free trial effect on customer purchases could be extended beyond the week subsequent to the free trial.

### **6.3 Limitations and Future Research**

Although this study was drafted with great care and was diligently executed, five limitations to this study were identified which will be discussed in the following. This discussion will guide an analysis of potentials for future free trial research.

The first limitation of this study is that there could exist a potential breach of the assumption of strict exogeneity in the main fixed effects regression models of this study due to time-changing confounding variables or reverse-causality. This potential limitation was addressed through the applied robustness check. However, the robustness check indicates limited robustness of the results obtained from the main fixed effects regression models of this study. Hence, the results of this study should be interpreted with caution.

The second limitation of this study is that observations for some independent as well as dependent variables were missing. For certain games all values for some variables were missing. In consultation with the third party data provider no plausible reason for the existence of missing observations could be identified. It is not clear if observations of the mentioned variables are missing at random or not. If data would be missing not at random,

which cannot be ruled out for certain, this would result in a non-representative sample and biased regression estimates, which again would impair this study's results.

The results of this study should be replicated in future research utilizing the scientific approach of a natural experiment. This way selection bias, and undoubtedly endogeneity as the first limitation of this study, could be ruled out and the entirely unbiased causal effect of free trials in a digital context could be identified. For instance, one could offer a randomly selected group of Steam customers a free trial for a game and test if these are more likely to buy the game than customers from a control group. When designing this natural experiment it would be beneficial to work jointly with a company from the digital industry. While working with primary data from a digital company and not from a third party data provider, problems caused by missing observations could be limited.

The third limitation of this study is that while the sample of this study was large, there were few games with a free trial, which could have limited this study's ability to identify a significant free trial effect. This could be the reason why the positive free trial effect on the number of owners was significant only at a 10% level.

Future research should consequently concentrate on designing own natural experiments for which the sample of treated observational units can be specified or should choose observational data with many treated observational units.

The fourth limitation of this study is that in this study game-level and not customer-level data is analyzed. Consequently, this study does not offer the possibility to analyze which customer traits or customer behavior during the free trial period determine a successful conversion of free trial into paying customers.

Future research should focus on customer-level studies of the free trial effect. In this way it could be inspected which customer characteristics and which customer behavior during the free trial are fundamental for free trial success. For instance, studies could analyze the effect of customer age, income, or digital affinity. In the same line of thought, future research on customer-level could aim to provide valuable practical input on how to optimally configure a free trial to address individual customer segments.

The fifth significant limitation of this study is related to external validity. While the results of this study indicate a positive "Free Weekend" effect in the week subsequent to its occurrence, it is arguable if this effect can be extrapolated to all digital products and services. A monthly Netflix subscription for all videos on the platform is substantially different than buying a video game on Steam. Hence, it can be argued that effect mechanisms that substantiate the

positive free trial effect for video games at Steam are different for a Netflix subscription. In this case the external validity of this study's results would be considerably limited.

It is advised for future research to replicate the results of this study for other digital products and services to address limitations of external validity this study entails.

Apart from the five identified limitations to this study, future research should concentrate on identifying further boundary conditions that moderate the effect of free trials in a digital context. This way a better understanding could be established regarding specific effect mechanisms that determine for which products or services free trials are successful or not. Potential boundary conditions worth exploring could be, for instance, whether a product or service is able to lock-in customers through means of storytelling or whether it is able to generate increased community exchange during the free trial period.

After all, this study represents only a first step into the scientific realm of free trial research for digital products and services. However, and most importantly, in this way it sets the ground for further in-depth research on the effect of free trials in a digital context.

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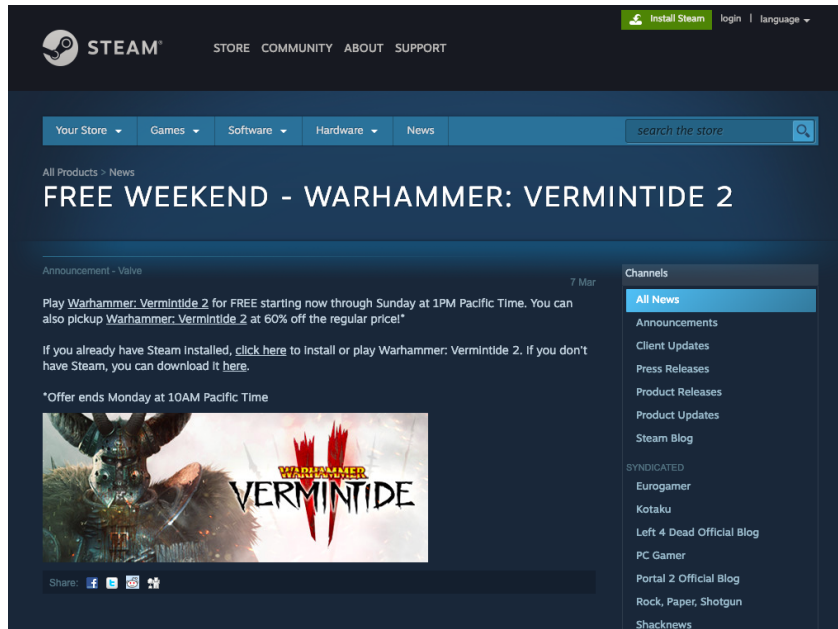
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## Appendix

### Appendix A

Example of “Free Weekend” promotion on Steam



## **Appendix B**

### Description of the meaning of game ownership on Steam

When gamers purchase a game on Steam they acquire ownership of the game and the game is added to their game library. Two cases exist in which the number of owners of a game could decrease: first, gamers can retreat from their ownership of a game by permanently deleting it from their game library. Second, gamers can delete their entire Steam account and in this way retreat from their ownership of all games purchased.

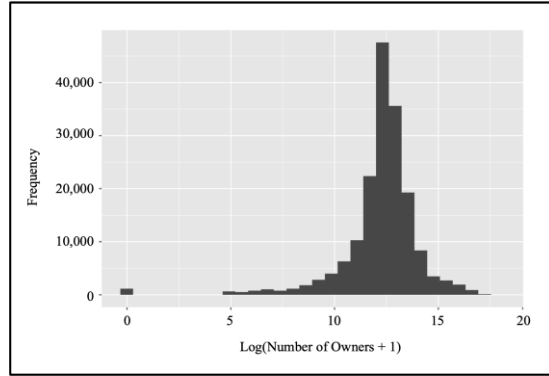
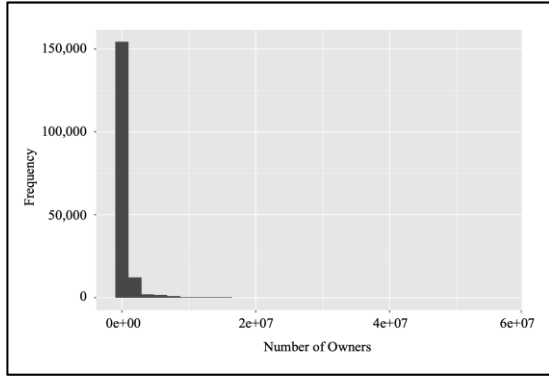
**Appendix C**

Overview missing observations

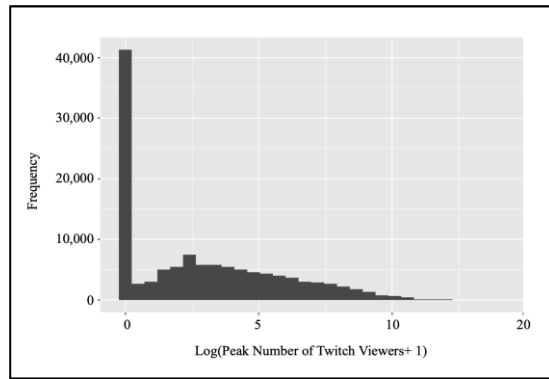
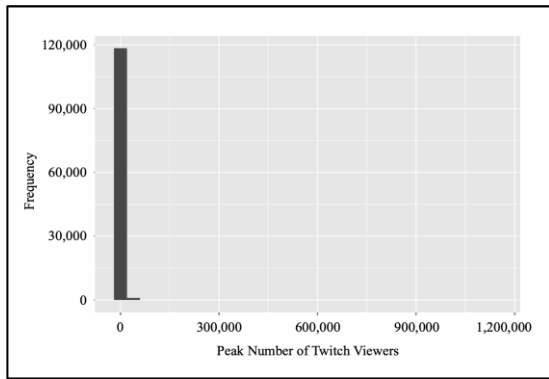
Variable	Missing observations	Number of games with missing observations	Number of games with all missing observations
Twitch viewers	52,928	456	456
Youtube views	3,745	42	42
Userscore	2,845	31	31
Perc2wk	8,054	732	33
PCU	2,371	24	24

## Appendix D

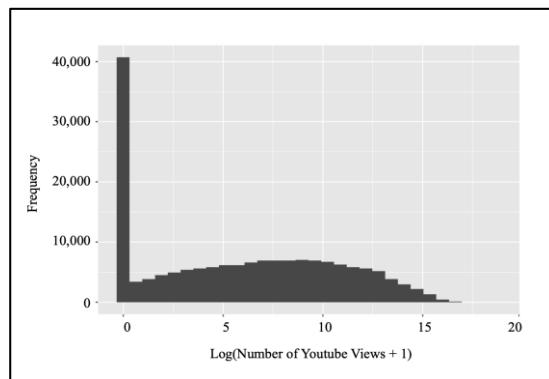
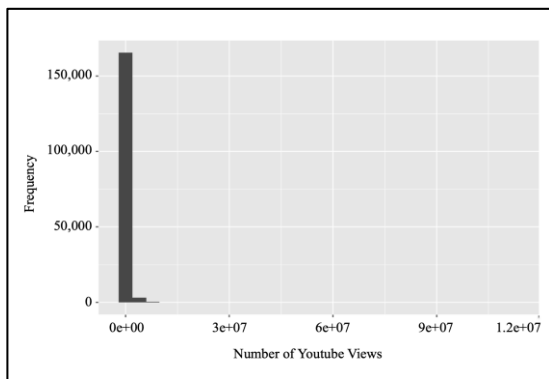
Histogram of the number of owners before and after the logarithmic transformation



Histogram of the peak number of Twitch viewers before and after the logarithmic transformation



Histogram of the number of Youtube views before and after the logarithmic transformation



**Appendix E**

Overview of descriptive statistics for relevant variables only for cases without missing data

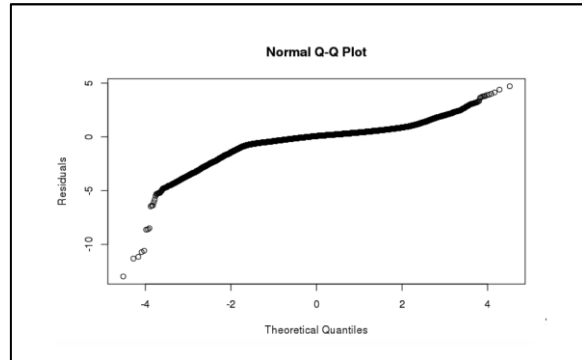
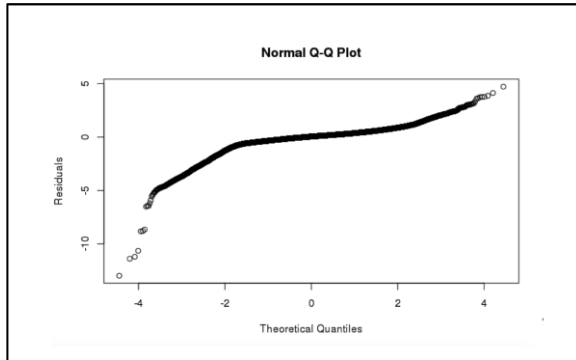
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Statistic	N	Mean	SD	Min	Max
Owners	114,341	781,498.60	2,088,325.00	0.00	56,153,000.00
TW Viewers	114,341	1,396.62	13,646.30	0.00	1,137,953.00
YT Views	114,341	235,247.80	1,552,151.00	0.00	114,483,120.00
Price	114,341	14.96	12.98	0.00	99.99
Rating	114,341	79.41	14.70	18.00	100.00
PCP	114,341	2,996.99	53,076.38	0.00	3,080,310.00
PERC2WK	114,341	6.39	11.20	0.00	100.00

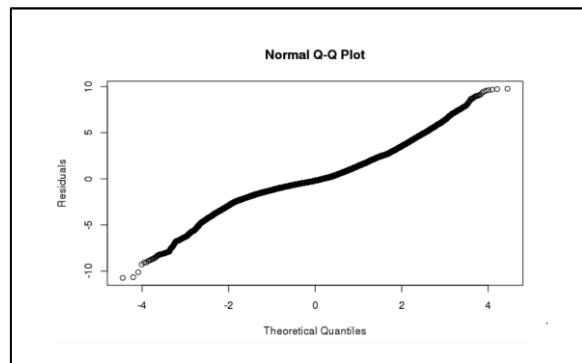
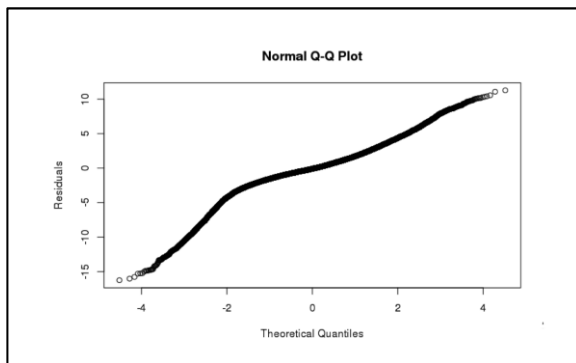
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## Appendix F

### Q-Q Plot of Model 1 and 2



### Q-Q Plot of Model 3 and 4



**Appendix G**

Results of Model 1, Model 2, Model 3 and Model 4 when calculated with balanced panel data

	<i>Dependent Variables</i>			
	<i>log(Owners+1)</i>	<i>log(Owners+1)</i>	<i>log(TW Viewers+1)</i>	<i>log(YT Views+1)</i>
	(Model 1)	(Model 2)	(Model 3)	(Model 4)
FW	-.040 (.080)	.557 (.482)	1.134 (.463)*	.296 (.484)
FW1	.096 (.076)	1.400 (.521)***	1.075 (.723)	.087 (.512)
FW2	.140 (.072)*	1.366 (.548)**	.678 (.428)	-.273 (.512)
FW3	.062 (.055)	.808 (.475)'	.664 (.362)*	.011 (.510)
FW4	.044 (.057)	.510 (.374)	1.006 (.591)*	-.040 (.507)
PCP	.043 (.009)***	.043 (.009)***	.111 (.030)***	.053 (.019)***
PERC2WK	-.021 (.003)***	-.021 (.003)***	.001 (.007)	.076 (.008)***
Price	-.002 (.005)	-.002 (.002)	.000 (.008)	.006 (.008)
Price Promo	-.012 (.021)	-.013 (.021)	.328 (.101)***	.462 (.094)***
Patch	-.050 (.048)	-.050 (.048)	.015 (.119)***	.015 (.144)
Update	-.038 (.029)	-.038 (.029)	.000 (.108)	.040 (.085)
Owners			.000 (.000)**	.218 (.077)***
FW × Rating		-.007 (.005)		
FW × Price		-.006 (.005)		
FW1 × Rating		-.013 (.006)**		
FW1 × Price		-.013 (.005)***		
FW2 × Rating		-.012 (.005)**		
FW2 × Price		-.012 (.005)**		
FW3 × Rating		-.009 (.005)*		
FW3 × Price		-.007 (.005)		
FW4 × Rating		-.007 (.003)**		
FW4 × Price		-.004 (.004)		
Season Dummy	Yes	Yes	Yes	Yes
Week Dummy	Yes	Yes	Yes	Yes
Within R <sup>2</sup>	.521	.522	.264	.115
Games	511	511	422	511
Game-Weeks	88,933	88,933	73,463	88,933

Significance levels are based on panel-robust standard errors.

\* p &lt; .10. \*\* p &lt; .05. \*\*\* p &lt; .01.