Engagement in platform markets: A (video) game changer?

Authors:

Michiel Van Crombrugge (corresponding author)

vancrombrugge@ese.eur.nl

Associate Professor, Erasmus School of Economics, Erasmus University Rotterdam,

Burgemeester Oudlaan 50, 3062 PA Rotterdam, The Netherlands

ORCID: 0000-0003-2537-3578

Stefan Stremersch

stremersch@ese.eur.nl

Chaired Professor of Marketing, Erasmus School of Economics, Erasmus University

Rotterdam, Burgemeester Oudlaan 50, 3062 PA Rotterdam, The Netherlands

Visiting Professor of Marketing, Center for Service Intelligence (CSI), Faculty of Economics

and Business Administration, Ghent University, Belgium.

Engagement in platform markets: A (video) game changer?

Abstract

Empirical studies of two-sided platform markets, like the video game console industry, typically rely on software and platform sales data, thereby overlooking today's managerial focus on engagement. This present research leverages a unique dataset tracking the daily engagement of over 14,000 users of Microsoft's Xbox One and Xbox Series video game platforms to remedy this gap. We investigate how software development and release characteristics affect consumers' engagement with software titles and the platforms on which they release. Our analysis finds that releasing software on subscription services is the strongest determinant of engagement, overshadowing established determinants like software quality or exclusivity. While superstar software and exclusive titles generate engagement, their relative importance is smaller compared to sales-based findings, reported in prior literature. Instead, franchises, non-superstars, and multihomed software perform much better on engagement than on sales, especially when included in a subscription service. These findings have important industry implications.

Keywords: Platform markets, Two-sided markets, User engagement, Software, Platforms, Video game console industry

Introduction

Historically, the marketing and economics literatures have devoted a lot of attention to two-sided platform markets, where the interaction between buyers and sellers (i.e., the two sides of the market) is facilitated through a platform. These markets typically consist of a platform and corresponding software.[1] A typical example is the video game console market. Other examples include music and movie streaming platforms or PC and mobile app stores.

In these markets, the expected utility of the platform (e.g., Microsoft Xbox or Sony PlayStation) typically depends on the availability of new software (e.g., video games such as Halo: Infinite or God of War). And vice versa, the availability of new software depends on the installed base of the platform (for a review, see Stremersch et al. 2007). While initially this literature was theoretical in nature (e.g., Church & Gandal 1992, 1993; Katz & Shapiro 1985), more recent empirical research on platform markets used *sales* data to measure the effects of software characteristics and software availability on the success of the software (e.g., Allen et al. 2022; Healey & Moe 2016; Rietveld & Eggers 2018) and consequently the platform (e.g., Allen et al. 2022; Binken & Stremersch 2009; Landsman & Stremersch 2011; Lee 2013; Stremersch et al. 2007).[2] Binken and Stremersch (2009), for instance, find that superstar games (i.e., video games of exceptional high quality) sell up to 7 times more software units than non-superstars and increase video game platform sales by 14%.

Yet the business model of platform markets has changed. Ahead of Microsoft's latest Xbox video game console launch, its CEO of Gaming Phil Spencer declared: "*Our strategy*

---

[1] Early research typically referred to the primary product as platform "hardware" (e.g., Church & Gandal 1992, 1993; Corts & Lederman 2009; Stremersch et al. 2007). The increased digitization of these products, however, has voided this term since many platforms no longer require proprietary devices to run (e.g., Netflix runs on TVs, PCs, mobile phones etc.). While the video game console market still features proprietary hardware (i.e., video game consoles), many of their software is also accessible through cloud streaming on other devices. In this study, we therefore consistently use the term "platform" to refer to the primary product, in line with recent research (e.g., Allen et al. 2022; Wiegand et al. 2023).

[2] Following extant literature, in our paper, s*ales* henceforth refer to the physical unit sales of standalone software titles and/or platform hardware, and excludes sales (revenue) of in-software content or subscriptions.

does not revolve around how many Xboxes I sell this year. [...] for us, it's about engagement with large player bases, giving them a great place to go play, find friends and find new games".
Spencer mentioned the industry pivoting to "*engagement metrics rather than device metrics*" to measure software and platform success (Cieslak 2020). This managerial focus on engagement, which platform literature defines as product usage (Huang et al. 2019; Rutz et al. 2019), reveals a shift in firm objectives.

Firms focus on engagement because their business models depend on engagement. For instance, in the video game console industry, both software sellers as well as platforms owners increasingly rely on subscription services to commercialize their software and platforms (Lehtonen et al. 2023; Van Crombrugge & Stremersch 2024).[3] But subscription services are usage platforms, not sales platforms. Understanding the drivers of usage at both the software and platform level is therefore crucial. Yet no research, so far, has used engagement data to study the effects of software characteristics and software availability on software and platform success, relying on sales data only instead. Because customers' purchase behavior tends to deviate from their usage behavior (Meyer et al. 2008), using sales data to explain engagement does not make sense.

Also theoretically, engagement data provide a better way to test theory on two-sided markets than sales data, because sales measures (typically measured monthly) are a more remote proxy of utility than engagement measures (measured daily). Consumers can disadopt the software and platform that they bought, or vary their usage, which sales data cannot reveal. Sales data also lead to limited data intervals on the lifecycle of software; software sales are typically observed for only a few monthly data points in the time domain. Yet, consumers may use their software daily and may continue to do so long after the initial purchase. Using monthly

---

[3] In our paper, subscription services henceforth refer to video game catalog subscriptions that give access to a rotating catalog of video games on a platform for a monthly fee. We distinguish these from in-game subscriptions within individual games that give access to in-game items or currency (e.g., Fortnite Crew) or platform access subscriptions that primarily give access to online multiplayer or other online features (e.g., Nintendo Online).

sales data to infer usage means that a lot of the short- and long-term variation in usage gets lost in the aggregation, and risks introducing bias. Usage, or engagement, is therefore theoretically closer to the software and platform utility that theory in two-sided platform market literature describes, especially given platform markets' managerial focus on usage instead of sales.

The current study aims to remedy these shortcomings. We empirically model engagement across multiple software products and platforms in the video game console industry, as a prime application area of platform markets. We follow the literature on two-sided markets in that we take a software perspective as well as platform perspective. From a software perspective, we investigate how certain software development and release characteristics, at the software level, affect the aggregate engagement of consumers with software over time. Subsequently, from a platform perspective, we investigate how software introductions with these software development and release characteristics, at the platform level, affect consumers' aggregate engagement on the platform over time.

Literature on two-sided markets in the video game console industry suggests that the main software development characteristics are the quality of the software (i.e., whether it is a superstar or non-superstar) (e.g., Allen et al. 2022; Binken & Stremersch 2009; Gretz et al. 2019; Kim et al. 2014), customers' familiarity with the intellectual property (IP) (i.e., whether it is part of an existing franchise or a new IP) (e.g., Allen et al. 2022; Marchand 2016; Rietveld & Eggers 2018), and the exclusivity of the software (whether it is exclusively available on only one brand's platforms or multihomes) (e.g., Corts & Lederman 2009; Landsman & Stremersch 2011; Lee 2013). The main release characteristic relates to whether the software releases on a platform's subscription service (Schaurte et al. 2023; Van Crombrugge & Stremersch 2024; Zhang & Seidmann 2010). These characteristics relate strongly to the theory of valuation-usage disparity that Meyer et al. (2008) describe and that forms the basis of theoretical expectations. We additionally consider the timing of the release in the lifecycle stage of the platform and

how the software's performance evolves over time (e.g., Gretz et al. 2019; Healey & Moe 2016; Landsman & Stremersch 2011; Rietveld & Eggers 2018).

We address the following research questions, that are new to the literature and that can be contrasted with prior insights from two-sided market literature using sales:

- How do software development and release characteristics affect the engagement of consumers with the software?
- How do software development and release characteristics affect the impact of software introductions on the engagement of consumers with the platform?
- How do these effects evolve over the software and platform lifecycle?

To address these questions, we collaborated with Circana to set up a unique dataset from the engagement data that they track in a panel. We acquired the aggregate daily video game player behavior of a representative panel of 14,080 consumers of Microsoft's Xbox One and Xbox Series' video game platforms between 2020 and 2022. The data cover the entire population of video games released on the U.S. market during this period, which consists of over 2,000 software titles. For these platforms and software titles, we sourced all relevant characteristics from Circana and combined these with software metadata from various sources. We additionally acquired the monthly aggregate unit sales for the same set of platforms and software titles from Circana. The availability of both engagement and sales data, for both the software as well as platform, enables us to assess the correspondence between engagement and sales outcomes and more directly relate to the prior academic literature that always used sales.

Our study of the new questions mentioned above, on unique and new data, allows us to supplement the prior literature with entirely new findings, as follows. We show that, in the more fast-paced decision-making process of choosing what to play (opposed to what to buy), the most influential driver of software engagement is whether a video game is available on a platform's subscription service. Superstars, new IPs and exclusive video games – without the

pre-purchase information search that typically boosts their sales – have declined in relative importance compared to prior insights from research on sales. Instead, non-superstars, franchises, and multihomed video games matter more to engagement than they do to sales, especially later in the platform lifecycle and when released on a platform's subscription service. This is attributed to a valuation-usage disparity, i.e., in a crowded market, consumers' usage (opposed to purchase) decisions are driven by a desire to seek variety as well as to regress to what is familiar. These results represent a substantial deviation from common wisdom on what drives software and platform success, and show that the video game industry's adoption of engagement as a key performance metric has changed the rules of the game.

We organize the remainder of this article as follows: In the next section, we review the literature on two-sided markets within the video game industry and lay out our theoretical expectations of the drivers of engagement. Then, we present our empirical setting, sample, and measurement of variables. Then, we subsequently take a software and platform perspective to test the developed concepts on, respectively, software and platform engagement. For each perspective, we present the model development and results. In the final section, we discuss the broader implications across all perspectives.

The determinants of software and platform engagement

We ground our research in literature on two-sided markets, where consumer utility for a platform typically depends on the available software, and vice versa. Given our empirical setting, we focus our inquiry on the video game console industry, which is a prototypical two-sided market and the subject of a broad literature (Lee 2013; Katz & Shapiro 1985; Stremersch et al. 2007). In this section, we first review two-sided market literature on video games which has predominantly focused on sales metrics, and then theorize on the effects that we expect in our empirical setting that focuses on engagement.

Two-sided markets: reviewing the interplay between software and platform

Broadly, two major streams of research have emerged from two-sided market literature on video games, summarized in Table 1.

[Insert Table 1 here]

A first focus of this literature is which *video game software* will sell most successfully on video game platforms (Allen et al. 2022; Binken & Stremersch 2009; Gretz et al. 2019; Haviv et al. 2020; Healey & Moe 2016; Lee 2013; Marchand 2016; Rietveld & Eggers 2018). A common theme in this literature is that video game software sales depend on the characteristics of the game. Research generally finds substantially more sales of superstar games (Allen et al. 2022; Binken & Stremersch 2009; Gretz et al. 2019) and franchised games (Allen et al. 2022; Rietveld & Eggers 2018), for instance. However, these characteristic effects may differ depending on the lifecycle of the platform. Prior literature finds that, for instance, exclusive video games or new IPs that are released earlier in a platform life cycle realize higher sales than those released later (Lee 2013; Marchand 2016; Rietveld & Eggers 2018). Crucially, this research thus establishes that not all video game software is valued alike.

Given the interplay between video game software and video game platforms, a second focus of the two-sided market literature on video games is on how the supply of such differently valued video games affects *video game platform* sales, and vice versa (Allen et al. 2022; Binken & Stremersch 2009; Corts & Lederman 2009; Gretz et al. 2019; Kim et al. 2014; Landsman & Stremersch 2011; Lee 2013; Sun et al. 2016). Collectively, this literature finds that the amount of video game introductions positively impacts video game platform sales (Stremersch et al. 2007). And similarly, that the video game platform installed base positively impacts its video game supply. Individually, they focus on the differences in these effects across video game software of different characteristics. In line with the literature's findings on software valuation, these studies similarly found that the availability of superstar software, franchised software,

and exclusive software affects platform sales substantially more (Allen et al. 2022; Binken & Stremersch 2009; Corts & Lederman 2009; Gretz et al. 2019; Kim et al. 2014; Landsman & Stremersch 2011; Lee 2013; Sun et al. 2016). They also identified that these effects typically depend on the age of the platform. Gretz et al. (2019), for instance, show that the positive impact of releasing superstars on platform sales decreases in the later stages of the platform lifecycle. Landsman and Stremersch (2011) similarly show that the negative impact of software multihoming on platform sales disappears as the platform matures.

The determinants of software and platform engagement: conceptual background

Our literature review reveals that extant literature on platform markets using sales data has focused on three key software characteristics to explain the success of software and the platform on which they are featured. These are the quality of the software, customers' familiarity with its IP, and its exclusivity to the platform's video game brand. Even though prior research has stated that these characteristics may explain software and platform sales success, their role in determining software and platform engagement remains unexplored.[4] Theoretically, we expect these effects to substantially differ.

Like movies' box office revenue, sales of video games take off immediately and decline exponentially (Healy & Moe 2016), leaving room for new releases in the market. Yet, consumers may continue to use their video games long after the initial purchase. Any observed sales are therefore spread out over much longer time when translated to engagement because consumers' engagement with other titles is still taking up their time. The lifecycle of video games engagement is thus much longer than their lifecycle in sales. This means that the market

---

[4] Rare studies on what drives engagement include Huang et al. (2019) and Jiao et al. (2022) who study, respectively, what keeps players within a game-play session and what makes them return, yet do so within the confines of a single, respectively online and mobile, video game title. Rutz et al. (2019) also model repeat usage of mobile video games but are restricted to one month of data. None of these studies model engagement based on high-frequency data nor take both a software as well as a platform perspective.

for what to play on video game platforms is much more saturated than the market for what to buy. This has important implications.

First, it suggests that the competition for consumers' engagement is much more intense than it is for sales. As a result, even video game titles with illustrious characteristics, such as those that are of exceptional quality or that are exclusive to the platform's brand, will have a harder time breaking through. They may still perform better, but will do so continuously over time, leaving less room for other titles of similar characteristics to take over the market as they do in sales. Major bumps in consumers' engagement with these titles (or with the platform at large upon their release) compared to the status quo, should be a rarer phenomenon, since there is still so much other content on the platform that keeps consumers occupied. We therefore expect previously found effects of software characteristics to be more subdued.

Second, the crowdedness of the market for deciding what to play instead of what to buy, may make consumers more susceptible to valuation-usage disparity that Meyer et al. (2008) have experimentally shown in a gaming context before, i.e., displaying a high willingness to pay for games that offer something rare, but failing to use these after purchase. This discrepancy is particularly salient in a crowded market since it is attributed to the fact that consumers' usage (opposed to purchase) decisions are much more driven by a desire to seek variety as well as to regress to what is familiar. The latter suggests that especially video games that are part of an existing franchise may perform particularly well in an engagement context, since they do not require the information search or learning that new IPs typically require. The former suggests that the volume and variety that is typically found among non-superstars and multihomed games may be more important than superstar quality and exclusivity that is much more scarcely available. It also establishes the crucial role that a platform's subscription service may play in driving engagement. Platforms' subscription services grant users access to a curated and rotating catalog of software for a recurring subscription fee (Van Crombrugge &

Stremersch 2024; Zhang & Seidmann 2010). Subscription services are thus particularly good in offering consumers the salience and variety that they seek. Releasing video games on a subscription service may therefore be a powerful driver of consumers' engagement with that software and the platform as a whole.

Summarizing, we envision theoretical support for the following:

- Superstar software (releases) lead to more software (platform) engagement than non-superstar software (releases), but less so than what one would expect based on earlier sales findings.
- Exclusive software (releases) lead to more software (platform) engagement than non-exclusive software (releases), but less so than what one would expect based on earlier sales findings.
- Franchise software (releases) lead to more software (platform) engagement than new IP software (releases), and more so than what one would expect based on earlier sales findings.
- Software that is available (released) on a platform's subscription service leads to more software (platform) engagement than software that is available (released) off a platform's subscription service.

Because our literature review shows that the utility of software changes as the software and the platform mature (Gretz et al. 2019; Healey & Moe 2016; Landsman & Stremersch 2011; Marchand 2016; Rietveld & Eggers 2018), we expect that these effects may vary across software and platform age.

Conceptual framework

To empirically explore our framework, we follow the platform market literature on video games in that we first investigate what software consumers engage with the most and then

investigate how the supply of such differently valued video games affects consumers' engagement with the platform at large.

In "Study 1: Software engagement" (Figure 1), we are interested in how software quality, familiarity, and exclusivity (labeled *development characteristics*, as they relate to characteristics that follow from the development of the software) will affect the engagement of consumers with their software over time. We additionally investigate whether the impact of these development characteristics depends on whether the software releases on a platform's subscription service (i.e., labeled the *release characteristic*, as it relates to the release of the software) and the age of the platform and the software.

[Insert Figure 1 here]

In "Study 2: Platform engagement" (Figure 2), we are interested in how software introductions with these software development and release characteristics will affect consumers' engagement with the platform over time.[5] We approach both studies one by one because both involve a different level of analysis; one is at the software title level, the other at the platform level.

[Insert Figure 2 here]

Empirical context

The U.S. video game console market

The U.S. video game market provides an ideal empirical setting for our inquiry for a number of reasons. First, the video game market is a prime application of a platform market. Key software characteristics in gaming (e.g., software quality, software familiarity, software exclusivity, subscription participation) directly generalize to other platform markets (e.g., markets of mobile and PC applications or movie and TV entertainment). The video game

---

[5] Software age does not interact with the daily software introductions since the software age at the time of each software introduction is always 0.

market is also the canonical empirical setting in platform market literature (Allen et al. 2022; Binken & Stremersch 2009; Healey & Moe 2016; Landsman & Stremersch 2011; Lee 2013; Rietveld & Eggers 2018).

Second, consumer engagement has become a key metric in the video game industry. The industry's leading business model is no longer to sell the most video game consoles or games, but to hold players within a video game (console) for as long as possible (Amenabar 2022). As a result, data on consumers' engagement with software and platforms are being tracked daily at a high-quality level across the entirety of the video game market. Because sales data are still simultaneously tracked as well, the video game market is one of the few allowing to contrast engagement and sales.

Third, the market for video games is the largest segment in the market for media and entertainment, valued at about $236 billion in 2022 and expected to grow to $321 billion by 2027. This is almost 9 times as large as the music market ($26 billion in 2022) (PwC 2022). As the favorite past-time activity of consumers (The Wall Street Journal 2022), it represents a fertile ground for impactful research on platform markets.

Sample

We focus on the eighth and ninth generation of video game platforms of Microsoft's Xbox brand, i.e., the Xbox One and Xbox Series platforms' families of consoles, in the U.S. video game market between June 2020 and July 2022 (791 consecutive days).[6] The Xbox Series entered the market in November 2020, yet Microsoft continued to support the Xbox One (Totilo

---

[6] We consider a platform's family of consoles because video game platforms typically consist of multiple consoles; they either introduce higher- and lower-end editions (e.g., Xbox Series X versus Xbox Series S) or mid-generation upgrades (e.g., Xbox One S, Xbox One X versus Xbox One) of their consoles.

2023). We focus on the entire library of software titles released for both platforms and their

subscription service during this period, leading to 2,707 unique title-platform combinations.[7]

For these video game platforms and software titles, we obtained the daily aggregate

player usage at the title-platform level for a representative panel of 14,080 consumers in the

U.S. video game market, from market research company Circana.[8] Daily usage includes both

the daily number of active users and the daily number of minutes played. Circana also provided

the monthly average price, aggregate unit sales and aggregate revenue for both platforms and

their software titles in the entire U.S. market, as well as each title's release date, review score,

software genre and other platform(s) on which it was released. Data on whether a title is part

of an existing franchise and whether it is available on the platform's subscription service were

hand-collected by research assistants and matched to the Circana data.

Data descriptives

Descriptive evidence confirms our expectation that customers engage with video software titles

and the platforms that they release on vastly different than their purchase behavior suggests.

First, Figure 3 illustrates that the lifecycle of video games' engagement evolves differently than

their lifecycle in sales. For example, on Microsoft's Xbox platform, a popular 2021 sports video

game displayed in the left graph sold over 200,000 copies in its first month in the United States

alone, capturing 17% of sales market share. However, it was only able to capture up to 1.2%

engagement share in its first 6 months (based on the number of active users). Both its sales and

engagement dropped to zero after one year. In contrast, a popular shooter video game of the

same year displayed in the middle graph captured 18% of sales market share in its first month,

---

[7] In Study 1: Software engagement, we excluded software titles that were released before our observation window since we do not observe the start of their lifecycle, which biases the impact of software age.
[8] Panelists join the panel by befriending a Circana-run gaming account. The panelists' gaming activity is visible to their friends (including the Circana-run account) by default and captured every 5 minutes via an automated process and processed into title-level engagement metrics.

but was able to engage up to 4.5% of the market within its first 4 months, and held on to that share even after sales had dried up.

[Insert Figure 3 here]

Not only do these examples show the disproportionate engagement that software may display vis-à-vis their sales, but they also show different patterns in usage across titles which we could not have picked up on through sales data. That is, while the market was buying both the sports title and the shooter title, predominantly the shooter title was being played, and well after its release. That software titles may display persisting engagement long after sales have died, is apparent from the rightmost example of Figure 3. This illustrative 2014 shooter title was engaging up to 1.5% of the market 6 years and more past its release, despite bringing in hardly any new sales. These descriptives confirm our expectation that video games' engagement may persist over time, leaving less room for other titles to take over the market as they do in sales.

Next, Figure 4 illustrates that, on Microsoft's Xbox platform, out of the top 10 most engaging video games of 2021 (see graph left), only 2 (at #3 and #5) appear within the top 10 most sold games (at #5 and #4, respectively). Likewise, most top selling titles (see graph right) display disproportionally little customer engagement, especialy compared to the top engagers. When the most engaging software titles are so clearly different from the most purchased ones, it calls into question whether the established drivers of platform and software utility still hold when considering engagement instead of sales. This is the theme of our research.

[Insert Figure 4 here]

Variable operationalization

Engagement We operationalize the engagement with a video game (platform) as its daily number of active users, in line with the definition we provided above (Rutz et al. 2019; Huang

15

et al. 2019).[9] The number of active users is also an established measure of software engagement and success in academic work (e.g., Claussen et al. 2013; Liu et al. 2024; Schulze et al. 2014), and the industry standard to track engagement in platform markets (NPD 2021). We replicated our results with the daily number of minutes played as an alternative measure of engagement (see Table WA.1-WA.3 in Web Appendix A).

Software quality We rely on the established practice of using superstar status as the operationalization of software quality (e.g., Allen et al. 2022; Binken & Stremersch 2009; Gretz et al. 2019). In line with the literature, a software title must have an expert review score of 90 or above to be considered a superstar. We obtained expert review scores for each software title in our data set from Circana, who operationalize the review score as a weighted average of expert review scores from different industry outlets. In total, 4.10% of title-platform combinations in our sample are considered superstars, a number in line with prior literature that studied superstars (Allen et al. 2022; Binken & Stremersch 2009; Gretz et al. 2019).

Software familiarity To operationalize software familiarity, we consider whether a software title is part of an existing franchise or a new IP at the time of its release (Allen et al. 2022; Binken & Stremersch 2009; Rietveld & Eggers 2018). Following Rietveld and Eggers (2018), a software title is considered part of a franchise when it is based on an existing video game property (i.e., it is a sequel, prequel, or spin-off) or on an existing non-video game license or tie-in (i.e., it is based on a sports, movie, TV-series, or book license) at the time of its release. It is considered a new IP when it is legally unrelated to any existing properties at the time of its release. Five research assistants consulted the websites of the software titles' developers and

---

[9] In our data, platform engagement is conditional on platform purchase, and software engagement is conditional on software purchase or subscribing to the platform's subscription service that provides access to the software. Factors that influence purchasing or subscribing thus do not confound engagement.

other online sources to classify each software title in the data set as either a new IP or part of an existing franchise. In total, 54.04% of our sample's title-platform combinations are part of a franchise.

Software exclusivity To operationalize software exclusivity, we consider whether a software title is exclusively available on one video game brand's platforms or multihomes on the platforms of multiple video game brands (Binken & Stremersch 2009; Rietveld & Eggers 2018; Landsman & Stremersch 2011). Software titles that are available on multiple (cross-generational) platforms of the same video game brand are not considered to multihome, in line with industry terminology. This is because nearly all software titles in the eighth and ninth generation of video game platforms are backwards and forwards compatible to the previous and next generation of platforms. In total, 5.82% of software titles in our sample are considered exclusive.

Subscription participation To operationalize whether a software title is available on a platform's subscription service, we traced each software title with respect to its entry and exit to and from Microsoft's Xbox Game Pass subscription catalog. Which video games enter and exit the subscription catalog are announced periodically on Xbox Wire, Microsoft's proprietary news channel for Xbox-related content. Five research assistants consulted this source to classify whether a software title was available on a subscription service or not. In total, 31.89% of title-platform combinations in our sample were available on the platform's subscription catalog at some point in our observation window. They remained available on the subscription service for, on average, 451 days.[10]

---

[10] All video games in the Xbox Game Pass subscription catalog are available for purchase to both subscribers and non-subscribers, yet subscribers can do so at a discount of 20%. If a video game exits the catalog or the user ends their subscription, the game can no longer be played unless the user purchases it for permanent ownership.

Overview of studies

As established, we follow the platform market literature on video games in that we model software and platform performance in two separate studies. The first study (Study 1: Software engagement) analyzes consumers engagement with software of different development and release characteristics over time. The second study (Study 2: Platform engagement) examines how the different development and release characteristics affect the impact of software introductions on total platform engagement. As a result, each study uses the constructs defined above differently. Table 2, Panel A summarizes variables and definitions for the software model(s) of Study 1. Table 2, Panel B summarizes variables and definitions for the platform model(s) of Study 2. We discuss these models and their respective results each in turn in more detail.

[Insert Table 2 here]

Study 1: Software engagement: model and results

Software engagement model

In Study 1, we investigate consumers' engagement with individual software titles over time, and how this differs across software with different development and release characteristics over the lifecycle of the platform. This software engagement model analyzes engagement at a daily software-platform level. We begin by estimating the following regression model (Equation 1), using an ordinary least squares (OLS) panel regression (see Table 2 for an overview of variable definitions and descriptives):

$$
\begin{aligned}
\text{(Eq. 1) } \ln(\text{SoftwareEngagement})_{ipt} = {} & \alpha_0 + \alpha_1 \times \text{Superstar}_i + \alpha_2 \times \text{Franchise}_i \\
& + \alpha_3 \times \text{Exclusive}_i + \alpha_4 \times \text{SubscriptionParticipation}_{it} + \alpha_5 \times \text{Superstar}_i \times \text{SoftwareAge}_{ipt} \\
& + \alpha_6 \times \text{Franchise}_i \times \text{SoftwareAge}_{ipt} + \alpha_7 \times \text{Exclusive}_i \times \text{SoftwareAge}_{ipt} \\
& + \alpha_8 \times \text{SubscriptionParticipation}_{it} \times \text{SoftwareAge}_{ipt} + \alpha_9 \times \text{Superstar}_i \times \text{PlatformAge}_{pt} \\
& + \alpha_{10} \times \text{Franchise}_i \times \text{PlatformAge}_{pt} + \alpha_{11} \times \text{Exclusive}_i \times \text{PlatformAge}_{pt} \\
& + \alpha_{12} \times \text{SubscriptionParticipation}_{it} \times \text{PlatformAge}_{pt} + \alpha_{13} \times \text{SoftwareAge}_{ipt} \\
& + \alpha_{14} \times \text{PlatformAge}_{pt} + \Delta \text{Control Variables} + \varepsilon_{ipt}
\end{aligned}
$$

where *ln(SoftwareEngagement)$_{pt}$* is the log-transformation of consumers' engagement with software i on platform p at time t, measured as the number of active users of software i on platform p at time t.

To examine the impact of development characteristics, we include dummy variables *Superstar$_i$* (which equals 1 if software i is a superstar, and 0 otherwise), *Franchise$_i$* (which equals 1 if software i is part of a franchise, and 0 otherwise), and *Exclusive$_i$* (which equals 1 if software i is exclusive to a video game brand's platforms, and 0 otherwise). The corresponding coefficients represent the marginal effects of the development characteristics on software engagement on the day of release of software i at the start of the lifecycle of platform p.

To examine the impact of releasing software on a platform's subscription service, we include a dummy variable *SubscriptionParticipation$_{it}$* (which equals 1 if software i is part of the subscription service at time t and 0 otherwise). The corresponding coefficient represents the marginal effect of subscription participation on software engagement on the day of release of software i at the start of the lifecycle of platform p. To investigate how the impact of the development characteristics and subscription participation evolve as the platform and the software age, we add 8 additional interactions terms between the *Superstar$_i$*, *Franchise$_i$*, *Exclusive$_i$*, and *SubscriptionParticipation$_{it}$* variables and the moderating variables of *PlatformAge$_{ipt}$* and *SoftwareAge$_{ipt}$*.

We include a number of control variables to account for factors that may additionally influence software engagement. First, we control for spillover in engagement from platform activity at large by including the log-transformation of platform engagement at time t-1 (*ln(PlatformEngagement)$_{pt-1}$*). Second, we include the price of software i on platform p at time t (*ln(SoftwarePrice)$_{ipt}$*), and the weighted average price of platform p at time t (*ln(PlatformPrice)$_{pt}$*). For platform price, we weigh each console of a platform's family of consoles by the console's sales market share at time t to reflect that the price of more popular

or recent consoles likely carries a larger weight in consumers' perception of the platform price. We use unit sales to calculate the market shares to not interfere with our focal metric of engagement. We also include the log-transformation of the number of competing software releases on platform p at the day of release of software i (*ln(CompetitionOnRelease)$_{ip}$*). To control for systematic variation in engagement across video game genres, we include a genre dummy for each video game genre. We control for seasonality in software engagement by including a weekend dummy, month dummies, and year dummies to take into account time-varying characteristics that are constant across software and platforms. Δ is the vector of coefficients for the control variables.

Then, in Equation 2, we extend Equation 1 by interacting the development characteristics with the *SubscriptionParticipation$_{it}$* variable, to examine whether the impact of the development characteristics on software engagement also depends on releasing on the platform's subscription service, aside from the timing of release vis-à-vis the platform's age, and vice versa. Other than the 3 additional interaction variables, Equation 2 follows the model specification of Equation 1:

(Eq. 2) $\ln(\text{SoftwareEngagement})_{ipt} = \alpha_0 + \alpha_1 \times \text{Superstar}_i + \alpha_2 \times \text{Franchise}_i$
$+\alpha_3 \times \text{Exclusive}_i + \alpha_4 \times \text{SubscriptionParticipation}_{it}$
$+\alpha_5 \times \text{Superstar}_i \times \text{SubscriptionParticipation}_{it}$
$+\alpha_6 \times \text{Franchise}_i \times \text{SubscriptionParticipation}_{it}$
$+\alpha_7 \times \text{Exclusive}_i \times \text{SubscriptionParticipation}_{it} + \alpha_8 \times \text{Superstar}_i \times \text{SoftwareAge}_{ipt}$
$+\alpha_9 \times \text{Franchise}_i \times \text{SoftwareAge}_{ipt} + \alpha_{10} \times \text{Exclusive}_i \times \text{SoftwareAge}_{ipt}$
$+\alpha_{11} \times \text{SubscriptionParticipation}_{it} \times \text{SoftwareAge}_{ipt} + \alpha_{12} \times \text{Superstar}_i \times \text{PlatformAge}_{pt}$
$+\alpha_{13} \times \text{Franchise}_i \times \text{PlatformAge}_{pt} + \alpha_{14} \times \text{Exclusive}_i \times \text{PlatformAge}_{pt}$
$+\alpha_{15} \times \text{SubscriptionParticipation}_{it} \times \text{PlatformAge}_{pt} + \alpha_{16} \times \text{SoftwareAge}_{ipt}$
$+\alpha_{17} \times \text{PlatformAge}_{pt} + \Delta\text{Control Variables} + \varepsilon_{ipt}$

Note that, in Equation 2, the additional interaction variables mean that coefficients of the main effects of the development variables represent the marginal effect of the development characteristics when the software is not available on the subscription service. Similarly, the coefficient of the main effect of the subscription participation variable represents the marginal

effect of subscription participation when the software is a non-superstar, new IP, and non-exclusive.

Software engagement results

We present the results of Equation 1 (Panel A) and 2 (Panel B) in Table 3. The adjusted R-square shows that the models fit the data well (R^2's $\geq$ 0.441).

<div align="center">[Insert Table 3 here]</div>

Software quality Based on the positive coefficient of *Superstar* ($\alpha_1^{Eq.1}$ = .595, p < .001), we find that superstars engage consumers about 1.81 times more than non-superstars, on their day of release at the start of a platform's lifecycle. In the days following their release, consumers' engagement with superstars decreases, and faster compared to non-superstars ($\alpha_5^{Eq.1}$ = -1.454, p < .001). Our estimates suggest that, after 6 months, superstars engage only 1.43 times more than non-superstars, having engaged on average 1.60 more across that time domain. Given the negative interaction between superstars and platform age ($\alpha_9^{Eq.1}$ = -.028, p < .001), those numbers shrink further throughout the platform lifecycle.

This result confirms that the superstar effect on engagement is much smaller than what is expected from prior literature that has looked at sales. Prior studies reported that superstars sell up to 10 times more than non-superstars in a 6-month period (Binken & Stremersch 2009, p.90; Gretz al. 2019, p.405). Superstars are thus bought considerably more in stores, but not consumed in the same magnitude. While budget constraints make software purchases a more well-thought-out decision (involving, for instance, more pre-purchase information search) that favors superstars, the daily decision what to play is open to a much larger variety of playing options that includes prior purchases, free-to-play software, or software that is available in a platform's subscription catalog.

This reasoning is confirmed when looking at the impact of releasing on a platform's subscription catalog. On average, joining a subscription service increases software engagement by 80% ($\alpha_4^{Eq.1} = .585$, p < .001), growing slightly as the platform ages ($\alpha_{12}^{Eq.1} = .021$, p < .001). This makes subscription participation the strongest driver of software engagement. From the results of Model 2 (Panel B in Table 3), however, we learn that the additional benefit of subscription entry for superstars compared to non-superstars is limited ($\alpha_4^{Eq.2} = .413$, p < .001; $\alpha_5^{Eq.2} = .107$, p < .001); superstars gain about 11% more from subscription entry than non-superstars. If quality was really what draws in consumers, one would have expected the difference between superstar and non-superstars to grow to a much larger extent once it becomes available to subscribers for free. The absence of that effect confirms the valuation-usage disparity of our conceptual framework where we expected consumers' usage to reflect a desire to seek variety rather than quality. For developers, bringing their superstars to a subscription service is thus not that important, whereas bringing their non-superstars can lead to engagement levels that only superstars can attain off the subscription service.

Software familiarity Concerning the effect of software familiarity on software engagement, at the start of a platform's lifecycle, we find that franchises engage consumers 1.34 times more than new IPs on the day of their release ($\alpha_2^{Eq.1} = .289$, p < .001). After 6 months, that number drops to 1.24 since franchises lose engagement slightly faster than new IPs as the software ages ($\alpha_6^{Eq.1} = -.408$, p < .001). The higher software engagement of franchises slightly grows across the platform lifecycle ($\alpha_{10}^{Eq.1} = .040$, p < .001); halfway through a platform lifecycle (in the case of video game consoles; typically after 4 years), franchises engage 1.42 times more than new IPs.

In prior work, Rietveld and Eggers (2018, p.314) report that franchises on average sell 1.45 times the number of new IPs. The recognizability of an franchised IP thus provides a

similar benefit in the decision what to play than it does in deciding what to buy. This is confirmed by the added engagement of joining a platform's subscription service, from which franchises gain about 42% more than new IPs ($\alpha_6^{Eq.2}$ = .352, p < .001). In the fast-paced environment of a subscription service with an entire catalog instantly available, known franchises catch the eye of consumers much more than new IPs, who – like superstars – may benefit more from consumers' pre-purchase information search in a sales environment. This is in line with our expectation that consumers regress to what is familiar in their usage decisions in a crowded market. For developers, continued support of franchises is thus an important driver of software engagement through the lifecycle of a platform.

Software exclusivity Finally, software exclusivity (versus multihoming) leads to a 20% positive difference in software engagement on the day of release ($\alpha_3^{Eq.1}$ = .181, p < .001). After 6 months, that number grows to 25% ($\alpha_7^{Eq.1}$ = .251, p < .001), yet slightly decreases over the platform lifecycle ($\alpha_{11}^{Eq.1}$ = -.015, p < .001). The additional benefit of subscription entry for exclusives compared to multihomed games is more substantial ($\alpha_7^{Eq.2}$ = .296, p < .001); exclusive games gain about 34% more from subscription entry than games that multihome. Despite that positive difference, the magnitude of the effect of exclusivity on engagement does not correspond to the importance that platforms generally attach to exclusive software, in line with our expectations. Platform owners therefore need to carefully consider the (often million-dollar) investments into exclusivity given average software engagement bumps of about 20%.

Contrasting the software engagement results with software sales results

Our results confirm the data descriptives that the patterns of software engagement contrast those of software sales. In line with our expectations of a valuation-usage disparity, the impact

of software quality, familiarity, and exclusivity on software engagement differ from prior findings on software sales. To ensure that such differences cannot be attributed to differences in sample or period, we assess the correspondence between the impact of the identified drivers on software engagement and that on software sales by rerunning the software models on sales instead of engagement.

We operationalize software sales as the log-transformation of the unit sales of software i on platform p at time t. For the explanatory variables, we retain the same model specification and variable operationalization as we did in Equation 1, but include the log-transformation of the unit sales (instead of engagement) of platform p at time t-1 to control for spillover from platform sales. Because sales are only available on a monthly basis, the models estimate the *monthly* effects of software development and release characteristics on software sales. We present the results in Table 4. The adjusted R-square shows that the models fit the data well ($R^2 \geq 0.506$).

[Insert Table 4 here]

The results of Model 1 on software sales confirm the disparity in effect sizes with the engagement models. Software sales of superstars are a tenfold of that of non-superstars ($\alpha_1^{Eq.1\ on\ sales\ [A]}$ = 4.596, p < .001), in line with the sales insights of Binken and Stremersch (2009). This is vastly different from the not even twofold difference that we found in their level of customer engagement. In terms of software familiarity, the sales model reveals that franchises sell significantly less than new IPs at the start of the platform's lifecycle ($\alpha_2^{Eq.1\ on\ sales\ [A]}$ = -.673 , p < .001). This corresponds to Allen et al. (2022)'s observation of the weak sales impact that franchise status alone may have. We find that franchises do sell more than new IPs as the platform ages ($\alpha_{10}^{Eq.1\ on\ sales\ [A]}$ = .828, p < .001), in line with Rietveld and Eggers (2018) who find that sales of new IPs decline as a platform's user base shifts toward more late than early adopters.

Our engagement models tell a different story. Based on engagement, franchises significantly drive both platform and software usage, and do so from the start and regardless of a platform's age. Finally, the sales model confirms the value of exclusivity to video game brands in terms of software sales ($\alpha_3^{Eq.1\ on\ sales\ [A]}= 1.553$, p < .05), especially at the start of the platform's lifecycle ($\alpha_{11}^{Eq.1\ on\ sales\ [A]} = -1.238$, p < .001). Exclusives sell up to 5 times more units than multihomed games when a platform is released on the market, which is typically when platform owners rely most on their exclusives to market their latest platform. This substantially contrasts to the mere 20% increase that they generate in software engagement.

These results confirm that an engagement metric leads to different conclusions than a sales metric, and that the effect size differences cannot be attributed to differences in sample or period.[11] Sales data thus underestimate the importance of software familiarity and overestimate the importance of software quality and exclusivity in explaining software usage. Therefore, both provide complementary insights for video game platform and developer management in these markets.

Our unique collection of data allows to connect engagement metrics to sales metrics to confirm the relevance of engagement as a construct of high academic and managerial interest. In Panel B of Table 4, we expand our sales model by including the log-transformation of consumers' engagement with software i on platform p at time t-1 and the log-transformation of platform p's engagement at time t-1, to investigate the impact of software and platform engagement on software sales. The results show that engagement is a substantial driver of sales; the more consumers engage with the software ($\alpha_{software\ engagement_{t-1}}^{Eq.1\ on\ software\ sales\ [B]}= .627$, p < .001) and

---

[11] To show that the differences cannot be attributed to differences in the level of aggregation either, Table WB.1 in Web Appendix B displays the results of a robustness check in which we reran Equation 1 using monthly (instead of daily) engagement data (i.e., the same level of aggregation as the sales analyses of Table 5) of the same sample of software titles as the sales analyses (i.e., excluding free-to-play software for which there are no sales). We find that disparities in effect sizes between the engagement and sales models hold.

platform ($\alpha_{platform\ engagement_{t-1}}^{Eq.1\ on\ software\ sales\ [B]} = 1.066$, p < .001), the higher their future sales. This establishes that consumers' engagement may spill over into sales (for instance, through consumers purchasing on-subscription software or through positive word-of-mouth) and points to the dependence of platforms' business models on engagement. Furthermore, we observe that the results of Panel B are substantially robust to those of Panel A that do not involve engagement. This suggests that the impact of software development and release characteristics has a standalone impact on software sales, above and beyond their impact on engagement, and confirms the importance of studying the drivers of engagement in platform markets separately from studying sales.

Summary of findings on software engagement

Study 1 reveals that the competition for what to play is much more intense than the competition for what to buy in the video game console industry. The most powerful determinant of software engagement is a novel one, i.e., whether the video game is available on a platform's subscription service, as theorized. The value of subscription participation outperforms established determinants such as the quality or exclusivity of the video game. In line with expectations, superstar or exclusive titles still attract more engagement than non-superstars or multihomed titles, but their advantage is notably smaller compared to how much more they sell. And although they also benefit more from subscription services, this boost is also less pronounced than earlier sales-based research would suggest. Franchises, on the other hand, outperform new IPs in player engagement and more so than they do on sales. They also gain the larger engagement boost from subscription participation.

In the fast-paced decision process of what to play, consumers thus mostly value what is available on the platform's subscription service and the franchises that they know. New IPs,

superstars and exclusive video games, in the absence of consumers' pre-purchase information search that benefited their sales, have substantially lost value.

Given the interplay between video game software and video game platforms, our next research question is how the supply of such differently valued video games affects consumers' engagement with the platform at large.

Study 2: Platform engagement: model and results

Platform engagement model

In Study 2, we examine the impact of software introductions with different development and release characteristics on the daily evolution of consumers' engagement with the platform over the lifecycle of a platform. To avoid multicollinearity (see correlation Table A3 in Appendix), we follow Binken and Stremersch (2009) and estimate three dynamic models using ordinary least squares (OLS) panel regressions, where each model captures the impact of, respectively, software quality (Equation 3), software familiarity (Equation 4), and software exclusivity (Equation 5) on platform engagement over the platform life cycle (see Table 2 for an overview of variable definitions and descriptives), as follows:[12,13]

$$
\begin{aligned}
\text{(Eq. 3) } \ln(\text{PlatformEngagement})_{pt} = {} & \beta_0 + \beta_1 \times \text{NonSuperstarIntroductions}_{pt} \\
& + \beta_2 \times \text{SuperstarIntroductions}_{pt} + \beta_3 \times \text{NonSuperstarIntroductions}_{pt} \times \text{PlatformAge}_{pt} \\
& + \beta_4 \times \text{SuperstarIntroductions}_{pt} \times \text{PlatformAge}_{pt} + \beta_5 \times \text{PlatformAge}_{pt} \\
& + \Phi \text{Control Variables} + \varepsilon_{pt}
\end{aligned}
$$

$$
\begin{aligned}
\text{(Eq. 4) } \ln(\text{PlatformEngagement})_{pt} = {} & \gamma_0 + \gamma_1 \times \text{NewIPIntroductions}_{pt} \\
& + \gamma_2 \times \text{FranchiseIntroductions}_{pt} + \gamma_3 \times \text{NewIPIntroductions}_{pt} \times \text{PlatformAge}_{pt} \\
& + \gamma_4 \times \text{FranchiseIntroductions}_{pt} \times \text{PlatformAge}_{pt} + \gamma_5 \times \text{PlatformAge}_{pt} \\
& + \Omega \text{Control Variables} + \varepsilon_{pt}
\end{aligned}
$$

---

[12] Fixed-effects models that include platform fixed effects yield substantially robust results.

[13] In alternative specifications in Web Appendix C, we use mutually exclusive counts of software introductions that differ in 1) software quality and software familiarity, 2) software quality and software exclusivity, and 3) software familiarity and software exclusivity. Our results remain substantially robust.

(Eq. 5) $\ln(\text{PlatformEngagement})_{pt} = \delta_0 + \delta_1 \times \text{NonExclusiveIntroductions}_{pt}$

$+\delta_2 \times \text{ExclusiveIntroductions}_{pt} + \delta_3 \times \text{NonExclusiveIntroductions}_{pt} \times \text{PlatformAge}_{pt}$
$+\delta_4 \times \text{ExclusiveIntroductions}_{pt} \times \text{PlatformAge}_{pt} + \delta_5 \times \text{PlatformAge}_{pt}$
$+\theta \text{Control Variables} + \varepsilon_{pt}$

The dependent variable in all equations (*ln(PlatformEngagement)$_{pt}$*) is the log-transformation of the number of active users of platform p at time t. We log-transform our dependent variable to pool data across the two platforms with different levels of platform engagement (Binken & Stremersch 2009).

As focal independent variables, in each respective equation, we include – for software quality – the count of non-superstar software introductions on platform p at time t (*NonSuperstarIntroductions$_{pt}$*) and the count of superstar software introductions on platform p at time t (*SuperstarIntroductions$_{pt}$*),– for software familiarity – the count of new IP software introductions on platform p at time t (*NewIPIntroductions$_{pt}$*) and franchised software introductions on platform p at time t (*FranchiseIntroductions$_{pt}$*), and – for software exclusivity – the count of exclusive software introductions on platform p at time t (*ExclusiveIntroductions$_{pt}$*) and non-exclusive software introductions on platform p at time t (*NonExclusiveIntroductions$_{pt}$*). We do not log-transform the counts of introductions to allow for increasing returns to platform engagement, as modeled by prior work (Binken & Stremersch 2009; Landsman & Stremersch 2011).

Because we are additionally interested in how these effects are influenced by the release characteristic to participate in a platform's subscription service, we adapt Equation 3-5 in subsequent analyses where we count the software introductions separately for releases on and off a platform's subscription service. As a result, Equation 6-8 contain 4 focal independent variables in each equation. For Equation 6's analysis of software quality, those are the count of non-superstar software introductions off the subscription platform on platform p at time t (*NonSuperstarIntroductionsOffSub$_{pt}$*), the count of superstar software introductions off the

subscription platform on platform p at time t ($SuperstarIntroductionsOffSub_{pt}$)[14], the count of non-superstar software introductions on the subscription service of platform p at time t ($NonSuperstarIntroductionsOnSub_{pt}$), and the count of superstar software introductions on the subscription service of platform p at time t ($SuperstarIntroductionsOnSub_{pt}$):

(Eq. 6) $\ln(\text{PlatformEngagement})_{pt} = \beta_0 + \beta_1 \times \text{NonSuperstarIntroductionsOffSub}_{pt}$
$+\beta_2 \times \text{SuperstarIntroductionsOffSub}_{pt} + \beta_3 \times \text{NonSuperstarIntroductionsOnSub}_{pt}$
$+\beta_4 \times \text{SuperstarIntroductionsOnSub}_{pt}$
$+\beta_5 \times \text{NonSuperstarIntroductionsOffSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\beta_6 \times \text{SuperstarIntroductionsOffSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\beta_7 \times \text{NonSuperstarIntroductionsOnSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\beta_8 \times \text{SuperstarIntroductionsOnSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\beta_9 \times \text{PlatformAge}_{pt} + \Phi\text{Control Variables} + \varepsilon_{pt}$

Equation 7 and 8 follow the same operationalizations for software familiarity and exclusivity, respectively:

(Eq. 7) $\ln(\text{PlatformEngagement})_{pt} = \gamma_0 + \gamma_1 \times \text{NewIPIntroductionsOffSub}_{pt}$
$+\gamma_2 \times \text{FranchiseIntroductionsOffSub}_{pt} + \gamma_3 \times \text{NewIPIntroductionsOnSub}_{pt}$
$+\gamma_4 \times \text{FranchiseIntroductionsOnSub}_{pt}$
$+\gamma_5 \times \text{NewIPIntroductionsOffSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\gamma_6 \times \text{FranchiseIntroductionsOffSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\gamma_7 \times \text{NewIPIntroductionsOnSub} \times \text{PlatformAge}_{pt}$
$+\gamma_8 \times \text{FranchiseIntroductionsOnSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\gamma_9 \times \text{PlatformAge}_{pt} + \Phi\text{Control Variables} + \varepsilon_{pt}$

(Eq. 8) $\ln(\text{PlatformEngagement})_{pt} = \delta_0 + \delta_1 \times \text{NonExclusiveIntroductionsOffSub}_{pt}$
$+\delta_2 \times \text{ExclusiveIntroductionsOffSub}_{pt} + \delta_3 \times \text{NonExclusiveIntroductionsOnSub}_{pt}$
$+\delta_4 \times \text{ExclusiveIntroductionsOnSub}_{pt}$
$+\delta_5 \times \text{NonExclusiveIntroductionsOffSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\delta_6 \times \text{ExclusiveIntroductionsOffSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\delta_7 \times \text{NonExclusiveIntroductionsOnSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\delta_8 \times \text{ExclusiveIntroductionsOnSub}_{pt} \times \text{PlatformAge}_{pt}$
$+\delta_9 \times \text{PlatformAge}_{pt} + \Phi\text{Control Variables} + \varepsilon_{pt}$

---

[14] Software that was released on the market and on the subscription service at the same time t is excluded from the count of software titles released off the subscription service of platform p at time t to make sure that all counts of introductions in the equations remain mutually exclusive.

Because the effects of software releases on platform engagement may vary over the life cycle of the platform, we interact each count of introductions in Equation 1-8 with the age of platform p at time t (*PlatformAge$_{pt}$*), measured in 1,000 days since platform p was first introduced on the market.

All equations also control for a number of factors that may additionally influence platform engagement. First, we control for inertia in platform engagement by including the log-transformation of platform engagement at time t-1 (*ln(PlatformEngagement)$_{pt-1}$*). Second, we control for the software catalog of past software releases on platform p at time t-1 (*ln(SoftwareCatalog)$_{pt-1}$*), and the subscription catalog of past software releases on platform p at time t-1 (*ln(SubscriptionCatalog)$_{pt-1}$*). Third, we include the weighted average price of platform p at time t (*ln(PlatformPrice)$_{pt}$*), the weighted average price of the software available on platform p at time t (*ln(SoftwarePrice)$_{pt}$*), and the weighted average review scores of the software available on platform p at time t (*ln(SoftwareReviews)$_{pt}$*). For platform price, we weigh each console of a platform's family of consoles by the console's sales market share at time t to reflect that the price of more popular or recent consoles likely carries a larger weight in consumers' perception of the platform price. Similarly, for software price and software review scores, we weigh each software title by its sales market share at time t. We use unit sales to calculate the market shares to not interfere with our focal metric of engagement. Finally, we control for seasonality in engagement by including a weekend dummy, month dummies and year dummies to take into account time-varying characteristics that are constant across platforms. Since our observation window includes the start of a new platform generation, we also include an additional dummy that captures its launch.

Platform engagement results

We present the results of Model 3-5 in Table 5, and of Model 6-8 in Table 6. The adjusted R-squares show that all models fit the data well (R²'s ≥ .992), which is not surprising as we include all key variables and the lagged dependent variable.

[Insert Table 5 here]

[Insert Table 6 here]

Software quality Concerning the impact of the supply of software of different qualities, we find that superstar introductions on the platform increase platform engagement more compared to non-superstars. At the start of the platform lifecycle, on average, a superstar release significantly increases the daily number of active users on the platform by 13.02% ($\beta_2^{Eq.3}$= .122, p < .001). In our empirical context, such an increase corresponds to about 10.4 million additional platform users on a superstar's day of release on top of the Xbox platform's average 80 million daily active users. For a non-superstar introduction, platform engagement significantly increases by 1.37% ($\beta_1^{Eq.3}$ = .014, p < .01), corresponding to about 1.1 million additional platform users in our context. However, as the platform ages, the impact of superstars on engagement decreases substantially ($\beta_4^{Eq.3}$ = -.069, p < .001), whereas less so for non-superstars ($\beta_3^{Eq.3}$ = -.004, p < .01). Halfway through the platform lifecycle, superstars increase engagement on the platform by 2.24% and non-superstars by .80%, corresponding to about 1.8 million and 640,000 additional users, respectively, in our setting.

This result confirms our expectations and the findings of the software engagement analyses that the superstar effect on engagement is much smaller than what is expected from prior literature that has looked at sales (Allen et al. 2022; Binken & Stremersch 2009; Corts & Lederman 2009; Gretz et al. 2019; Kim et al. 2014). Binken and Stremersch (2007), for instance, report superstar effects on platform adoption up to 14%, averaged across platforms of different ages. For each 100 platforms that they find are sold due to a superstar release, we

find that only 37 of users become active on theirs.[15] When it comes to driving platform engagement, superstars thus offer much less bang for buck to platform owners, than when evaluated with a sales metric. In fact, contrasting the conventional wisdom of prior work (Gretz et al. 2019), non-superstars matter, and do so early on. When it comes to deciding which platform to play on opposed to which one to purchase, consumers value the best of the best, but also the sheer volume that is found among non-superstars.

We see this result confirmed in the results of Model 6 (Table 6), and the effect of software additions to the platform's subscription service catalog, which subscribing consumers can play free of charge. Non-superstar additions to a subscription catalog increase platform engagement by 2.09% ($\beta_3^{Eq.6}$ = .021, p < .001); a number higher than what non-superstars attain off the subscription service ($\beta_1^{Eq.6}$ = .003, p < .01). That is not true for superstars that, on average, drive platform engagement more when they release off the subscription service ($\beta_2^{Eq.6}$ = .042, p < .001). In fact, on a subscription service, superstars were not found to significantly impact platform engagement ($\beta_4^{Eq.6}$ = .018, p = .175). This suggests that, for platform owners looking to increase platform engagement, securing superstar software for their subscription services may not necessarily be worth the potential cost.

Note also the persistence found in our model(s) (i.e., the coefficient of the lagged engagement variable: $\beta_6^{Eq.4}$ = .875, p < .001). Each 1% change in platform engagement thus still leads to up to .88% increased engagement the day after. This high level of inertia in platform engagement means that software introductions that increase platform engagement on release have a lasting effect over time. For instance, of the 10.4 million additional platform users on a superstar's day of release, 4.1 million remain one week later.

---

[15] Binken and Stremersch (2009) report a mean platform age of ±3 years in their analysis, which corresponds to a superstar impact of 5.13% in our analysis, or 37% of the 14% superstar impact that they find.

Software familiarity Concerning the impact of the supply of software that differs in familiarity, we find that franchised software increases engagement on the platform more than new IPs. On average, at the start of the platform's lifecycle, the release of a franchised IP leads to a significant increase in platform engagement of 4.48% ($\gamma_2^{Eq.4}$ = .044, p < .001), corresponding to about 3.6 million additional active users in our empirical context. The impact of new IPs, in contrast, was not found to be significant ($\gamma_1^{Eq.4}$ = .002, p = .354). However, as the platform ages, new IPs gain importance ($\gamma_3^{Eq.4}$ = .002, p < .05), whereas franchises do not ($\gamma_4^{Eq.4}$ = -.020, p < .001). Based on our estimations, new IP releases drive platform engagement just as much as franchises after 5 years and 2 months; little over halfway a typical console lifecycle.

These results persist when we separate the impact of software introductions off and on the platform's subscription service in Model 7 (Table 6). At the start of the platform lifecycle, releasing franchises on a subscription service increases engagement by 2.56% ($\gamma_4^{Eq.7}$ = .025, p < .001), corresponding to little over 2 million additional active users in our empirical context; a number higher that what franchises attain off the subscription service ($\gamma_2^{Eq.7}$ = .010, p < .001). Through the platform lifecycle, the advantage flips and platform engagement fares better by launching new IPs on the subscription service, as they display smaller decreasing returns to platform age ($\gamma_7^{Eq.7}$ = -.002, p = .15) compared to franchises ($\gamma_8^{Eq.7}$ = -.015, p < .001).

These results show that platform owners need franchises when they enter the market to drive engagement on the platform. Familiar and established IPs counterbalance the uncertainty that comes with the new platform and convince consumers to play. As the platform ages and becomes established on its own, platforms need to bring in new IPs to offer new stimuli and excitement that counterbalances consumers' fatigue with the platform. This is a novel result. Prior literature that considered sales found that franchised titles do not increase

platform adoption (Allen et al. 2022), unless they are also superstars (Allen et al. 2022, Binken and Stremersch 2009). Conform the valuation-usage disparity, our results show that franchise status alone is sufficient to drive platform engagement, and is especially important early on in the platform lifecycle. New IPs are needed too, but mostly later when the platform has aged.

Software exclusivity Finally, we find that software introductions that are exclusive to the platform's brand increase platform engagement more compared to multihomed introductions. At the start of the platform lifecycle, on average, an exclusive release significantly increases the daily number of active users on the platform by 7.65% ($\delta_2^{Eq.5}$= .074, p < .001), which corresponds to about 6.1 million additional platform users on an exclusive's release day. For a non-exclusive introduction, platform engagement significantly increases by 1.27% ($\delta_1^{Eq.5}$ = .013, p < .001), corresponding to about 1 million additional platform users. However, as the platform ages, the impact of exclusives on engagement decreases substantially ($\delta_4^{Eq.5}$ = -.035, p < .001), whereas less so for non-exclusives ($\delta_3^{Eq.5}$ = -.004, p < .01). Halfway through the platform lifecycle, exclusive releases increase platform engagement by just 2.36%.

This result confirms our expectations and the findings of the software engagement analyses that the effect of exclusives on engagement does not correspond to the importance that platforms generally attach to it. We see this result confirmed when we consider the impact of introducing exclusives on the platform's subscription service in Model 7 (Table 3). Non-exclusive titles that are added to a subscription catalog increase platform engagement by 2.28% ($\delta_3^{Eq.8}$ = .021, p < .001), whereas exclusive software additions are not found to significantly impact platform engagement at all ($\delta_4^{Eq.8}$ = -.002, p = .787). Similar to the subdued benefit of adding superstars, securing exclusive software for their subscription services may thus not necessarily be worth platforms owners' investments.

Summary of findings on platform engagement

When it comes to driving sales, platforms traditionally rely on software releases that are characterized by their quality, familiarity, or exclusivity to convince consumers to adopt their platform. Study 2 finds that, when it comes to engagement however, consumers are much less easily swayed by characteristics that typically drive sales. In line with our expectations on a valuation-usage disparity and the findings of Study 1, consumers treat software releases much more equally when deciding whether to play opposed to whether to buy. In the former decision, consumers still value quality, IP novelty, and exclusivity, but also the sheer volume that is found among non-superstars, franchises, and non-exclusives. This is especially true for releases on the platform's subscription service, where no purchase decisions are made and consumers can freely decide what to play. In that more democratic environment, the pay-off that platform owners generally receive from investing in superstars, exclusives, or new IPs almost entirely disappears.

Implications and future research

The high managerial relevance of engagement in many platform markets has not been met by prior platform market literature. Given the prominent business model then, prior literature historically always used *sales* data to measure the effects of software availability and software characteristics on the success of the platform or its software (e.g., Allen et al. 2022; Binken & Stremersch 2009; Healey & Moe 2016; Landsman & Stremersch 2011; Lee 2013; Rietveld & Eggers 2018; Stremersch et al. 2007). In the current study, we address this gap theoretically and empirically. We are the first to model and estimate the effects of software development and release characteristics on both software engagement and platform engagement. We do so using a unique dataset of the daily engagement of consumers with multiple platforms and software products in the video game industry, as a prime application area of platform markets.

35

We are also the first to assess the (lack of) correspondence between engagement and sales outcomes and the key characteristics of quality, familiarity, and exclusivity that drive them. We frame their divergent impact against the historical shifts in business model and consumer decision making in platform markets.

Implications

Our work raises several important implications that are relevant to both theory and managerial practice. From a theoretical perspective, we show that academic scholars should complement the sales focus that so far has dominated the marketing and economics literature on platform markets with engagement metrics. Engagement data offer a novel and alternative proxy of utility in the study of two-sided platform markets. It also closes the gap with the vision of industry players and analysts that engagement is the key performance metric of platform and software success (Lehtonen et al. 2023).

Using sales data to inform engagement is insufficient; we establish differences in their patterns, outcomes and drivers, chief among them software quality, software familiarity, and software exclusivity. Given the value that extant research has credited to these dimensions (e.g., Allen et al. 2022; Binken & Stremersch 2009; Corts & Lederman 2009; Gretz et al. 2019; Kim et al. 2014; Rietveld & Eggers 2018), the realizations that they matter less in driving engagement than anticipated, is a substantial theoretical contribution. By taking an engagement perspective, we argue and empirically demonstrate that the impact of software quality, familiarity, and exclusivity depends on the outcome metric under study, and that platforms and software may not necessarily need superstar quality, new IPs, or exclusives to drive engagement. These insights also have important managerial significance.

From an engagement perspective, video game platforms and developers should not obsess over releasing superstar quality or achieving exclusivity deals, which anecdotally have

been increasingly hard to attain (Valentine 2022), and take up unsustainable amounts of time and costs (Tucker 2023). Non-superstars and multihomed titles matter too, to provide enough richness in the customer experience to draw consumers in. Platforms and developers should also avoid underestimating the value of familiar franchises to support engagement, notably early on. Platforms have shown a renewed interest in launching new IPs (Smith 2022), despite their higher costs, longer development times, and the lack of an established audience (Handrahan 2012). This drive to launch new IPs, especially when new platforms come around, risks losing the engagement of the audience from the start. However, platforms and developers also should not overexploit, because new IPs still drive platform engagement later in the platform lifecycle. And, in the end, new IPs may breed future franchises (Wada 2011).

These insights matter in industries, such as the video game console industry, where platforms are increasingly outspending each other on studio acquisitions and exclusivity rights (Bloomberg 2022; Mochizuki & Savo 2022). For example, Microsoft's 2021 acquisition of superstar developer Bethesda was in part to secure the rights to *Starfield*, the developer's first new IP in 29 years and potential superstar (Warren 2023). While such acquisitions may make sense from a sales perspective (Binken & Stremersch 2009), impact on platform and product engagement of a similar magnitude is not guaranteed. Since our results suggest that there is value in familiar titles that are not necessarily of superstar quality, acquisition opportunities lie more in studios or projects attached to established IPs. This also has implications for the valuation of these acquisitions.

We also demonstrate that these insights are especially important in contexts where subscription services are causing sales metrics to take an even further backseat to engagement metrics. For example, our work shows that non-superstars drive platform and software engagement substantially in a video game subscription environment, while the benefit of releasing superstars on subscription is lower than one would expect from offering such high

quality to subscribers for free. This calls into question whether releasing superstar software on subscription services is worth the potential costs that both platform and sellers incur from, respectively, securing the rights and foregoing software sales (Tassi 2022). This insight provides opportunities for subscription services such as Microsoft's Xbox Game Pass, Google's Play Pass in smartphone applications or Apple's Apple TV+ in video streaming; these services may just as well achieve large engagement numbers with accessible catalogs of non-superstars.

Limitations and future research

To the best of our knowledge, this article is the first to study engagement in the two-sided market of the video game console industry. This offers an important steppingstone to the two-sided market literature that may provoke further research. A first source of future research lies in the limitations of the study. They are the following.

First, our empirical research focuses on the video game console industry as a prime application area of platform markets. However, the shift in industry focus from sales metrics to engagement metrics pertains to many other platform and entertainment markets, such as markets of mobile gaming, mobile and PC applications, or movie and TV entertainment. In these and many other industries, active usage of the platform and its products has become of similar managerial importance. Future research should investigate the extent to which our insights on the drivers of engagement generalize to other industries.

Second, active usage of a platform and its software assures post-purchase revenue. Our research follows the customer-centric strategy of the video game console industry that monetary goals are secondary to creating strong and positive engagement, as software sellers and platform owners believe that such experiences pay off in the longer term. Nevertheless, we encourage future research to take the next step into investigating how to optimally monetize

engagement across platform markets. Note that different markets may also feature more diverse monetization models, such as advertising-supported or digital-only revenue models, which are still absent or scarce in the video game console industry.

Third, our research focuses on the demand for platforms and software from an engagement and sales perspective, and largely ignores the software supply side as this falls outside of the descriptive models of our research. Although a demand focus is common in platform literature (e.g., Binken & Stremersch 2009, Shankar & Bayus 2003), it raises potential endogeneity concerns. However, in our case, we have indications that endogeneity is not a concern. Our focal variables – software introductions, timing of release, and subscription participation – are unlikely to depend on current platform or software engagement. This is due to the long development cycles of video games (often three to five years [Wiegand et al. 2023]) and the high costs of altering pre-set release schedules (typically fixed and announced months in advance [Haviv et al. 2020]). Consequently, the timing of software releases is largely independent of engagement expectations, aside from the control variables that we account for.[16] This is especially true since we consider daily software introductions, as opposed to the monthly frequency used in prior research.

Stretching beyond the scope of the current study, one can think of other fruitful avenues for future research. Platform markets' pivot to engagement metrics opens up the domain to set up a new stream of literature on platform markets with engagement at its core. For instance, our research presents a first probe of the drivers of platform and software engagement, and reassessed the role of software quality, familiarity, and exclusivity. By investigating the impact of releasing on a platform's subscription service, we also uncovered an underresearched driver of performance in platform markets. We encourage future research to discover even more

---

[16] A similar logic applies to pricing: price changes primarily reflect temporal trends in the video game console market, where prices typically decline over time in line with software and platform lifecycles.

drivers of engagement in platform and entertainment markets that are novel or behave differently from what was established through sales data.

Similarly, we encourage future research to further explore the mechanisms behind the disparity between sales and usage that our results display. We attributed the differences between consumers' usage and purchase decisions to consumers' desire to seek variety as well as to regress to what is familiar in a crowded market. Individual-level consumer (panel) data, for example, would enable a more granular investigation of this phenomenon that could unveil alternative mechanisms, such as divergent consumer segments.

Envoy

We hope we have succeeded to establish engagement as a novel and critical measure of performance within two-sided markets and the video game console industry. As the rules of the game continue to change, we believe engagement offers a path ahead for research in two-sided markets, unlocking fresh opportunities for academics and practitioners to further redefine the dynamics of software and platform success.

Declarations

The authors have no conflict of interest to declare that are relevant to this article.

References

Allen, Bradley J., Richard T. Gretz, Mark B. Houston, and Suman Basuroy (2022), "Halo or Cannibalization? How New Software Entrants Impact Sales of Incumbent Software in Platform Markets," *Journal of Marketing*, 86 (3), 59-78.

Amenabar, Teddy (2022), "Video Games Keep Getting Longer. It's All About Time and Money," *The Washington Post* (March 18).

Binken, Jeroen L.G., and Stefan Stremersch (2009), "The Effect of Superstar Software on Hardware Sales in System Markets," *Journal of Marketing*, 73 (2), 88-104.

Bloomberg (2022), "Amazon Closes $8.5B Deal to Acquire Hollywood Studio MGM," (March 17).

Church, Jeffrey, and Neil Gandal (1993), "Complementary Network Externalities and Technological Adoption," *International Journal of Industrial Organization*, 11 (2), 239-260.

Church, Jeffrey, and Neil Gandal (1992), "Network Effects, Software Provision, and Standardization," *The Journal of Industrial Economics*, 85-103.

Cieslak, Marc (2020), "Xbox Series X: Microsoft Tails Launch Plans for the Pandemic," *BBC News* (June 8).

Claussen, Jörg, Tobias Kretschmer, and Philip Mayrhofer (2013), "The effects of rewarding user engagement: The case of Facebook apps," *Information Systems Research*, 24 (1), 186-200.

Corts, Kenneth S., and Mara Lederman (2009), "Software Exclusivity and the Scope of Indirect Network Effects in the US Home Video Game Market," *International Journal of Industrial Organization*, 27 (2), 121-136.

Gretz, Richard T., Ashwin Malshe, Carlos Bauer, and Suman Basuroy (2019), "The Impact of Superstar and Non-Superstar Software on Hardware Sales: The Moderating Role of Hardware Lifecycle," *Journal of the Academy of Marketing Science*, 47, 394-416.

Handrahan, Matthew (2012), "Infinite Loop: IP, Innovation and the Console Cycle," *gamesindustry.biz* (December 10).

Haviv, Avery, Yufeng Huang, and Nan Li (2020), "Intertemporal Demand Spillover Effects on Video Game Platforms," *Management Science*, 66 (10), 4788-4807.

Healey, John, and Wendy W. Moe (2016), "The Effects of Installed Base Innovativeness and Recency on Content Sales in a Platform-Mediated Market," *International Journal of Research in Marketing*, 33 (2), 246-260.

Huang, Yan, Stefanus Jasin, and Puneet Manchanda (2019), ""Level Up": Leveraging Skill and Engagement to Maximize Player Game-Play in Online Video Games," *Information Systems Research*, 30 (3), 927-947.

Jiao, Yifan, Christopher S. Tang, and Jingqi Wang (2022), "An Empirical Study of Play Duration and In-App Purchase Behavior in Mobile Games," *Production and Operations Management*, 31 (9), 3435-3456.

Katz, Michael L., and Carl Shapiro (1985), "Network Externalities, Competition, and Compatibility," *The American Economic Review*, 75 (3), 424-440.

Kim, Jin-Hyuk, Jeffrey Prince, and Calvin Qiu (2014), "Indirect Network Effects and the Quality Dimension: A Look at the Gaming Industry," *International Journal of Industrial Organization*, 37, 99-108.

Landsman, Vardit, and Stefan Stremersch (2011), "Multihoming in Two-Sided Markets: An Empirical Inquiry in the Video Game Console Industry," *Journal of Marketing*, 75 (6), 39-54.

Lee, Robin S. (2013), "Vertical Integration and Exclusivity in Platform and Two-Sided Markets," *American Economic Review*, 103 (7), 2960-3000.

Lehtonen, Miikka J., Robin Gustafsson, and Lobna Hassan (2023), "The multiplex of value creation and capture logics in the video game industry: An integrative review of 20 years of studies and a future research agenda," *Technological Forecasting and Social Change*, 195, 122756.

Liu, Che-Wei, Weiguang Wang, Guodong Gao, and Ritu Agarwal (2024), "The Value of Virtual Engagement: Evidence from a Running Platform," *Management Science*, 70 (9), 6179-6201.

Marchand, André (2016), "The Power of an Installed Base to Combat Lifecycle Decline: The Case of Video Games," *International Journal of Research in Marketing*, 33 (1), 140-154.

Meyer, R. J., Zhao, S., & Han, J. K. (2008). Biases in valuation vs. usage of innovative product features. *Marketing Science, 27*(6), 1083-1096.

Mochizuki, Takashi, and Vlad Savov (2022), "Sony Plans to Buy More Game Studios, Grow With Live Services, PC," *Bloomberg* (May 26).

NPD (2021), "Take Your Games Analysis to the Next Level with the Player Engagement Tracker," NPD.com.

PwC (2022), "Perspectives from the Global Entertainment & Media Outlook 2022–2026," pwc.com.

Rietveld, Joost, and J.P. Eggers (2018), "Demand Heterogeneity in Platform Markets: Implications for Complementors," *Organization Science*, 29 (2), 304-322.

Rutz, Oliver, Ashwin Aravindakshan, and Olivier Rubel (2019), "Measuring and Forecasting Mobile Game App Engagement," *International Journal of Research in Marketing*, 36 (2), 185-199.

Schauerte, N., Schauerte, R., Becker, M., & Hennig-Thurau, T. (2024). Making new enemies: How suppliers' digital disintermediation strategy shifts consumers' use of incumbent offerings. *Journal of the Academy of Marketing Science*, *52*(3), 672-694.

Schulze, Christian, Lisa Schöler, and Bernd Skiera (2014), "Not All Fun and Games: Viral Marketing for Utilitarian Products," *Journal of Marketing*, 78 (1), 1-19.

Shankar, Venkatesh, and Barry L. Bayus (2003), "Network effects and competition: An empirical analysis of the home video game industry," *Strategic Management Journal*, 24 (4), 375-384.

Smith, David (2022), "PlayStation Looks To Make Significant Push Into Live Service Games, New IP," *Kotaku* (May 26).

Stremersch, Stefan, Gerard J. Tellis, Philip H. Franses, and Jeroen L.G. Binken (2007), "Indirect Network Effects in New Product Growth," *Journal of Marketing*, 71 (3), 52-74.

Sun, Li, Surendra Rajiv, and Junhong Chu (2016), "Beyond the More the Merrier: The Variety Effect and Consumer Heterogeneity in System Markets," *International Journal of Research in Marketing*, 33 (2), 261-275.

Tassi, Paul (2022), "Xbox Game Pass's Continued Underperformance Raises Questions," *Forbes* (October 28).

The Wall Street Journal (2022), "Why Gaming is So Popular With Consumers," (June 29)

Totilo, Stephen (2023), "Xbox's Game Studios Are Finally Ready to Show Off," *Axios* (June 15).

Tucker, Jake (2023), "The AAA games industry is doomed," *NME* (February 3)

Valentine, Rebekah (2022), "Turns Out The Hardest Part of Making a Game Is...Everything," *IGN* (October 5).

Van Crombrugge, Michiel, and Stefan Stremersch (2024), "The Rise of the Subscription Model in the Video Game Console Industry: Unveiling the Commercial Consequences for Platform Owners and Video Game Sellers," *Erasmus School of Economics Working Paper*.

Wada, Takeaki (2011). "Exploitation Reduces Novelty An Empirical Analysis of the Japanese Video Game Industry," *Annals of Business Administrative Science*, 10, 1-12.

Warren, Tom (2023), "Microsoft acquired Bethesda after hearing Starfield would be exclusive to PlayStation," *The Verge* (June 23).

Wiegand, Nico, Yuri Peers, and Alexander Bleier (2023), "Software multihoming to distal markets: Evidence of cannibalization and complementarity in the video game console industry," *Journal of the Academy of Marketing Science*, 51(2), 393-417.

Zhang, Jie, and Abraham Seidman (2010), "Perpetual versus subscription licensing under quality uncertainty and network externality effects," *Journal of Management Information Systems*, 27(1), 39-68.

Table 1 Overview of empirical literature on two-sided markets within the video game industry

Author(s)	Dependent Variables				Independent Variables					Sample Size		
	Software Sales	Platform Sales	Software Engagement	Platform Engagement	Quantity	Quality	Fami-liarity	Ex-clusivity	Sub-scription	Data Frequency	Number of Software Units	Number of Hardware Units
Haviv et al. 2020	✓				✓			✓		Monthly	1,113	2
Healey & Moe 2016	✓									Weekly	288	3
Marchand 2016	✓						✓			Monthly	1,898	3
Rietveld & Eggers 2018	✓					✓	✓	✓		Life-time	2,918	3
Allen et al. 2022	✓	✓			✓	✓	✓			Monthly	8,470	19
Lee 2013	✓	✓			✓	✓		✓		Monthly	1,581	3
Binken & Stremersch 2009	✓	✓			✓	✓	✓	✓		Monthly	5,800	11
Gretz et al. 2019	✓	✓			✓	✓		✓		Monthly	5,044	15
Corts & Lederman 2009		✓			✓	✓		✓		Monthly	Undiscl.	Undiscl.
Kim et al. 2014		✓			✓	✓		✓		Weekly	2,591	3
Landsman & Stremersch 2011		✓			✓			✓		Monthly	Undiscl.	12
Shankar & Bayus 2003		✓					✓			Monthly	20	2
Stremersch et al. 2007		✓			✓					Yearly	+1M	9
Sun et al. 2016		✓			✓	✓				Monthly	1,848	3
Wiegand et al. 2023		✓			✓	✓		✓		Monthly	8,000	6
Huang et al. 2019			✓							Session	1	Undiscl.
Jiao et al. 2022			✓				✓			Weekly	1	Undiscl.
Rutz et al. 2019			✓				✓			Single-period	193	2
Our Study	✓	✓	✓	✓	✓	✓	✓	✓	✓	**Daily (Engagement)/ Monthly (Sales)**	**2,707**	**2**

Table 2 Variable names and definitions of software and platform model

Variables	Definition	Mean	SD
Panel A: Study 1: Software engagement			
Dependent Variable			
Software Engagement	Number of active users of software i on platform p at time t	4.76	23.82
Focal Variables[a]			
Superstar (vs. Non-Superstar)	1 if software i is a superstar, and 0 otherwise	4.10%	
Franchise (vs. New IP)	1 if software i is part of an existing franchise or license, and 0 otherwise	54.04%	
Exclusive (vs. Non-Exclusive)	1 if software i is exclusive to the platform's video game brand, and 0 otherwise	5.82%	
Subscription Participation	1 if software i is available on the platform's subscription service at time t, and 0 otherwise	31.87%	
Software and Platform Age			
Software Age	Age of software i on platform p at time t in 1,000 days	.27	.19
Platform Age	Age of platform p at time t in 1,000 days	1.57	1.27
Control Variable			
Platform Engagement in t-1	Number of active users on platform p at time t-1	1785.43	758.92
Software Price	Price of software i on platform p at time t	25.97	11.52
Platform Price	Price of platform p at time t in dollar	338.16	107.12
Competition on Release	Number of competitive releases on platform p at the day of release of software i	3.14	4.45
Genre dummy	Dummy that equals 1 for each video game genre		
Weekend dummy	Dummy that equals 1 if t is part of a weekend		
Monthly dummy	Dummy that equals 1 for each month of the year		
Yearly Dummy	Dummy that equals 1 for each year of the observation period		
Panel B: Study 1: Platform engagement			
Dependent Variable			
Platform Engagement	Number of active users on platform p at time t	1802	880
Focal Variables			
Non-Superstar Introductions	Number of non-superstar software titles released on platform p at time t	1.85	2.32
Superstar Introductions	Number of superstar software titles released on platform p at time t	.04	.21
New IP Introductions	Number of new IP software titles released on platform p at time t	1.29	1.71
Franchised Introductions	Number of franchised software titles released on platform p at time t	.61	1.06
Non-Exclusive Introductions	Number of non-exclusive software titles released on platform p at time t	1.77	2.23
Exclusive Introductions	Number of exclusive software titles released on platform p at time t	.13	.39
Non-Superstar Introductions (Subscription Participation = 0)[b]	Number of non-superstar software titles released off subscription service of platform p at time t	1.84	2.31
Superstar Introductions "	Number of superstar software titles released off subscription service of platform p at time t	.04	.21
New IP Introductions "	Number of new IP software titles released off subscription service of platform p at time t	1.28	1.70
Franchised Introductions "	Number of franchised software titles released off subscription service of platform p at time t	.60	1.06
Non-Exclusive Introductions "	Number of non-exclusive software titles released off subscription service of platform p at time t	.08	.30
Exclusive Introductions "	Number of exclsuive software titles released off subscription service of platform p at time t	1.63	2.08

Non-Superstar Introductions	(Subscription Participation = 1)	Number of non-superstar software titles released on subscription service of platform p at time t	.60	3.36
Superstar Introductions	"	Number of superstar software titles released on subscription service of platform p at time t	.03	.20
New IP Introductions	"	Number of new IP software titles released on subscription service of platform p at time t	.29	1.01
Franchised Introductions	"	Number of franchised software titles released on subscription service of platform p at time t	.33	2.70
Non-Exclusive Introductions	"	Number of franchised software titles released on subscription service of platform p at time t	.55	3.27
Exclusive Introductions	"	Number of non-exclusive software titles released on subscription service of platform p at time t	.08	.34
Platform Age				
Platform Age		Age of platform p at time t in 1,000 days	1.69	1.24
Control Variables				
Platform Engagement at t-1		Number of active users on platform p at time t-1	1617	998
Platform Price		Weighted average price of platform p at time t in dollar	344.28	96.79
Software Price		Weighted average price of software available on platform p at time t	40.70	13.21
Software Reviews		Weighted average review scores of software available on platform p at time t	65.48	12.79
Software Catalog at t-1		Size of available software catalog on platform p at time t-1	2275	197
Subscription Catalog at t-1		Size of available subscription catalog on platform p at time t-1	320	69
Platform Launch Day		Dummy that equals 1 if t is launch day of platform p		
Weekend dummy		Dummy that equals 1 if t is part of a weekend		
Monthly dummy		Dummy that equals 1 for each month of year		
Yearly Dummy		Dummy that equals 1 for each year of the observation period		

[a]For the focal dummy variables, we report the % of observations taking the value of 1.

[b]These introductions do not include software that simultaneously released on the subscription service.

Table 3 Results of the impact of software quality, familiarity, exclusivity, and subscription participation on ln(software engagement)

		Panel A: Model 1[a]			Panel B: Model 2[b]		
		Coef.	SE	p	Coef.	SE	p
Software Quality							
Superstar (vs. Non-superstar)		.595	.016	.000 ***	.471	.019	.000 ***
Superstar (vs. Non-superstar)	× Software Age	-1.454	.037	.000 ***	-1.422	.037	.000 ***
Superstar (vs. Non-superstar)	× Platform Age	-.028	.006	.000 ***	-.018	.006	.002 ***
Software Familiarity							
Franchise (vs. New IP)		.289	.006	.000 ***	.169	.007	.000 ***
Franchise (vs. New IP)	× Software Age	-.408	.015	.000 ***	-.378	.015	.000 ***
Franchise (vs. New IP)	× Platform Age	.040	.002	.000 ***	.042	.002	.000 ***
Software Exclusivity							
Exclusive (vs. Multihomed)		.181	.013	.000 ***	-.076	.019	.000 ***
Exclusive (vs. Multihomed)	× Software Age	.251	.034	.000 ***	.522	.035	.000 ***
Exclusive (vs. Multihomed)	× Platform Age	-.015	.005	.003 ***	-.016	.005	.001 ***
Subscription Participation							
Subscription Participation		.585	.007	.000 ***	.413	.008	.000 ***
Subscription Participation	× Software Age	-.343	.018	.000 ***	-.427	.018	.000 ***
Subscription Participation	× Platform Age	.021	.003	.000 ***	.023	.002	.000 ***
Subscription Participation	× Superstar (vs. Non-superstar)				.107	.016	.000 ***
Subscription Participation	× Franchise (vs. New IP)				.352	.007	.000 ***
Subscription Participation	× Exclusive (vs. Multihomed)				.296	.015	.000 ***
Control Variables							
ln(Platform Engagement$_{t-1}$)		.198	.004	.000 ***	.196	.004	.000 ***
Software Age		-.024	.014	.087 *	-.060	.014	.000 ***
Platform Age		-.109	.003	.000 ***	-.108	.003	.000 ***
ln(Platform Price)		-.004	.005	.417	-.005	.005	.302
ln(Software Price)		.385	.004	.000 ***	.386	.004	.000 ***
ln(Competition on Release)		.092	.002	.000 ***	.087	.002	.000 ***
Intercept		-2.078	.034	.000 ***	-1.970	.034	.000 ***
Genre		✓			✓		
Seasonal Variables		✓			✓		
R²		.441			.447		
N		311 120			311 120		

*** $p < .01$, ** $p < .05$, * $p < .10$.

[a]Main effects are interpreted as the marginal effects when Platform Age and Software Age equal 0.

[b]Main effects of the software development variables are interpreted as the marginal effects when Platform Age, Software Age, and Subscription Participation equal 0. The main effect of subscription participation is interpreted as the marginal effect when Platform Age, Software Age, Superstar, Franchise, and Exclusive equal 0.

Table 4 Results of the impact of software quality, familiarity, exclusivity, and subscription participation on ln(software sales)

		Panel A: Model 1 on software sales without controlling for engagement[a]			Panel B: Model 1 on software sales controlling for engagement[a]		
		Coef.	SE	*p*	Coef.	SE	*p*
Software Quality							
Superstar (vs. Non-superstar)		4.596	.588	.000 ***	3.839	.613	.000 ***
Superstar (vs. Non-superstar)	× Software Age	-.379	1.162	.744	-.431	1.169	.713
Superstar (vs. Non-superstar)	× Platform Age	-2.037	.227	.000 ***	-1.757	.232	.000 ***
Software Familiarity							
Franchise (vs. New IP)		-.673	.176	.000 ***	-.549	.185	.003 ***
Franchise (vs. New IP)	× Software Age	.174	.383	.649	.412	.401	.305
Franchise (vs. New IP)	× Platform Age	.828	.070	.000 ***	.642	.075	.000 ***
Software Exclusivity							
Exclusive (vs. Multihomed)		1.553	.610	.011 **	.587	.621	.344
Exclusive (vs. Multihomed)	× Software Age	2.282	.949	.016 **	3.734	.958	.000 ***
Exclusive (vs. Multihomed)	× Platform Age	-1.238	.255	.000 ***	-1.430	.258	.000 ***
Subscription Participation							
Subscription Participation		-.950	.215	.000 ***	-2.109	.229	.000 ***
Subscription Participation	× Software Age	1.640	.468	.000 ***	2.069	.492	.000 ***
Subscription Participation	× Platform Age	.116	.079	.142	.133	.085	.119
Engagement							
ln(Software Engagement$_{t-1}$)					.627	.027	.000 ***
ln(Platform Engagement$_{t-1}$)					1.066	.216	.000 ***
Control Variables							
ln(Platform Sales$_{t-1}$)		.222	.017	.000 ***	.089	.035	.011 **
Software Age		-.910	.408	.026 **	-1.774	.414	.000 ***
Platform Age		.244	.104	.018 **	-.368	.224	.100 *
ln(Platform Price)		.305	.111	.006 ***	.082	.127	.518
ln(Software Price)		.963	.084	.000 ***	.278	.085	.001 ***
ln(Competition on Release)		.540	.082	.000 ***	.188	.102	.066 *
Intercept		-8.371	.871	.000 ***	-10.330	1.077	.000 ***
Genre		✓					
Seasonal Variables		✓					
R²		.506			.567		
N		4 750			4 215		

*** $p < .01$, ** $p < .05$, * $p < .10$.

[a]Main effects are interpreted as the marginal effects when Platform Age and Software Age equal 0.

Table 5 Results of the impact of software introductions that differ in quality, familiarity, and exclusivity on ln(platform engagement)

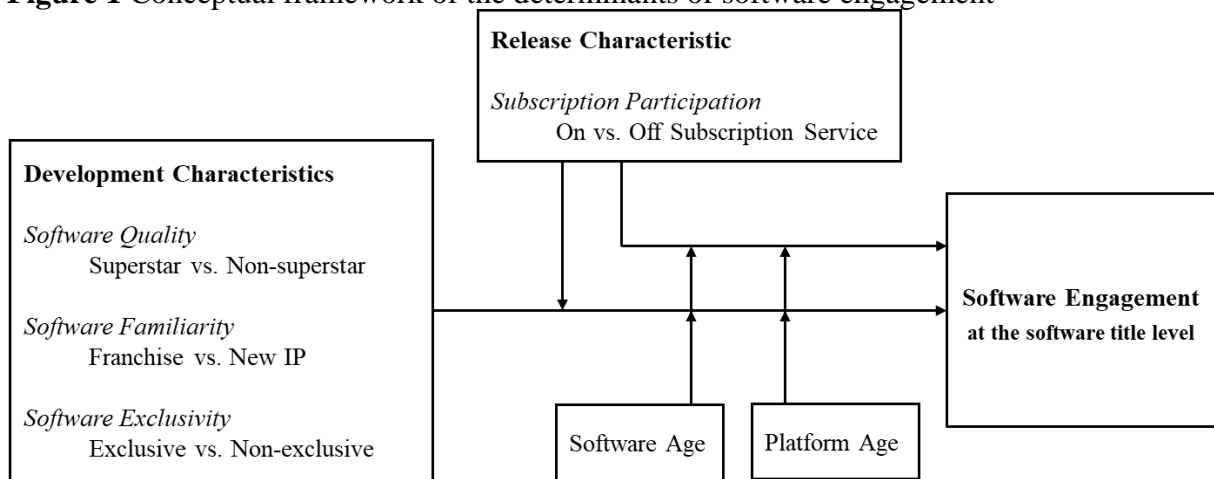|		Model 3: Software Quality			Model 4: Software Familiarity			Model 5: Software Exclusivity		
		Coef.	SE	*p*	Coef.	SE	*p*	Coef.	SE	*p*
Software Quality[a]										
Non-Superstar Introductions		.014	.001	.000 ***						
Superstar Introductions		.122	.014	.000 ***						
Interaction of Software Quality and Platform Age										
Non-Superstar Introductions	× Platform Age	-.004	.001	.000 ***						
Superstar Introductions	× Platform Age	-.069	.007	.000 ***						
Software Familiarity[a]										
New IP Introductions					.002	.002	.354			
Franchise Introductions					.044	.003	.000 ***			
Interaction of Software Familiarity and Platform Age										
New IP Introductions	× Platform Age				.002	.001	.030 **			
Franchise Introductions	× Platform Age				-.020	.002	.000 ***			
Software Exclusivity[a]										
Non-Exclusive Introductions								.013	.001	.000 ***
Exclusive Introductions								.074	.008	.000 ***
Interaction of Software Exclusivity and Platform Age										
Non-Exclusive Introductions	× Platform Age							-.004	.001	.000 ***
Exclusive Introductions	× Platform Age							-.035	.004	.000 ***
Control Variables										
ln(Platform Engagement$_{t-1}$)		.875	.008	.000 ***	.886	.008	.000 ***	.877	.008	.000 ***
Platform Age		-.127	.028	.000 ***	-.126	.027	.000 ***	-.123	.028	.000 ***
ln(Platform Price)		.028	.008	.000 ***	.028	.008	.000 ***	.030	.008	.000 ***
ln(Software Price)		.034	.027	.206	.049	.027	.066 *	.036	.027	.186
ln(Software Reviews)		.153	.028	.000 ***	.126	.028	.000 ***	.136	.028	.000 ***
ln(Software Catalog$_{t-1}$)		5.035	.623	.000 ***	4.870	.622	.000 ***	4.873	.631	.000 ***
ln(Subscription Catalog$_{t-1}$)		-.183	.045	.000 ***	-.194	.045	.000 ***	-.187	.045	.000 ***
Platform Launch Day		1.287	.056	.000 ***	1.230	.055	.000 ***	1.248	.055	.000 ***
Intercept		-37.417	4.608	.000 ***	-36.101	4.601	.000 ***	-36.121	4.673	.000 ***
Seasonal Variables		✓			✓			✓		
R²		.992			.992			.992		
N		1419			1419			1419		

*** $p < .01$, ** $p < .05$, * $p < .10$.

[a]Main effects are interpreted as the marginal effects when Platform Age equals 0.

Table 6 Results of the impact of software introductions that differ in quality, familiarity, and exclusivity on ln(platform engagement), moderated by subscription participation
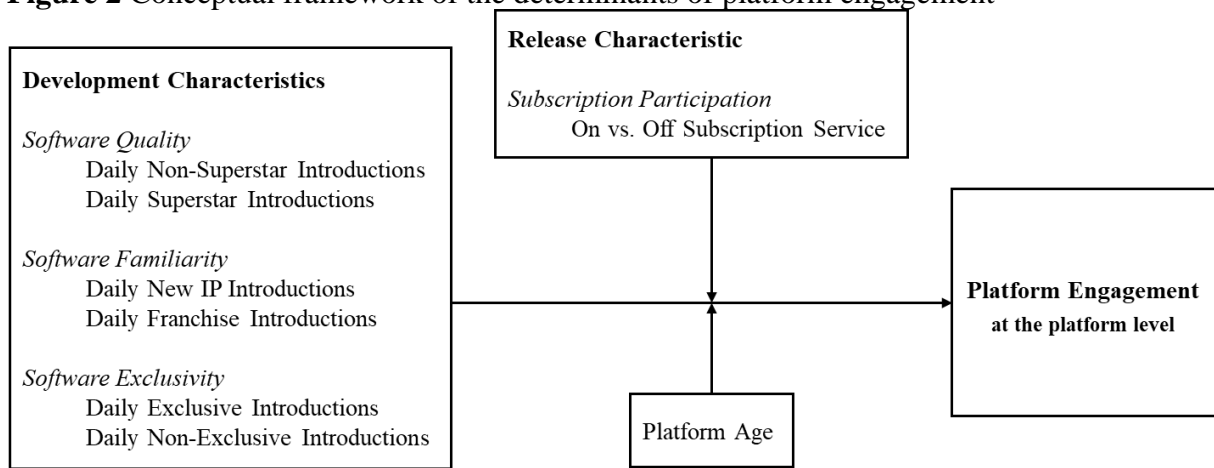
			Model 6: Software Quality			Model 7: Software Familiarity			Model 8: Software Exclusivity		
			Coef.	SE	p	Coef.	SE	p	Coef.	SE	p
Software Quality[a]											
Non-Superstar Introductions	(Subscription Participation = 0)		.003	.001	.001 ***						
Superstar Introductions	"		.042	.012	.000 ***						
Non-Superstar Introductions	(Subscription Participation = 1)		.021	.001	.000 ***						
Superstar Introductions	"		.018	.013	.175						
Interaction of Software Quality and Platform Age											
Non-Superstar Introductions	(Subscription Participation = 0)	× Platform Age	.002	.000	.001 ***						
Superstar Introductions	"	"	-.018	.006	.001 ***						
Non-Superstar Introductions	(Subscription Participation = 1)	"	-.012	.000	.000 ***						
Superstar Introductions	"	"	-.011	.006	.098 *						
Software Familiarity[a]											
New IP Introductions	(Subscription Participation = 0)					.002	.001	.238			
Franchise Introductions	"					.010	.003	.000 ***			
New IP Introductions	(Subscription Participation = 1)					.004	.003	.132			
Franchise Introductions	"					.025	.002	.000 ***			
Interaction of Software Familiarity and Platform Age											
New IP Introductions	(Subscription Participation = 0)	× Platform Age				.003	.001	.000 ***			
Franchise Introductions	"	"				-.003	.001	.015 **			
New IP Introductions	(Subscription Participation = 1)	"				-.002	.001	.150			
Franchise Introductions	"	"				-.015	.001	.000 ***			
Software Exclusivity[a]											
Non-Exclusive Introductions	(Subscription Participation = 0)								.004	.001	.000 ***
Exclusive Introductions	"								.010	.007	.159
Non-Exclusive Introductions	(Subscription Participation = 1)								.023	.001	.000 ***
Exclusive Introductions	"								-.002	.007	.787
Interaction of Software Quality and Platform Age											
Non-Exclusive Introductions	(Subscription Participation = 0)	× Platform Age							.001	.001	.009 ***
Exclusive Introductions	"	"							-.003	.003	.446
Non-Exclusive Introductions	(Subscription Participation = 1)	"							-.013	.000	.000 ***
Exclusive Introductions	"	"							.001	.004	.764
Control Variables[b]		✓									
ln(Platform Engagement_{t-1})			.958	.006	.000 ***	.962	.006	.000 ***	.958	.006	.000 ***
Platform Age			-.043	.019	.026 **	-.041	.019	.032 **	-.044	.019	.024 **
ln(Platform Price)			.010	.005	.058 *	.009	.005	.101	.010	.005	.055 *
ln(Software Price)			.011	.019	.563	.015	.018	.405	.009	.019	.616
ln(Software Reviews)			.045	.020	.024 **	.048	.019	.013 **	.049	.020	.013 **
ln(Software Catalog_{t-1})			1.679	.443	.000 ***	1.571	.432	.000 ***	1.689	.441	.000 ***
ln(Subscription Catalog_{t-1})			-.059	.031	.061 *	-.055	.031	.075 *	-.056	.031	.073 *
Platform Launch Day			1.143	.094	.000 ***	1.182	.106	.000 ***	1.157	.095	.000 ***
Intercept			-12.462	3.280	.000 ***	-11.716	3.200	.000 ***	-12.572	3.267	.000 ***
Seasonal Variables			✓			✓			✓		
R²			.996			.996			.996		
N			1419			1419			1419		

*** $p < .01$, ** $p < .05$, * $p < .10$. [a]Main effects are interpreted as the marginal effects when Platform Age equals 0.

Figure 1 Conceptual framework of the determinants of software engagement

```
                        ┌──────────────────────────────┐
                        │ Release Characteristic       │
                        │                              │
                        │ Subscription Participation   │
                        │    On vs. Off Subscription Service │
                        └──────────────────────────────┘
                                  │        │
┌──────────────────────────────┐ │        │         ┌──────────────────────────┐
│ Development Characteristics  │ │        └────────→ │                          │
│                              │ │                   │  Software Engagement     │
│ Software Quality             │ │                   │  at the software title level │
│    Superstar vs. Non-superstar │ └─────────────────→│                          │
│                              │──────────────┐       │                          │
│ Software Familiarity         │              │   ↑  ↑└──────────────────────────┘
│    Franchise vs. New IP      │              │   │  │
│                              │              │   │  │
│ Software Exclusivity         │        ┌──────────┐ ┌──────────┐
│    Exclusive vs. Non-exclusive │      │Software Age│ │Platform Age│
└──────────────────────────────┘       └──────────┘ └──────────┘
```

Figure 2 Conceptual framework of the determinants of platform engagement

Development Characteristics

Software Quality
    Daily Non-Superstar Introductions
    Daily Superstar Introductions

Software Familiarity
    Daily New IP Introductions
    Daily Franchise Introductions

Software Exclusivity
    Daily Exclusive Introductions
    Daily Non-Exclusive Introductions

Release Characteristic

Subscription Participation
    On vs. Off Subscription Service

Platform Age

Platform Engagement
at the platform level

Figure 3 Market share in sales and engagement of selected software over time
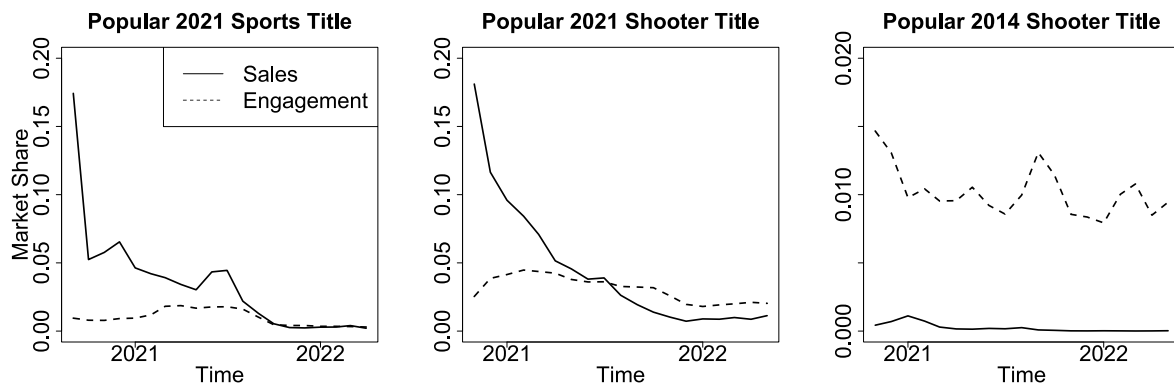
Figure 4 Top 10 2021 software titles in sales and engagement compared
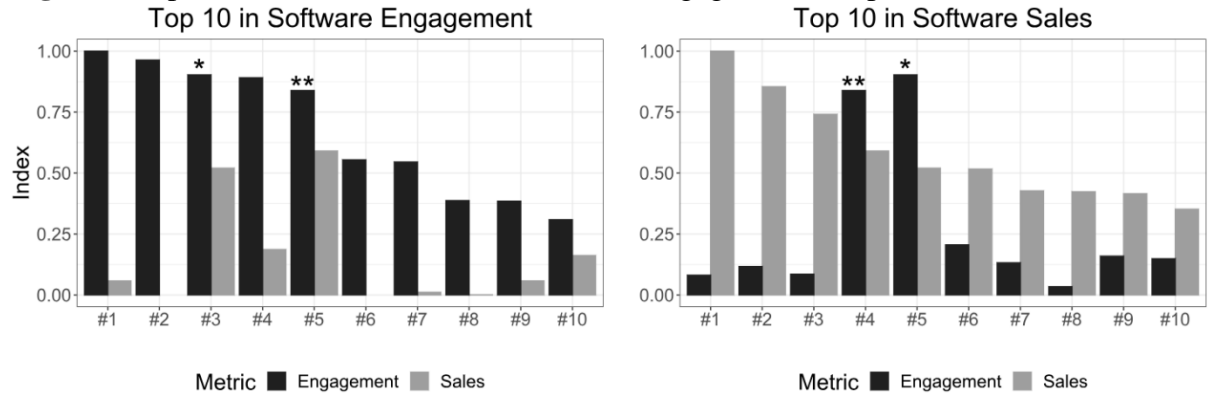
Note: The sales (engagement) index of a software title is calculated as a software title's 2021 unit sales (number of active users) divided by the maximum 2021 unit sales (number of active users) across all software titles. The "*" and "**" indicate that it concerns a software title that appears in both top 10 lists.