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The power of an installed base to combat lifecycle decline: The case of video games

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ABSTRACT

Declining demand in later stages of product lifecycles challenges managers. Especially in system markets, content providers must decide whether to publish new content in late lifecycle stages or wait for the next system generation. This study investigates whether content providers can compensate for declines in demand for a system by relying on the benefits offered by a large installed base in later lifecycle stages. Drawing on extensive market data from the video game industry – an underresearched but economically and culturally relevant category of the entertainment sector – this study examines ways to achieve such compensation. The data analyses show a negative association between the age of a system generation and content sales. However, an online multiplayer feature can counteract this negative effect by exploiting the large installed base and providing consumers with additional social value through direct network effects. These findings should help managers position their products more successfully in the late lifecycle stages of a particular system generation.

1. Introduction

Marketing product innovations in declining stages of their lifecycles constitutes a highly challenging task for managers. It is often accompanied by shrinking budgets and demand, along with less time available to amortize the new products. This challenge is particularly relevant for systems, which often arrive in generations and comprise interdependent products. Relevant examples are hardware platforms such as computers, smartphones, televisions, and industrial robots, along with their compatible software, as well as automobiles, motorcycles, stroller systems, e-book readers, payment systems, camera bodies and lenses, and espresso machines with capsules (Katz & Shapiro, 1994). Platform-based system markets have increasingly important effects on the economy (Eisenmann, Parker, & Van Alstyne, 2011; Gallaugher & Wang, 2002), especially in high-technology software industries such as video gaming (Landsman & Stremersch, 2011; Zhu & Zhang, 2010).

As customers start to expect a new system generation in the later stages of a product's lifecycle, they might strategically withhold their spending on content specific to the current system generation (delayed consumption), whose technology is soon to become outdated (e.g., stop buying CDs in anticipation of digital music options).[1] Yet the installed base (e.g., CD players) also has reached its maximum at this point, so managers face a dilemma: introduce new content for the current but mature system or focus on the next system generation, which starts with a lower installed base, leading to lower potential demand and revenue possibilities for new content. When development periods are long, content providers cannot afford to wait to introduce content for a mature generation. Instead, they use internal scale effects for learning to minimize development costs and seek to maximize the

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[1] In the music industry, platform generations with limited product lifecycles have included phonographs, cassette decks, and compact disc players, as well as digital music platforms such as iTunes (Bourreau, Gensollen, Moreau, & Waelbroeck, 2012).

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performance and platform fit of the content. However, content providers still face a challenge: how can they systematically address the peak of the installed base to counter declining demand and extend their products' lifecycle?

This article examines the declining product lifecycle stage of a system generation and applies product lifecycle theory, using the video games industry as a relevant example. It investigates this dynamic industry for three main reasons. First, the global impact of the video games market is growing, with estimated revenues of $101 billion in 2014 (Van der Meulen & Rivera, 2013). It is predicted to grow into the second largest entertainment industry, in terms of revenues, following only movies. According to the entertainment software association (theesa.com), 59% of U.S. consumers and more than 90% of teenagers play video games regularly, the average game purchaser is 35 years old, and 48% of all game players are women. Video games already are the most important entertainment product for many teenagers and young adults, with huge cultural significance (The Economist, 2011).

Second, despite its importance, the video game industry remains poorly investigated, especially compared with other entertainment industries, leaving unanswered a variety of questions, such that industry practitioners tend to rely on empirically unproven rules of thumb. Furthermore, the video game industry drives technology innovation and has exemplified the digital age from its very start, such that it often appears temporally in advance of other industries, which can learn from the innovations of the video games industry. Moreover, the fundamental characteristics of the video game market are common to many other two-sided markets.

Third, this industry offers a good example of a cyclical platform market, because the regular and frequent changes in platform generations emerge approximately every 6 years (Marchand & Hennig-Thurau, 2013). From 1972 to 2014, there have been approximately eight video game generations. Figs. 1 and 2 detail the lifecycles of the Microsoft Xbox 360, Sony PlayStation 3, and Nintendo Wii consoles of the seventh generation (2005–2014).

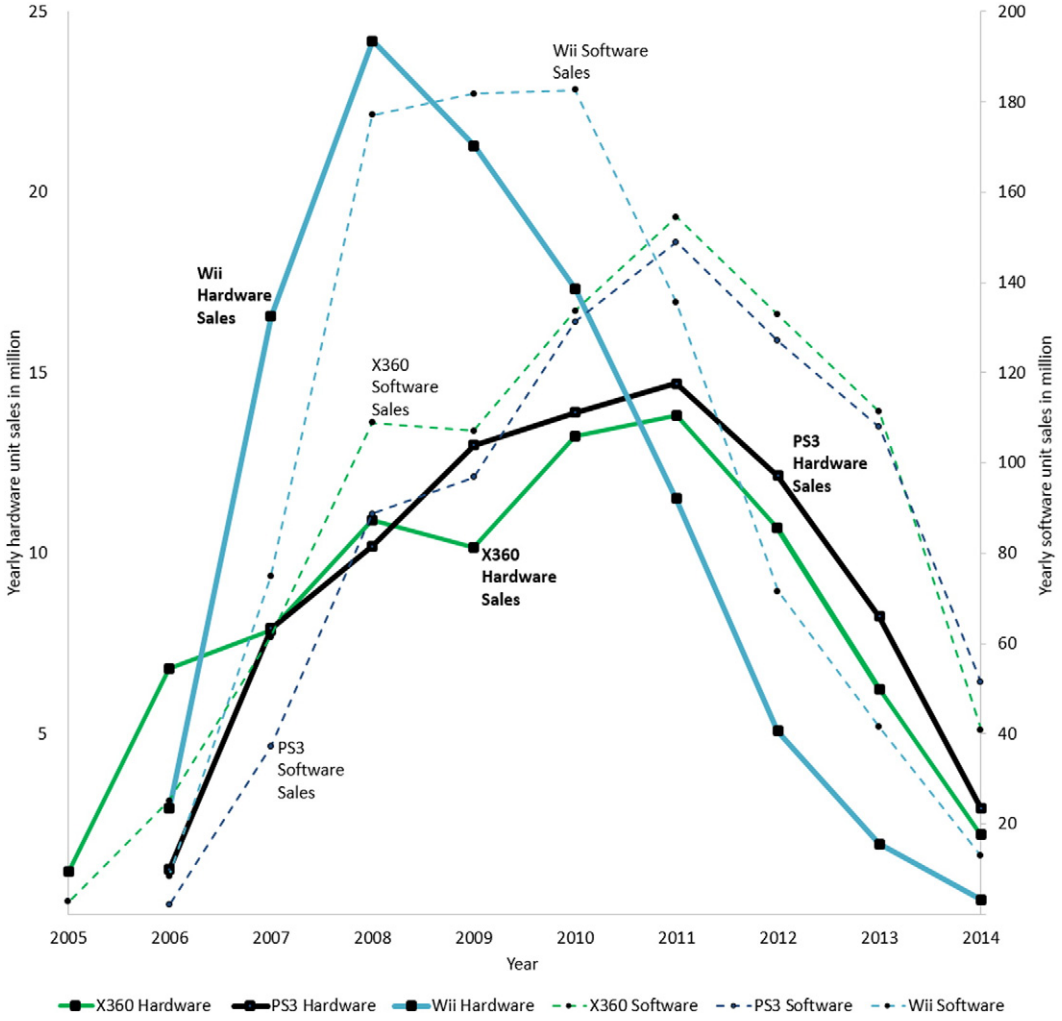

Fig. 1. System lifecycle of the seventh video game generation. Notes: Numbers represent the yearly global hardware and software unit sales in millions retrieved from vgchartz.com. X360 = Microsoft Xbox 360; PS3 = Sony PlayStation 3; Wii = Nintendo Wii.

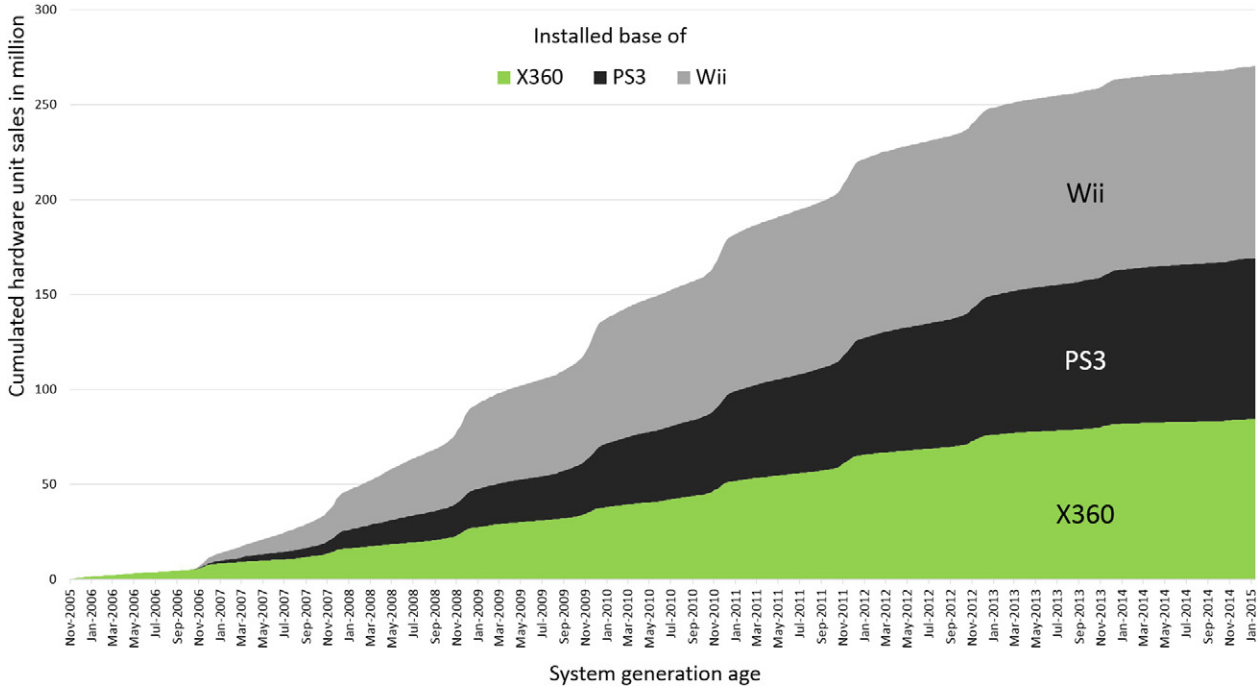

Fig. 2. Rise of the installed base of the seventh video game generation over time. Notes: Numbers represent the cumulative weekly global hardware sales in million units from 22 November 2005 to 31 January 2015; X360 = Microsoft Xbox 360; PS3 = Sony PlayStation 3; Wii = Nintendo Wii (data source: vgchartz.com).

For this research, the key decision makers are game publishers introducing new games to the market, who must operate in contexts marked by the lifecycle decline of their consoles. This study proposes a strategy for using the installed base of consumers to combat lifecycle declines, on the basis of a conceptual framework that details success factors for video game content.

A key variable in this framework is the online multiplayer feature of a video game. In contrast with single-player games (i.e., a consumer solves pre-programmed challenges or plays against opponents controlled by artificial intelligence), multiplayer formats provide features that enable consumers to play games cooperatively or competitively with other human players, in a simultaneous virtual game environment. Such collaboration can take place without a network, in front of the same screen, which can be referred to as a local multiplayer game. Some of the earliest video games relied on this type of format (e.g., Tennis for Two, released in 1958), often as family-centered video gaming (Chambers, 2012) that was restricted to a maximum of four players. However, games with an online multiplayer feature allow interactions among millions of consumers over the Internet and can be played jointly and simultaneously with other consumers, anywhere in the world. This feature thus leverages the direct network effects among consumers of a video game.

To test this framework empirically, I use market data about the seventh video game generation (2005–2014), with 1898 cases. I find that an online multiplayer feature increases the success of video games released in a later stage of a particular platform's lifecycle (i.e., higher system generation age), an effect that likely can be explained by self-determination theory (Ryan & Deci, 2000) and the basic need for relatedness through social interactions. In turn, these findings suggest actionable implications for the video game industry, and many other industries.

2. Background

2.1. Shrinking markets

The notion that product categories have limited lifetimes is central to strategic marketing (Day, 1981) and related disciplines (Cao & Folan, 2012). However, most research focuses on the introduction and growth stages (e.g., Chandrasekaran, Arts, Tellis, & Frambach, 2013; Chandrasekaran & Tellis, 2011), often grounded in the Bass (1969) diffusion model and its extensions, such as technological generations (Norton & Bass, 1987). Golder and Tellis (2004, p. 208) define the decline stage as a "period of steadily decreasing sales until a product's demise" and argue that it is essential to predict its start, to avoid excessive investments or premature withdrawal. Structural causes for decline include sociological or demographic changes, changing fashions, and technological obsolescence (Harrigan, 1980). According to product lifecycle theory, prices, revenues, and profitability decline in this stage, so companies must reposition their products (Cao & Folan, 2012) or allow them to fade out (Kotler, 1965).

In the entertainment industry, many content products have rapid revenue decays in competitive environments, as exemplified by movies in cinemas (Ainslie, Drèze, & Zufryden, 2005; Krider & Weinberg, 1998) and on DVD (Luan & Sudhir, 2010). However, to the best of my knowledge, specific strategies for content producers who deal with declining demand for entertainment systems with relatively long lifecycles, such as system hardware that reaches technological obsolescence only over time, have not been investigated, nor are the consequences for related content producers and the correlation with direct network effects through online multiplayer gaming clear.

2.2. The video game industry

For the global video game industry, most marketing investigations focus on demand for hardware, namely, video game consoles. Clements and Ohashi (2005) find that the elasticity of demand for consoles initially is low, then increases in the middle and declines at the end of their lifecycle. Gretz (2010) shows that consoles' technical quality and the number of available games positively influences demand. Binken and Stremersch (2009) concur that "superstar software" titles more than proportionally influence demand for consoles. Other marketing research topics include multihoming (Landsman & Stremersch, 2011) and pricing (Liu, 2010), though still with a primary focus on console demand (for an overview, see Marchand & Hennig-Thurau, 2013).

Regarding software content, we know virtually nothing about sales drivers, particularly in comparison with the findings pertaining to other entertainment products such as movies (Eliashberg, Elberse, & Leenders, 2006; Hadida, 2009). Basic observation reveals that video games are more expensive for end consumers than other entertainment media; for example, at its release, a typical video game costs about $60, whereas a Blu-ray movie is about $25, a book runs around $10–$20, and a music album is about $15. Yet consumption of the entertainment provided by a video game can exceed 100 hours, far more than provided by movies for example. Overall though, buying a relatively expensive video game, which is also a hedonic experience product, constitutes a high risk for a consumer.

In an initial but limited exploration of demand drivers for video games, Cox (2014) stresses the significant influence of major publishers and professional game reviews, along with significant effects of genres, mature age ratings, and sequels. However, his model lacks a theoretical framework and excludes potentially important factors, such as advertising for the focal game or competitors' game releases, non-expert evaluations, retail prices, and system hardware.

3. Conceptual framework and research questions

3.1. Overview

Fig. 3 depicts the conceptual framework for this study. The dependent variable is game sales as influenced by the other model factors. The factors on the left and upper side (marketing actions and third-party quality information sources) are similar to those previously researched in movie industry settings (e.g., Hadida, 2009; Hennig-Thurau, Marchand, & Hiller, 2012); because I expect comparable influences (e.g., advertising should have a strong impact on success), I treat these search and experience traits as control variables. The focal independent variables are the lifecycle stage (system generation age) and social value, attained through the online multiplayer features of video games. I therefore develop research questions to test the links of these factors to game success.

3.2. Research questions

3.2.1. Online multiplayer

Online multiplayer formats can be jointly played by people in different locations, connected through a network such as Battle.net, the Nintendo Wi-Fi Connection/Miiverse, Xbox Live, or PlayStationNetwork. The number of players is restricted only by servers' capacity. Because millions of people potentially play simultaneously, a common designation refers to massively multiplayer online games (MMOG), which also can be expanded to specific genres (e.g., MMORPG for massively multiplayer online role-playing game). Such offerings are complex and extensive; they even integrate features of professional events, including world rankings, tournaments with audiences and live broadcasts, prize money, sponsorships, and professional coaches. These MMOG features were introduced at the end of the sixth console system generation (i.e., only for the newer PS2 slim models and a few games) and became fully enabled with the seventh (2005–2014) console system generation.

Games with online multiplayer features also allow for social interactions during play by supporting direct communication among players (e.g., personal text messages, group chats, voice over Internet protocol services; Williams, Caplan, & Xiong, 2007) or cooperation among factions. Players can make new friends and develop their existing relationships. This important perceived gaming utility goes beyond the fun of gaming itself, to include communication that builds on and enhances interpersonal relationships (Ledbetter & Kuznekoff, 2011). Consumers can express themselves in different ways than they would in real-life contexts, because the virtual setting enables them to mask their appearance, social class, and other personal characteristics (Cole & Griffiths, 2007). According to self-determination theory (Ryan & Deci, 2000), such joint consumption experiences satisfy a basic need for relatedness through interpersonal social interactions (Downie, Mageau, & Koestner, 2008). In addition, players do not just consume but also create the virtual worlds of MMOGs, such that the games constitute cocreated narratives (Buchanan-Oliver & Seo, 2012). Other players become part of the social servicescape (Tombs & McColl-Kennedy, 2003) and consumption experience. Therefore, they may influence enjoyment of a game, similar to their effect in general social servicescapes.

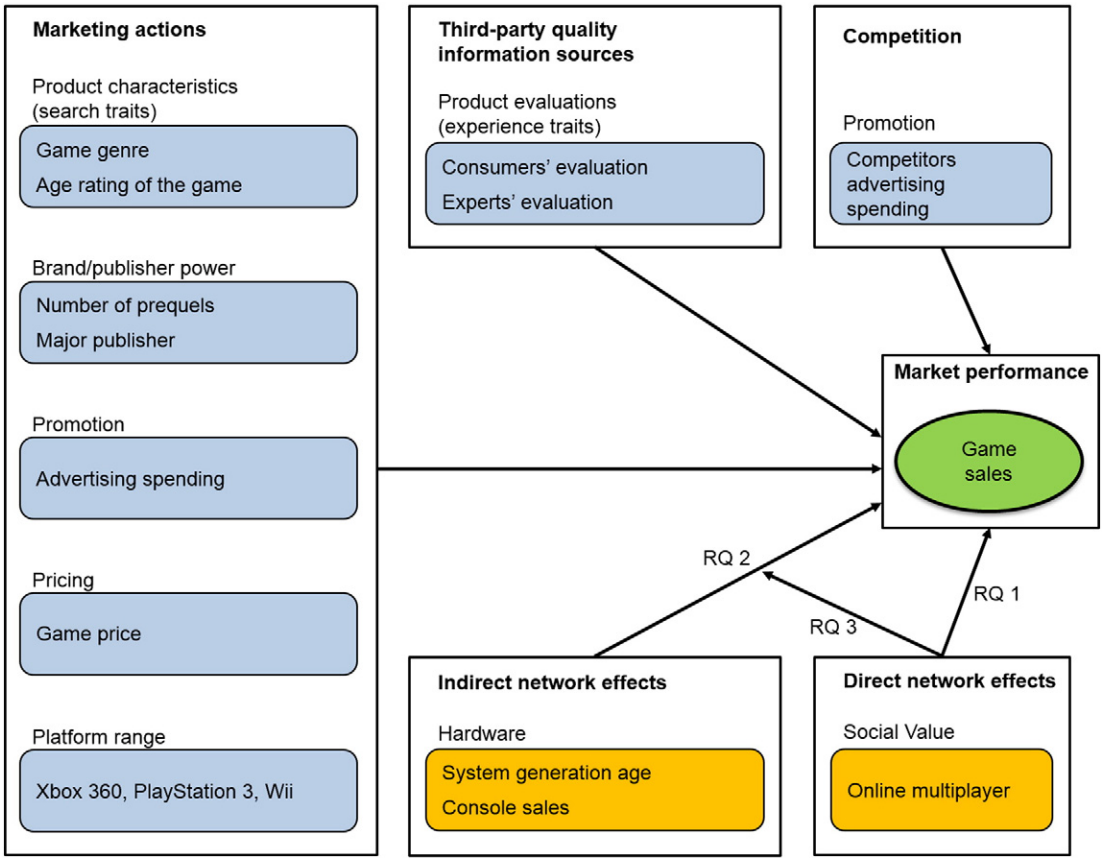

Fig. 3. Conceptual model for software sales.

Research into multiplayer games is relatively scarce (for an initial overview, see Quandt & Kroger, 2014). Game theoreticians consider the outcomes of simple, two-person games (Petrosjan & Zenkevich, 1996), but MMOGs such as World of Warcraft, Starcraft, Call of Duty, and Battlefield involve literally millions of players. The big data that result are difficult to analyze. Some psychology research has addressed the virtual representation of the self, player interactions, team leadership, and motivation to play (Barnett & Coulson, 2010); in particular, studies of motivation tend to rely on consumer surveys. For example, Cole and Griffiths (2007) and Hsu and Lu (2004) find that the social aspects of multiplayer games enhance enjoyment, and Shieh and Cheng (2007) indicate that the social function of playing with others drives satisfaction, in line with the notion of play as an experiential, ludic form of consumption (Holbrook, Chestnut, Oliva, & Greenleaf, 1984).[2]

To provide some empirical evidence about the probability of success of games with online multiplayer features, in comparison with games without them, I formulate the first research question (RQ):

RQ1: What is the association between the presence of an online multiplayer feature and content sales?

3.2.2. System generation age

A new console system generation displaces earlier systems, because new generations tend to be technologically incompatible with older generations (e.g., video games for the PlayStation 2 cannot be played on a PlayStation 3 console). Gretz and Basuroy (2013, p. 297) cite a manager who claims that the numbers of game releases decrease at the end of a system's lifecycle, because "most developers go to the next generation platform." Furthermore, the technical possibilities for new games become exhausted by the limited hardware power of a late-stage console, such that newly released games are mostly incremental improvements. In addition, these games lack content-related innovativeness and often feature sequels of well-known brands, with minor new features or gaming elements

[2] To explore other potential benefits of multiplayer gaming, I conducted focused interviews with eight regular male consumers of online multiplayer games (24–-30 years of age), which revealed another possible motivation: consumers value playing with other human players, because they act more flexibly, creatively, and imaginatively, which can make the play more fun. Artificial players, or "bots" in the interviewees' terms, lack such flexibility and ingenuity, such that they appear predictable. Interviewees also reported that non-human players sometimes seem dull or cheat (e.g., know details that human players could not know in that situation). Therefore, playing with other people who start the games from the same position can be more fun.

(vgchartz.com). Consumers, especially variety-seeking ones (Inman, 2001), may lose interest, or else they might exhibit commitment by sticking to their favorite games (which could be the reason they bought the console originally) rather than "upgrading" to newer game versions (e.g., they do not buy the game FIFA Soccer 14 when they already own FIFA Soccer 13). Furthermore, consumers may save their money for the next generation in later system generation stages.

On the basis of these arguments, I expect a saturation effect that might lead to a decline in video games sales in later product lifecycle stages for a particular console system generation. However, the installed base also reaches its maximum in late lifecycle stages, which could increase game sales at this point. It is unclear which of these two possible effects is stronger, which invokes the second research question:

RQ2: What is the association between a system's generation age and content sales?

3.2.3. Online multiplayer × system generation age

From an economic perspective, online multiplayer features should induce direct network effects between consoles, such that their value increases with a greater installed base (Katz & Shapiro, 1994). Because consoles and games are complementary products, a large customer base should increase the utility of a multiplayer video game too (Shankar & Bayus, 2003); the more consoles in use, the more people have an opportunity to become game partners. Thus they have an easier time finding the "right" playing partners with equivalent skills. That is, consumers benefit from positive network externalities when more consumers use the same console in a network.

When consumers consider both online multiplayer features and the system's generation age, they likely confront a trade-off: Buying a game later in the console's lifecycle implies greater access to fellow players in the network (positive effect) but virtually no innovative technology upgrades and games that are similar to those already in existence (negative effect). I anticipate that the negative effect of generation age might be surpassed by the positive effect of the online multiplayer feature in later stages, because the additional social value of a multiplayer feature should be greater than the weak ludic value of a less differentiated or innovative games. For example, in the seventh video game generation, the online multiplayer franchise Call of Duty: Modern Warfare featured the release of Part 2 in 2009, in the middle of the lifecycle, which generated U.S. unit sales of approximately 7.7 million games for the Xbox 360 until September 2014. Part 3, released at the end of the lifecycle in 2011, generated even higher unit sales of about 8.1 million (vgchartz.com). In contrast, the non-multiplayer game Assassin's Creed 1 (2007) generated more sales (3.0 million) for the Xbox 360 than its successor Assassin's Creed 2 (2009, 2.7 million; vgchartz.com). Accordingly, I consider:

RQ3: What is the association between an online multiplayer feature and content sales when the system generation age is high?

4. Empirical study

4.1. Data

The relevant consoles of the seventh video game generation are the Microsoft Xbox, Sony PlayStation, and Nintendo Wii. Their games are complementary products, and they represent the latest technology and highest processing power for the seventh console system generation. I consider a comprehensive data set of 1898 cases with 968 Xbox 360 (X360), 811 PlayStation 3 (PS3), and 1078 Wii video games released in the United States between 22 November 2005 and 31 January 2014. I include all stand-alone, non-arcade console titles sold at least 5000 times. Among these games, 721 were released on more than one console, 260 were released exclusively on the X360, 140 appeared only for the PS3, and 777 only for the Wii. To account for long-term effects and the rapid sales decay after several weeks, as well as to ensure the comparability of the results of later and earlier introduced games, I measured the total sales dependent variable up to August 2014. I excluded handheld devices, such as the Sony PlayStation Portable or Nintendo DS, because they are not high-end/high-definition consoles, and they feature relatively few online multiplayer games. Table 1 provides detailed information about the operationalization and data sources for all the variables; Table 2 contains the descriptive statistics for the variables.

4.2. Procedure

I test the research questions with a regression analysis. To form the interaction term (*online_multiplayer* × *system_generation_age*), I applied a residual centering approach (Lance, 1988), regressed the product term of the interaction variables on both variables, then used the residuals from that regression in the final estimation. The residual centering enabled to focus on only that part of the interaction term that was not explained by the two interacting variables, so I eliminated potential multicollinearity problems and gained a conservative estimate of interaction effects. Next, I analyzed the spotlights of the interactions, using a simple slope analysis (Aiken & West, 1991).

I log transformed the skewed variables (i.e., *game_sales*, *console_sales*, *advertising*, and *competition_advertising*) to approximate a normal distribution, consistent with extant research (e.g., Hennig-Thurau, Houston, & Heitjans, 2009). The remaining variables, which I did not log-transform, were binary variables such as genre and ordinal variables such as *age_rating*. In robustness checks, I log transformed these variables too and found consistent results, except that the unstandardized coefficients increased. Because

Table 1
Operationalization and data sources of model variables.

Variable	Operationalization	Data source
ln_game_sales	Log-transformed number of video game units sold in the United States from 22 November 2005 to 23 August 2014	vgchartz.com
platform_range_vector	Three binary variables for the particular consoles (X360, PS3, Wii) on which a game is released	vgchartz.com
genre	Twelve binary variables for particular game genres: _action, _adventure, _fighter, _platform, _puzzle, _racer, _rpg (role-playing game), _shooter, _simulation, _sports, _strategy, _other (_fighter is excluded from the regressions to avoid dummy variable trap)	vgchartz.com
age_rating	Equal to 1 if the game's ESRB rating is E (everyone, all ages); 2 if it is E10+ (everyone 10+, ages 10 and up); 3 if it is T (teen, ages 13 and up); 4 if it is M (mature, ages 17 and up)	gamespot.com
ln_price_game	Log-transformed price mean of the particular game at release on amazon.com	camelcamelcamel.com
ln_number_of_prequels	Log-transformed number of all prequels of the game	vgchartz.com
major_publisher	Binary variable; 1 if the publisher of the game was one of the top ten biggest publishers in the release year of the game; 0 otherwise	gamasutra.com
ln_advertising	Log-transformed advertising expenses for the game in thousands of US$	kantarmedia.com
ln_competition_advertising	Log-transformed advertising expenses for all other games released in the same month in thousands of US$	kantarmedia.com
consumers_evaluation	Average quality rating (user score from 1.0 to 10.0) of the game for the particular console by non-experts	gamespot.com
experts_evaluation	Composite experts review score (1.00 to 100.00) of the game for the particular console	gamerankings.com
ln_console_sales	Log-transformed unit sales of the particular console during the release month of the game	vgchartz.com
system_generation_age	Number of months since the first console launch in the seventh console system generation (22 November 2005)	vgchartz.com
online_multiplayer	Binary variable; 1 if the game can be played simultaneously with other players from different locations through the Internet; 0 otherwise	gamespot.com

the log-transformed version of the binary and ordinal variables did not distort the estimates (i.e., R^2 values and other coefficients remained stable), I retained their raw versions.[3]

To rule out confounding effects and alternative explanations, I also included relevant control variables, as inspired by extant research in the film industry. In the following sections, I structure the variables according to the conceptual model (Fig. 3).

4.3. Model variables

4.3.1. Main variables

Because I focus on game publishers, the central dependent variable is software sales (*ln_game_sales*). The main independent variables comprise two groups, namely, online multiplayer features (direct network effects) and system hardware (indirect network effects). The multiplayer features refer to whether a game can be played jointly by more than one consumer over the Internet (*online_multiplayer*). For the hardware variables, I considered the age of the console system generation (*system_generation_age*; see Gretz & Basuroy, 2013) by measuring the stage of the consoles' product lifecycles with a general time variable that correlated well with both the overall installed base and the diffusion of fast Internet access in U.S. households (both $r > .9$, $p < .001$). This age measure also is more generalizable than other variables and less prone to external effects, such as the introduction of Kinect for the Xbox 360 in 2010, which had a sudden, positive effect on hardware sales.

4.3.2. Product characteristics

Two important search traits that I treat as control variables in the model are similar to variables prominent in the movie industry: game genre (e.g., *genre_action*; see Hixson, 2006) and the ESRB age rating of the game (*age_rating*; similar to MPAA movie ratings; Leenders & Eliashberg, 2011; Ravid, 1999; Ravid & Basuroy, 2004).

4.3.3. Brand and publisher power

The power of the brand and its publisher also could influence demand. I focus on potential brand awareness (which alternately might be labeled "cultural familiarity"), which can be increased through brand extensions such as sequels of a particular game (*ln_number_of_prequels*; see Hennig-Thurau et al., 2009).[4] For example, games with many prequels such as Call of Duty or Super Mario have higher brand awareness than a game with no prequels such as Watch Dogs. For publishers' power, I distinguish

[3] Interpreting parameter estimates in this case is not straightforward. If our *games sales* model is $\ln(Y) = \gamma_0 + \gamma_1 X_1 + \gamma_2 \ln(X_2)$, and we increase the *non-log-transformed independent variable* X_1 by one unit, holding the other predictors constant, it would lead to: $\ln(Y_1) = \gamma_0 + \gamma_1 X_1 + \gamma_2 \ln(X_2)$ and $\ln(Y_2) = \gamma_0 + \gamma_1 (X_1 + 1) + \gamma_2 \ln(X_2) \Rightarrow \gamma_1 = \ln\left(\frac{Y_2}{Y_1}\right) \Rightarrow e^{\gamma_1} = 1 + \frac{Y_2 - Y_1}{Y_1}$ and a change in the (log-transformed) dependent variable of $(e^{\gamma_1} - 1) \cdot 100$ percent. For the *log-transformed independent variable* $\ln(X_2)$ a 1% change would lead to: $\ln(Y_1) = \gamma_0 + \gamma_1 X_1 + \gamma_2 \ln(X_2)$ and $\ln(Y_2) = \gamma_0 + \gamma_1 X_1 + \gamma_2 \ln(X_2) \cdot (1 + 1\%) \Rightarrow \ln\left(1 + \frac{Y_2 - Y_1}{Y_1}\right) = \gamma_2 \ln(1.01)$.Though, an increase of a log-transformed independent variable by one percentage would lead to a change in the (log-transformed) dependent variable of $(1.01^{\gamma_2} - 1) \cdot 100$ percent.

[4] In terms of empirical conceptualizations, most studies use a dummy variable to identify whether a game is a sequel (e.g., Ainslie et al., 2005; Akdeniz & Talay, 2013; Basuroy, Desai, & Talukdar, 2006; Dhar, Sun, & Weinberg, 2012). However, the number of prequels offers a more accurate operationalization. I also tested the success of the prequels, following Hennig-Thurau et al. (2009), and obtained similar results. For very old prequels, I lacked reliable sales data (some date back to the 1980s), so I decided to use the clear information represented by the number of prequels.

Table 2
Descriptive statistics.

Metric variables	Mean	Median	SD	Min	Max
ln_game_sales	12.22	12.23	1.46	1.10	17.39
age_rating	2.23	2.00	1.14	1.00	4.00
ln_price_game	3.76	3.89	.34	1.38	5.01
ln_number_of_prequels	.81	.69	.93	.00	3.53
ln_advertising	3.68	4.01	3.53	.00	10.66
ln_competition_advertising	10.32	10.40	1.10	4.77	12.46
consumers_evaluation	6.78	7.20	1.67	.00	9.80
experts_evaluation	61.75	66.66	22.33	.00	97.46
ln_console_sales	13.28	13.21	.73	10.94	15.49
system_generation_age	46.50	47.00	20.88	1.00	99.00

Categorical variables	Sum	%
release_on_X360	968	51%
release_on_PS3	811	43%
release_on_Wii	1078	57%
genre_action	335	18%
genre_adventure	132	7%
genre_fighter	84	4%
genre_platform	67	3%
genre_puzzle	53	3%
genre_racer	165	9%
genre_rpg	106	6%
genre_shooter	227	12%
genre_simulation	101	5%
genre_sports	344	18%
genre_strategy	34	2%
genre_other	250	13%
major_publisher	955	50%
online_multiplayer	673	35%
n	1898	

minor from major publishers, assuming that a major publisher has more distribution resources and possibilities (e.g., negotiating power) to list its product prominently in the market (*major_publisher*; see Elberse & Eliashberg, 2003; Hsu, 2006).

4.3.4. Promotion

Advertising expenditures for a product typically offer a strong predictor of its success, because they increase buzz about the product (*ln_advertising*; see Karniouchina, 2011; Zufryden, 1996). Similar to other entertainment products, games release simultaneously with other games. Therefore, I also consider advertising expenditures by all competing publishers for games released in the same month to capture competitive intensity (*ln_competition_advertising*; see Krider & Weinberg, 1998).

4.3.5. Pricing and platform range

For video games, I do not expect a typical negative effect between higher prices and lower sales, because usually the best-selling video games (e.g., Call of Duty, Grand Theft Auto; see vgchartz.com) are AAA games that offer the highest technological standard currently available, combined with high production budgets, at high retail prices. One pricing classification might refer to games as high (e.g., $69.99), medium (e.g., $49.99), or low (e.g., $29.99) priced. However, instead of this ordinal operationalization, I use log-transformed mean prices at release for all relevant consoles (*ln_price_game*). Because I use pooled video game data across all three consoles, I add a platform range vector (*platform_range_vector*) as another control variable, assuming that game sales increase with the number of platforms on which a game has been released.

4.3.6. Third-party quality information sources

For the rather subjective experience traits, I use the valence of ordinary evaluations (*consumers_evaluation*; see Holbrook & Addis, 2007; Moon, Bergey, & Iacobucci, 2010) and experts' judgments (*experts_evaluation*; see Eliashberg & Shugan, 1997; Hennig-Thurau et al., 2012). In the movie industry, multiple studies have established the positive effects of third-party quality ratings on box office success, because high ratings signal higher quality. I expect similar positive effects on video games sales.

4.3.7. Equation

The resulting Eq. (1) displays the model with $genre\_vector_i$ as a vector of dummy variables to indicate the genre of video game *i*, and the $platform\_range\_vector_i$, which represents a vector of three dummy variables to indicate the platforms (X360, PS3, Wii) on which game i is released. The γs are the parameters to be estimated, and ε_i is the error term. The estimations generally refer to the

Table 3
Bivariate correlations.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12
1	*ln_game_sales*	1											
2	*release_on_X360*	.346[a]	1										
3	*release_on_PS3*	.386[a]	.521[a]	1									
4	*release_on_Wii*	−.159[a]	−.557[a]	−.451[a]	1								
5	*genre_action*	.055[a]	.128[a]	.159[a]	−.082[a]	1							
6	*genre_adventure*	−.051[a]	−.097[a]	−.044	.105[a]	−.127[a]	1						
7	*genre_platform*	.044	−.070[a]	−.009	.092[a]	−.089[a]	−.052[a]	1					
8	*genre_puzzle*	−.138[a]	−.128[a]	−.133[a]	.103[a]	−.078[a]	−.046[a]	−.032	1				
9	*genre_racer*	−.096[a]	−.001	−.006	−.010	−.143[a]	−.084[a]	−.059[a]	−.052[a]	1			
10	*genre_rpg*	.015	.018	.054[a]	−.168[a]	−.113[a]	−.066[a]	−.047[a]	−.041	−.075[a]	1		
11	*genre_shooter*	.108[a]	.144[a]	.095[a]	−.219[a]	−.171[a]	−.101[a]	−.071[a]	−.062[a]	−.114[a]	−.090[a]	1	
12	*genre_simulation*	−.054[a]	−.129[a]	−.134[a]	.088[a]	−.110[a]	−.065[a]	−.045[a]	−.040	−.073[a]	−.058[a]	−.087[a]	1
13	*genre_sports*	.035	.007	−.017	.085[a]	−.218[a]	−.129[a]	−.090[a]	−.080[a]	−.145[a]	−.114[a]	−.173[a]	−.112[a]
14	*genre_strategy*	−.039	.037	−.052[a]	−.051[a]	−.063[a]	−.037	−.026	−.023	−.042	−.033	−.050[a]	−.032
15	*genre_other*	−.019	−.095[a]	−.110[a]	.160[a]	−.180[a]	−.106[a]	−.075[a]	−.066[a]	−.120[a]	−.095[a]	−.144[a]	−.092[a]
16	*age_rating*	.198[a]	.367[a]	.330[a]	−.490[a]	.249[a]	.047[a]	−.107[a]	−.167[a]	−.208[a]	.204[a]	.390[a]	−.121[a]
17	*ln_price_game*	.536[a]	.493[a]	.481[a]	−.475[a]	.096[a]	−.085[a]	.014	−.209[a]	−.071[a]	.129[a]	.149[a]	−.032
18	*ln_number_of_prequels*	.315[a]	.203[a]	.254[a]	−.104[a]	−.021	−.039	.025	−.077[a]	.012	−.030	−.042	−.024
19	*major_publisher*	.375[a]	.143[a]	.172[a]	−.146[a]	−.032	−.068[a]	.042	−.107[a]	−.004	−.043	.042	−.027
20	*ln_advertising*	.582[a]	.369[a]	.337[a]	−.213[a]	.100[a]	−.077[a]	.064[a]	−.124[a]	−.039	−.009	.112[a]	−.037
21	*ln_competition_advertising*	.130[a]	.020	.046[a]	.022	.006	−.011	.013	−.006	−.022	−.022	−.012	.004
22	*consumers_evaluation*	.475[a]	.254[a]	.325[a]	−.356[a]	.082[a]	−.017	.040	−.052[a]	−.029	.146[a]	.083[a]	−.040
23	*experts_evaluation*	.537[a]	.333[a]	.370[a]	−.380[a]	.062[a]	−.031	.056[a]	−.061[a]	−.062[a]	.110[a]	.101[a]	−.074[a]
24	*ln_console_sales*	.157[a]	.155[a]	.127[a]	.315[a]	.007	.014	.019	.017	−.001	−.133[a]	−.048[a]	−.002
25	*system_generation_age*	.001	.102[a]	.343[a]	−.124[a]	.099[a]	.011	−.019	−.057[a]	−.062[a]	.044	.001	−.075[a]
26	*online_multiplayer*	.294[a]	.478[a]	.379[a]	−.485[a]	−.124[a]	−.146[a]	−.112[a]	−.079[a]	.115[a]	−.008	.209[a]	−.078[a]
	Variable	1	2	3	4	5	6	7	8	9	10	11	12

[a] Significant at $p < .05$ (two-sided).

total level, with the exceptions of *ln_price_game*, *ln_competition_advertising*, *ln_console_sales,* and *system_generation_age*, for which the subscript t indicates the release month of the particular game.

$$\begin{aligned} ln\_game\_sales_{i,t} &= \gamma_0 + \gamma_1\, platform\_range\_vector_i + \gamma_2\, genre\_vector_i + \gamma_3\, age\_rating_i \\ &+\gamma_4\, ln\_price\_game_{i,t} + \gamma_5\, ln\_number\_of\_prequels_i + \gamma_6\, major\_publisher_i \\ &+\gamma_7\, ln\_advertising_i + \gamma_8\, ln\_competition\_advertising_{i,t} + \gamma_9\, consumers\_evaluation_i \\ &+\gamma_{10}\, experts\_evaluation_i + \gamma_{11}\, ln\_console\_sales_{i,t} + \gamma_{12}\, system\_generation\_age_{i,t} \\ &+\gamma_{13}\, online\_multiplayer_i + \gamma_{14}\, online\_multiplayer_i \times system\_generation\_age_{i,t} + \varepsilon_i \end{aligned} \quad (1)$$

4.4. Results

I provide the bivariate correlations among the variables in Table 3.

With this procedure, the variance inflation factors (VIF) were all less than 2.5 and below the recommended threshold of 10 (Hair, Black, Babin, & Anderson, 2009), so multicollinearity was not an issue in either analysis (Cohen, Cohen, West, & Aiken, 2003). Inspired by previous media studies, I tested the model for endogeneity with Durbin–Wu–Hausman tests, using several instruments. The results confirmed that endogeneity was not a problem in the model. A Breusch–Pagan test indicated heteroscedasticity ($\chi^2 = 56.37$, $p < .01$). I thus analyzed the model with a robust linear regression, using the Huber/White estimator of variance to correct for the effects of outliers and inefficiency in estimates and to avoid heteroskedasticity problems (Kennedy, 2008). Although rarely used in marketing, robust regression is an efficient alternative to standard ordinary least squares regression in the presence of heteroskedasticity and outliers (Mahajan, Sharma, & Wind, 1984). The R^2 for the model was .565; its parameters appear in Table 4.

The online multiplayer feature alone was not significantly associated with game sales (RQ1). The system generation age correlates negatively with game sales (RQ2). Moreover, I found a significant positive moderating effect of *online_multiplayer* × *system_generation_age* on game sales, consistent with the theoretical arguments related to RQ3.

To gain a more detailed understanding of the significant interactions, I calculated simple slopes at one standard deviation above and below the mean of the moderator variable in each interaction, using the IRSE software by Meier (2011). This method is superior to a median split, because it does not make arbitrary dichotomous assignments to the metric variable *system_generation_age*. For the binary *online_multiplayer* variable, I calculated slopes for nominal values of 1 and 0, along with specific spotlight analyses (Fitzsimons, 2008). In these analyses, I shifted the mean level of the moderator variable up and down by one standard deviation, then conducted significance tests for an individual slope (Aiken & West, 1991). The results supported my theoretical arguments. The online multiplayer feature is associated with higher sales for games introduced later in the system generation (high *system_generation_age*); the spotlight analysis in Table 5 confirmed that the increase in game sales was significant.

13	14	15	16	17	18	19	20	21	22	23	24	25	26
1													
−.064[a]	1												
−.183[a]	−.053[a]	1											
−.340[a]	.039	−.156[a]	1										
−.034	.020	−.125[a]	.385[a]	1									
.145[a]	−.016	−.063[a]	.004	.265[a]	1								
.104[a]	−.001	.029	.035	.319[a]	.219[a]	1							
.005	−.059[a]	−.062[a]	.193[a]	.514[a]	.253[a]	.276[a]	1						
−.015	.002	.046[a]	−.037	.020	.079[a]	.060[a]	.078[a]	1					
−.086[a]	.052[a]	−.185[a]	.312[a]	.462[a]	.279[a]	.252[a]	.330[a]	.003	1				
−.041	.043	−.140[a]	.291[a]	.528[a]	.290[a]	.282[a]	.401[a]	.027	.700[a]	1			
.023	−.053[a]	.079[a]	−.116[a]	−.028	.071[a]	.004	.053[a]	.240[a]	−.108[a]	−.079[a]	1		
−.064[a]	−.028	.069[a]	.102[a]	.019	.107[a]	−.067[a]	.002	.136[a]	.029	.039	.091[a]	1	
.134[a]	.058[a]	−.155[a]	.193[a]	.414[a]	.292[a]	.206[a]	.289[a]	−.030	.310[a]	.348[a]	−.070[a]	−.013	1
13	14	15	16	17	18	19	20	21	22	23	24	25	26

The results for the control variables were as expected, though a few variables require particular mention. In terms of the age rating, studies pertaining to the movie industry usually indicate a negative correlation between a higher age rating and success. For video games, I cannot confirm these findings. A higher price for a game is associated positively with game sales, in line with my theoretical arguments. Similar to studies in the movie industry, the number of prequels, a major publisher, advertising expenses, and evaluations by ordinary consumers (eWOM) and experts all correlated positively with game sales.

4.5. Post hoc analyses

To check these findings, I compared the results of the robust regression with ordinary least squares (OLS) and 3SLS regressions. The key effects of the model remained stable (see the Appendix A). Although not formally hypothesized, in the post hoc analysis I identified two additional significant interactions with system generation age, using stepwise procedures. The interaction of *major_publisher* × *system_generation_age* was negative, whereas the interaction of *ln_advertising* × *system_generation_age* correlated positively with the dependent variable (*ln_game_sales*).

The negative interaction of *system_generation_age* with *major_publisher* implied that the positive direct effect of a major publisher was weaker for games introduced later in the system generation. This result might reflect variety-seeking motivations of consumers, who shift their interest to games released by smaller publishers over time, because they already know or own the big hits. Another motivation might arise at the last stage of a system generation, when the next generation has been announced. Some consumers might strategically withhold their spending on the games from major publishers until the subsequent console, and an enhanced version of the games, get released. For example, Grand Theft Auto V from the major publisher Take-Two Interactive was released for PlayStation 3 in September 2013 and for PlayStation 4, in a substantially enhanced version, in November 2014. In contrast, minor, independent publishers usually release their games for one system generation only or do not alter the games across system generations.

The positive interaction of *system_generation_age* with *ln_advertising* suggests that advertising for a video game becomes more effective with a higher installed base, likely because it can address the higher number of potential buyers who already own the required console to play the game.

5. Discussion

5.1. Summary of findings

This study suggests a strategy for contesting lifecycle decline and saturation effects on demand at a late stage of a product lifecycle in the video game industry. It is among the first investigations to explore what makes a video game successful. It thus offers new insights into this rarely researched but economically and culturally relevant entertainment industry. Specifically, this

empirical research shows that an online multiplayer feature, which exploits a large installed user base and provides social value to customers, correlate positively with higher sales at a late lifecycle stage. This strategy thus combines the benefits of direct (multiplayer) with indirect network effects (higher installed base at later lifecycle stages). Furthermore, this research identifies factors that correlate with video game sales: advertising, retail price, brand awareness, distribution power, and quality judgments by consumers and experts. In addition, genres such as shooter, sports, and "other" correlate positively with game sales.

I did not find a significant influence of the age rating on game sales, even though this rating implies restrictiveness, such that a higher rating limits the number of consumers who legally may buy the game. This point is particularly relevant for video games, because at least 32% of all video game consumers are not adults (theesa.com), suggesting that games with high age ratings are not suitable for these potential consumers. Young consumers also might be less interested in games with a high age rating, because they want to avoid potentially harmful game consumption. This reduced market potential implies a tainted fruit effect (Bushman & Stack, 1996). Alternatively, it could induce a forbidden fruit effect, in line with reactance theory (Brehm, 1966), such that some young consumers feel motivated to reestablish their lost freedom of choice by consuming a restricted video game (e.g., without parents' permission), which could increase demand. Because the age rating usually signals mature content (Leenders & Eliashberg, 2011), such as sexual or violent images, a higher rating also could exert a positive effect on demand among adults. Such behavior might be motivated by an explicit willingness to consume negative content (Andrade & Cohen, 2007) or, specifically for video games, to breach taboos, such as when players engage in violence virtually. I posit that the tainted fruit effect (negative effect on game sales) and forbidden fruit effect (positive effect on game sales) might compensate for each other.

5.2. Managerial implications

For the video games industry, the findings indicate that it might advisable to release software titles before the interrelated sales of consoles and games decline, especially single-player software titles that cannot be played simultaneously with others. These titles should offer compelling single-usage experiences to help build a large installed base for the related hardware. When a hardware generation matures, content managers might introduce a feature that exploits the larger network to connect consumers and thereby counter declining effects. In a gaming setting, an online multiplayer feature can be capable of exerting this effect. Therefore, I recommend that video game content producers introduce online multiplayer video games later in a particular system's lifecycle. In so doing, they offer a possibility to counter the saturation effect that causes consumers to resist buying new content in later lifecycle stages. A new game may offer a new story, but consumers probably buy games for new visual effects too, and radical changes and improvements generally are possible only with a new system generation.

The appeal of online multiplayer features is good news for content managers, in that it is more difficult to pirate a game that appears on the company-provided multiplayer network, on which only consumers who can prove they bought the game legally can play. However, it is also bad news, in that multiplayer features tend to incur more development and testing costs. They also consume more server capacity for a long period after the game's release, and those costs cannot always be passed directly to consumers (e.g., a consumer who buys StarCraft II can play this non-ad-financed game online with millions of others for an unlimited time without paying any additional fees). Content mangers can use my model to reduce the uncertainty surrounding sales predictions for products after their release.

5.3. Directions for further research

Consumer researchers should address how the consumption experience of online multiplayer games differs for play with in-person friends versus game partners whom the player has never met. Additional studies could develop industry-specific or general strategies for dealing with declining demand at a late stage of a product lifecycle and validate them empirically. Findings derived from other entertainment industries also need to be verified for video games. An important stream of research should address distribution strategies, which remain unexplored for the video game industry, such as consumers' rent versus buy decision. The major console producers allow people to play used games, and rental games, similar to movies, offer an attractive option for consumers. However, whereas a movie lasts around 2 hours, a game can be played for literally hundreds of hours. Therefore, it would be interesting to learn more about rental and buying decisions and how they differ from those in other entertainment industries (Knox & Eliashberg, 2009).

A related question is whether video game consoles should seek to close the physical distribution market and rely completely on digital distribution (e.g., integrated virtual stores, such as the PlayStation Network or Xbox Live), which could address illegal file sharing (Hennig-Thurau, Henning, & Sattler, 2007) and the possibility of reselling games with digital rights management (Sinha, Machado, & Sellman, 2010). Another distribution issue relates to strategic release scheduling; unlike movies, games are overproportionally released between October and December. A competitive scheduling analysis for games in different console lifecycle stages could be interesting (see Eliashberg et al., 2009).

Console manufacturers might wonder about the potential benefits of compensating game publishers for introducing online multiplayer games late in the lifecycle of their consoles. Because of the high installed base at this point, these games should sell well, and the console manufacturer could earn a contractually determined percentage of the game sales, as well as additional demand for its mature generation consoles. However, limited consumption budgets may mean that increased current generation sales will reduce sales of consoles of the next generation. This potential effect raises profitability questions. Console manufacturers often lower the prices of consoles at the end of their lifecycles, so they might generate higher returns if consumers buy new

Table 4
Robust regression results.

Group	Variable	*B*	SE	*t*	*p*
Intercept	*constant*	3.762[a]	.727	5.18	.000
Platform range	*release_on_X360*	.180[a]	.061	2.98	.003
	release_on_PS3	.312[a]	.060	5.21	.000
	release_on_Wii	.536[a]	.067	8.01	.000
Product characteristics	*genre_action*	.146	.112	1.31	.191
	genre_adventure	.182	.133	1.37	.171
	genre_platform	.115	.148	.78	.436
	genre_puzzle	−.072	.186	−.39	.700
	genre_racer	−.073	.135	−.55	.586
	genre_rpg	.178	.126	1.42	.157
	genre_shooter	.323[a]	.115	2.82	.005
	genre_simulation	.144	.132	1.09	.275
	genre_sports	.286[a]	.125	2.29	.022
	genre_strategy	−.090	.136	−.66	.510
	genre_other	.450[a]	.123	3.64	.000
	age_rating	.022	.030	.73	.466
Pricing	*ln_price_game*	.658[a]	.139	4.74	.000
Brand/publisher power	*ln_number_of_prequels*	.069[a]	.025	2.79	.005
	major_publisher	.354[a]	.048	7.37	.000
Promotion	*ln_advertising*	.117[a]	.008	15.35	.000
	ln_competition_advertising	.084[a]	.025	3.37	.001
Product evaluations	*consumers_evaluation*	.138[a]	.022	6.28	.000
	experts_evaluation	.013[a]	.002	6.99	.000
Indirect network effects	*ln_console_sales*	.158[a]	.038	4.21	.000
	system_generation_age	−.004[a]	.001	−3.18	.001
Direct network effects	*online_multiplayer*	.063	.061	1.04	.296
	online_multiplayer × *system_generation_age*	.007[a]	.002	3.07	.002

Notes: The dependent variable is *ln_game_sales*, *B* = unstandardized coefficient, SE = standard error.
[a] Significant at $p < .05$.

consoles instead of old ones. We need empirical evidence to specify these complex potential effects. Additional studies also could investigate consumers' decision paths. Do they care more about the software and buy some hardware, providing it offers them the option to use the software, or do they first decide what hardware they want, then look for compatible software?

According to conventional wisdom, product lifecycles are becoming shorter (cf. Bayus, 1998). In the seventh generation of video games (2005–2014), product lifecycles actually were longer than in previous generations (e.g., sixth generation, 1999–2005), which is an effective strategy for delaying cannibalization effects and making "leap frogging" (i.e., skipping a system generation) less attractive. In turn, it becomes easier to extend the installed base, such that a console grows more attractive for consumers who can enjoy the online multiplayer games, as I have shown. A strategy that extends lifecycles is advisable only if all competitors do the same though.

This study offers some evidence that the consumption of entertainment products is becoming an increasingly networked, social activity in the digital age. I expect direct network effects to grow even more important in the future. In online multiplayer video games, millions of players already meet friends and companions from all over the world while playing, offering them a joint experience for several hours each day. This phenomenon is not limited to games but encompasses music, novels, and television, as

Table 5
Spotlight analyses for ln_game_sales.

Slope of	at	Beta	*t*	*p*
online_multiplayer	high system_generation_age	1.513[a]	5.198	<.001
	low system_generation_age	1.130[a]	8.568	<.001
system_generation_age	yes online_multiplayer	.009[a]	2.328	.020
	no online_multiplayer	.001	.154	.878

[a] Significant at $p < .05$.

well as non-entertainment products in business markets, such as tools and machines that help customers exchange product knowledge or solve problems on online platforms. Further studies should explore this general potential change in consumption and usage behaviors, as a trend from mostly individual to socially connected consumption and usage styles, with enhanced customer value achieved from the installed base of users and direct network effects, especially in later stages of a product's lifecycle.

The main finding about direct network effects might generalize to other industries that deal with product generations and feature interdependent products. Digitalization enables customers to connect globally and opens new possibilities for using direct network effects. For example, digitalization in the automobile industry means that companies could help customers interact while they drive, in a closed environment accessible by customers with the same car system (e.g., shared traffic information). Smartphone producers could offer specific interaction benefits for customers of the same product generation (e.g., free worldwide communication), especially when that mature generation has attracted many users. The enhanced use of such direct network effects also could provide an effective protection against brand switching. Customers of espresso machines that use a specific type of capsules might exchange specific receipts or receive exclusive invitations to product club events for example. Such ideas represent only a small selection of potential applications, outside the software industry, of direct network effects.

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Appendix A. Post hoc analyses results

Group	Variable	Robust regression			OLS regression			3SLS regression		
		B	SE	*t*	*B*	SE	*t*	*B*	SE	*z*
Intercept	*constant*	3.269*	.747	4.37	3.269*	.637	5.13	2.701	.856	3.16
Platform range	*release_on_X360*	.126*	.061	2.06	.126	.070	1.80	.098	.077	1.27
	release_on_PS3	.326*	.060	5.42	.326*	.065	5.02	.307*	.066	4.64
	release_on_Wii	.482*	.069	7.01	.482*	.076	6.37	.435*	.086	5.04
Product characteristics	*genre_action*	.086	.121	.71	.086	.129	.67	.090	.128	.70
	genre_adventure	.122	.139	.88	.122	.145	.84	.126	.144	.88
	genre_platform	.084	.155	.55	.084	.173	.49	.085	.171	.49
	genre_puzzle	−.145	.192	−.76	−.145	.184	−.79	−.142	.182	−.78
	genre_racer	−.087	.143	−.61	−.087	.143	−.61	−.084	.142	−.59
	genre_rpg	.132	.138	.96	.132	.153	.87	.139	.152	.92
	genre_shooter	.254*	.124	2.04	.254	.131	1.93	.257*	.130	1.97
	genre_simulation	.098	.137	.71	.098	.153	.64	.108	.151	.72
	genre_sports	.263*	.132	1.99	.263*	.132	1.99	.268*	.131	2.04
	genre_strategy	−.102	.144	−.71	−.102	.206	−.49	−.094	.204	−.46
	genre_other	.421*	.131	3.22	.421*	.135	3.11	.421*	.134	3.14
	age_rating	.008	.031	.26	.008	.031	.26	.009	.031	.29
Pricing	*ln_price_game*	.722*	.144	5.01	.722*	.100	7.20	.717*	.099	7.22
Brand/publisher power	*ln_number_of_prequels*	.066*	.026	2.55	.066*	.028	2.32	.065*	.028	2.30
	major_publisher	.372*	.049	7.54	.372*	.052	7.17	.370*	.051	7.20
Promotion	*ln_advertising*	.108*	.008	13.98	.108*	.008	13.16	.107*	.008	13.25
	ln_competition_advertising	.090*	.027	3.27	.090*	.023	3.89	.080*	.024	3.29
Product evaluations	*consumers_evaluation*	.135*	.022	6.20	.135*	.020	6.82	.135*	.020	6.86
	experts_evaluation	.012*	.002	6.68	.012*	.002	7.96	.012*	.002	8.06
Indirect network effects	*ln_console_sales*	.194*	.040	4.82	.194*	.042	4.67	.249*	.068	3.65
	system_generation_age	−.006*	.001	−4.12	−.006*	.001	−4.12	−.006*	.002	−3.95
Direct network effects	*online_multiplayer*	.077	.063	1.21	.077	.068	1.13	.078	.068	1.15
	online_multiplayer × *system_generation_age*	.008*	.003	3.07	.008*	.003	2.93	.008*	.003	2.98
Further interaction effects	*major_publisher* × *system_generation_age*	−.006*	.003	−2.19	−.006*	.003	−2.14	−.006*	.003	−2.14
	ln_advertising × *system_generation_age*	.001*	.000	3.61	.001*	.000	3.36	.001*	.000	3.45

Notes: The dependent variable is *ln_game_sales*, *B* = unstandardized coefficient, SE = standard error. The R^2 values are .5691 for robust and OLS regressions, and .5686/.5761 for the 3SLS regressions. The second equation for the 3SLS regression contains the three significant binary console variables and a binary Christmas release variable (1 if the game was released between October and December, 0 otherwise; retrieved from vgchartz.com).*Significant at $p < .05$.

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