Technology and demand: an empirical analysis of the video game industry

Student Name: Spartaco Menesatti
Student Number: 428076

Thesis Supervisor: Dr. Christian Handke

Master in Cultural Economics and Entrepreneurship
Erasmus School of History, Culture and Communication
Erasmus University Rotterdam

Technology and demand: an empirical analysis of the video game industry

There is a strong bond between technology and video-games. This relation is reflected in many economic aspects of the industry, from the network effects to the cyclical nature of the market. This paper investigates in which way technological changes affect video games and the demand for these goods. In order to do so, this study takes into account the best-selling software products of the last two generations of console video games. In the first stage of data analysis the effect of different technological variables on the genre of best-selling video games was investigated through a series of logistic regressions. This study looked in particular at online multiplayer capabilities and at the level of graphic simulation. The results showed that shooter and fighting games are the only genres positively correlated with both graphic simulation and online multiplayer. In the second phase of the analysis a demand model was employed in order to identify the drivers of revenues. The results showed that the genres that put online gameplay at their core represent the most successful type of videogames in the current generation. Differently from the last generation, reviews and age of the players are not significant anymore to determine the success of a product.

Keywords: video games, technological innovation, demand, online playing,

Special thanks to Dr. Handke, Martin, Margo
and my Family

Table of Contents

List of figures and Tables:

BUY SOMETHIN' WILL YA!

- Shopkeeper, *Legend of Zelda*

1. INTRODUCTION

In 2016, video-games still struggle to earn a place in the spotlight in the field of cultural economics. Despite being celebrated and exhibited by institutions such as the MoMA (Antonelli, 2013) and the Smithsonian (Eby, 2011), many scholars seem reluctant about the inclusion of such a lowbrow medium in a more broad "cultural" category. This is counterproductive and wrong for two reasons. First of all, as a typical example of interactive design, video-games are evolving at a quicker pace than almost any other good. As highlighted by Elon Musk at the Code Conference 2016, forty years ago we had *Pong*, which consisted in just two rectangles and a floating circle. Now we have photorealistic 3D simulations with millions of people connected from all around the globe, playing and competing simultaneously. This puts us in the advantageus position of witnessing a constant revolution of the field. The second reason why video-games deserve more academic interest is that it has been several years since this sector started to put up sales figures comparable to those for the cinema and music industry. Competition in the market is stronger than ever, with different platforms, distribution channels and new type of business models.

This research wants to investigate these two aspects that make the video-game industry unique in the field of cultural economics: fast technological evolution in a highly performing sector. In particular, this paper wants to address two different issues. First of all, how does technological change affect different genres of video-games. In this first phase, the focus will be on the good itself and on how technology determine the shape of final products. The second question is how does technological change influences the demand for this good. At this stage the focus will shift from the product to the consumers, in particular on their reaction to a more modern technological environment. In order to find an answer to these questions, the analysis covers a vast time period and different kinds of hard-wares, focusing on the best-selling console games from the last ten years. A quantitative method, consisting of different analysis and regressions, was employed to perform this task.

The research is divided into six comprehensive sections. Section two introduces the theoretical framework of the video-game industry, highlighting what makes video-games unique goods and how this affects the competitive environment. Section three presents the history of the video-game industry, giving prominence to technological and competitive changes and showing the crucial events for the evolution of digital games. In the fourth section will be presented other quantitative analysis on the video-game market. The fifth section will introduce the models and the logic used for this research, focusing on the methodology and its relevance. The sixth section will present the data, proving their validity and introducing descriptive statistics and general trends of the market. The seventh section is the core of the paper, in which the data are analyzed in order to give an answer to the research questions. Finally, the last section offers a critical discussion and introduces possible future researches.

2. DEFINING CHARACTERISTICS OF VIDEOGAMES AND THEIR INDUSTRY

Video-game systems follow the classical Software / Hardware paradigm, showing the scheme of complementarity common in many technological devices. A video-game system is composed of a console (hardware) and of games that can be played on it (software). At the current state of the art, software designed for a particular console do not work on a different hardware. This leads to a reduced number of competing incompatible video-game systems. However, not necessarily all video-games are exclusive to one certain hardware: the same game might be produced in different versions and be suitable for different consoles (Corts & Lederman, 2009). Video-games systems belong hence to the category of forming systems, composed of two complementary products that do not need to be consumed in fixed proportions.

Users of different systems origin different networks. In the case of video-games, every additional user of a certain network affect positively the value of the network itself, generating network effects. Two different kinds of network effects can be found in the video-game industry. First, indirect network effect happen when for every hardware sold the benefit of the consumer arise from an increase in complementary products (software) developed (Shankar & Bayus, 2003). Second, direct network effects appear when users benefit of a larger network because of the wider participation to online games (Clements, 2004).

Two main concepts are related to network effects: switching cost and installed base. Switching costs are those that the consumer face when moving from a system to another. The installed base is the number of user of a certain product (Shapiro & Varian, 1999). Network externalities' major role is reflected also in the standard-based nature of the industry. A standard-based system is established with the common adoption of a certain technological level by a variety of developers and users (Park & Gallagher, 2002). Standards are created to facilitate the development of markets that need to connect products together into a network (Kindleburger, 1983). Often standard-based industries competition is different from the one in traditional markets. In the case of video-game industry, competition in a standard-based industry led to an oligopoly, at least on the hardware market, with a limited number of consoles competing for the leadership of the market (Williams, 2002). Even more important for the purposes of this research, the battle over standards empowered the role of technology. Technology is in fact the key in order to develop a standard, and technological advancement is what makes standards mutable, evolving through time and competitive in the market.

Video-games evolution can be seen through the progress of two factors. First, video-games console history presents milestones called generations. Generations are marked by the evolution of

standards through the introduction of new state of the art consoles. New consoles present an increase of computing power, cause a switching cost to the consumer and the reset of the previous installed bases. Often with new generations the competitive environment changes, with players exiting the market and new competitors entering it. Because of this particular situation, video-games are considered a cyclical business (Marchand & Hennig-Thurau, 2013).

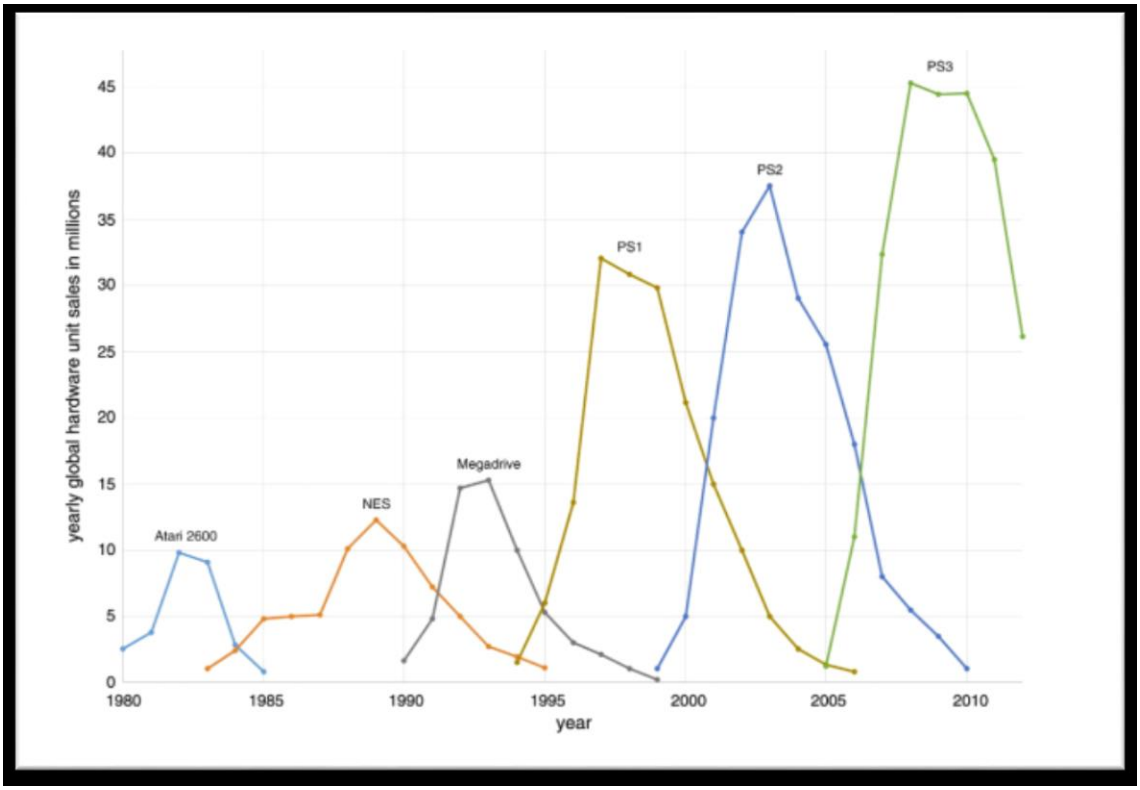

***Figure 1**: Hardware sales for different generations over time. Is evident the cyclical nature of the market (Marchand & Hennig-Thurau, 2013).*

Although every generation has different characteristics and life span, some major themes are consistent:

- Since the second generation, profit margins on software are higher than those on hardware (Park & Gallagher, 2002);
- All hardware firms developed also part of their video-games (Aoyama & Izuishi, 2003)
- Being video-games typical Christmas gifts, sales and introduction of new products are significantly higher in November and December (Park & Gallagher, 2002);
- Since the third generation, many Japanese games and consoles are first introduced in Japan and only later in the US and European market (Park & Gallagher, 2002). Still, not necessarily success in Japan influences the result in the West (Herman, 1994).

The second way to identify technological progress in the video-game industry is by looking at the switching of dominant design. In the video-game environment, the dominant design is "the product architecture that first embodies all the primary characteristics of later products" (Park & Gallagher,

2002 p.68). The dominant design switch is not only related to processing power or graphic performances, but to more radical innovations. An example is the software support evolution from cartridges to CD. Such an innovation led in fact to a massive improvement in video-games quality due to the bigger storage available.

3. A BRIEF HISTORY OF THE VIDEO-GAME MARKET

The first video-game ever to be developed was never intended to be on sale. Steve Russell, researcher at MIT and massive science fiction aficionado, created *Spacewar* in 1961, profiting of the advanced tools at his disposal. *Spacewar!*, the simulation of a battle between two spaceships in which the player had to shoot beams to the opponent, generated a huge buzz in the academic world. Nolan Bushnell, a talented businessman considered "the first of that generation of much-hyped super-successful high-tech entrepreneurs" (Sheff and Eddy, 1999, pp. 133–134), encountered *Spacewar!* At the University of Utah's computer laboratory (Aoyama & Izushi, 2003). Decided to commercialize computer games, in 1971 Bushnell moved to California and developed a simplified arcade version of *Spacewar!*(Aoyama & Izushi, 2003). However, the breakthrough for his company happened the next year: after having founded Atari, Bushnell developed an electronic version of tennis called *Pong*, the cornerstone of the first generation of videogames. The huge success of *Pong* was a surprise even for Atari. The company had problems to fulfill the demand and only a minor share of the whole *Pong*-type video-games available in the market in the years between 1972 and 1976 were produced by Atari (Cohen, 1984). While in this phase Atari focused only on coin-operated machines, many other companies introduced *Pong* style video-games for home systems, with Magnavox as the first comer in the business (Herman, 1994).

These game systems were hardwired into the console and allowed the user only to play one game. Consumers wanted more variety, and in 1976 Fairchild Instrument and Camera introduced the Channel F game system (Gallagher and Park, 2002). This system used replaceable cartridges and offered for the first time a variety of video-games, such as *Tic Tac Toe, Shooting Gallery, Blackjack* and *Space War* (Kent, 2010). Atari followed this new dominant design by introducing its own console, the *VCS.*

In 1978 Atari headed back to arcade games. In particular, Atari distributed the coin-operative hit *Space Invaders*, bought from Japanese development house Taito (Aoyama & Izuishi, 2003). This game, in which the player controls a moving cannon and has to shoot down every alien spaceships, was an instant classic and one of the most influential games ever (Herman, 1994). In 1979 Atari bought the license to produce a home version of *Space Invaders* and developed another cosmic shooting cult classic, *Asteroids.* These two games led to a massive explosion of sales for the *VCS.*

Table 1 *Examples of technological evolution in the first ten years of U.S. home video game industry (Gallagher & Park, 2002).*

Generation	*Rival Platforms*	*Introduction date*	*Technology*		
			CPU	*Bit*	*ROM*
1st	Channel F (Fairchild)	Aug. 1976	2MHz	8	
	VCS (Atari)	Oct. 1977	1.19MHz	8	4K
	Odyssey (Magnavox)	Jan. 1977		8	2K
2nd	Intellivision (Mattel)	1980	0.5 MHz	16	16K
	Colecovision (Coleco)	Sep. 1982	3.58 MHz	8	16k
	Atari 5200 (Atari)	1982	1.79 MHz	8	
3rd	NES (Nintendo)	Oct. 1985	1.79 MHz	8	32K
	Master System (SEGA)	Jun. 1986	3.6 MHz	8	64K
	Atari 7800 (Atari)	Jun. 1986	1.79 MHz	8	52K

Atari model was dominating the market because of the perfect fit of its model in the industry: by producing both arcade and home video-games, the American company was able to benefit of economies of scope and to anticipate the rivals (Herman, 1994).

Atari dominance leadership to cease when, due to the constant increase of the number of software, the core of competition switched from hardwares to games. In 1980, four former Atari programmers started Activision, a development house that focused solely on cartridges. The success of Activision, with more than 50 million of dollars generated in the first year, was led mostly by sports game such as *Ice Hockey*, *Skiing* and *Freeway* (Gallagher and Park, 2002).

The second generation of video-games was marked by the introduction in the US of the Coleco's *Colecovision.* Coleco had two big intuitons. First, it made *VCS* games compatible with the *Colecovision,* maximising automatically the portfolio of games of the console. Second, Coleco got the license for *Donkey Kong* from a Japanese toy company, Nintendo (Cohen, 1984). *Donkey Kong,* a platform game were the player had to avoid the barrels thrown at him by a gorilla, introduced two of the most popular characters of the video-game universe: *Donkey Kong* and *Mario.* Needless to say, the success of the game was huge. Nintendo had already release its first console in Japan and some software in the US, but *Donkey Kong* was its real breakthrough to the western market (Sheff & Eddy, 1997).

Thanks to the experience gained with its first home console (the *Color TV Game 6)* and its extraordinary R&D team, constituted by former Sharp and Mitsubishi engineers, Nintendo dominated the third generation of video-games (Aoyama & Izushi, 2003). Its new console, the *Nintendo*

Entertainment System (NES), was a huge success in Japan before and in the US later. The *NES* presented way superior graphics from any Atari and Coleco console: both the CPU (central processor unit) and the GPU (graphics processor unit) were considered to be twice as powerful as the *VCS 5200*, the most advanced console available on the release date of the *NES* (Gallagher & Park, 2002). Thanks to the improvement of graphics, *NES* video-games introduced different gameplays, such as role playing games (RPG) and more complex action games such as *Castlevania*. Moreover, Nintendo established a monopoly for its software, making *NES* cartridges not compatible with any other console system (Gallagher & Park, 2002). Finally, Nintendo introduced a "Seal of Quality" for its own games, the first example of standard term to identify software developed by a major publisher (Kent, 2001).

The fourth generation saw another massive improvement in term of technology: the two main competitors, the *Sega Genesis* in 1989 and Nintendo *SNES* in 1991, went from 8bit graphics to 16bit. The biggest innovation was however brought by the *Genesis*: the introduction of video-games on CD, a format that was able to contain a bigger amount of data than cartridges. Despite consoles at the time were not ready to take full advantage of this format, CDs would represent in the future the new dominant design. Colors, sounds and gameplay were revolutionary. With such innovations, RPGs, action games and fighting games kept on getting bigger shares of the market (Kent, 2010). The fourth generation was also marked by the success of handheld consoles, in particular Nintendo's *Game Boy* and its puzzle game *Tetris*. Handheld consoles presented a lower computing power (the *Game Boy* system was 8 bit graphics) but earned an important share of the market, that resists up to the present day. With handheld consoles, developers established a parallel console competition.

With the fifth generation the dominant design changed again. In 1995, Sony introduced its first console. The *PlayStation* used not only CDs, but also memory cards that permitted to the user to store personalized file, in particular the in-game progresses. This tool allowed a further shift in the state of the art: saving the progresses of the player allowed games to fully benefit of the potential of the CD, by making the player dive into more complex stories and different gameplay. For the first time, action games constituted the majority of the offer for home consoles (Warner, 1996). Moreover, in this generation developer started to refer to major games as "AAA Games", not as an acronym but as a reference to the academic grading in the United States (Demaria & Wilson, 2003).

In the sixth generation, Microsoft entered the market with the *Xbox*, bringing its technological experience to the field. Xbox introduced the Xbox live network, the first highly successful platform for online playing. On the other hand, Sony's *PlayStation 2* presented two interesting characteristics. First, for the first time a console was backward compatible (games for *PlayStation* could run on *PlayStation 2).* Second, *PS2* could also function as a DVD player (Gallagher & Park, 2002).

In the seventh generation Sony and Microsoft dominant position in the market was opposed to the success of Nintendo's *Wii*, that for the first time for a home console did not put graphic

performances at its core. *Wii* in fact, despite a bit-rate similar to sixth generation consoles, integrated the controller with the movements of the player. Online multiplayer functions increase further their popularity, with Sony following Microsoft and developing the online platform PlayStation Network. As regards the handheld market, Nintendo *de facto* monopoly is interrupted by the introduction of Sony's *PlayStation Portable* (*PSP*).

Finally, we arrive at today. The eight generation presents a competitive environment similar to the sixth, with Nintendo *Wii U* being incapable of replicating the exploit of the predecessor. The real change in the video-game console market is in the substitutes, with digital distribution of computer games and smartphones getting a growing share of the market.

4. OVERVIEW OF EMPIRICAL RESEARCHES

In general, compared to music and cinema, there is a lack of economic studies regarding video-games. The most investigated aspect of the market are network effects. Clements and Ohashi (2005) used sales data for eight consoles and all the related software from 1994 to 2002, finding that the number of available games influence positively the demand for console. Gretz (2010) confirmed this result for the next generation of videogames, finding that also the power of the hardware (measured mixing CPU speed rate and memory) influence the number of software. Binken and Stremersch (2009) results suggested that only superstar games had a significant effect on console sales. Venkatraman and Lee (2004), using data on 2815 games released between 1995 and 2002, showed the effect of a platform dominance of the market on its development decisions. Stremersch et al. (2007) found similar implications with the study of *Game Boy* software between 1989 and 1991. Landsman and Stremersch (2011), studying the sales of video-games from 12 consoles, found that not exclusive games affect negatively console sales. Gil and Warzynski (2015) estimated cross-sectional differences between integrated and not integrated games using three performance measures: revenue, quantity and price. The results of their study showed a negative correlation between exclusive games and revenues. Sacranie (2010) expected exclusivity to have a negative effect on sales, but the result hold no significance. Corts and Lederman (2009) aimed at the analysis of network effect related to exclusive games but found out that predictions on sales were not possible with their model.

Pricing strategies for consoles have been widely investigated, with a general agreement about recognizing penetration pricing as the best option (Clements & Ohashi, 2005). Liu (2005) developed an estimated demand model, in which Nintendo would have dominated the fifth generation of console if it had followed a penetration pricing strategy instead of a skimming one.

The papers mentioned above inspired this research because of their results. The studies presented in the following section were instead considered for their methodology. In order to explain

the demand for video-games and how it is affected by technology and genre, this research will take into account a number of different independent variables, each standing for factors composing a simple demand model. This kind of research is typical of the cinema field, where Litman (1983) introduced for the first time a model designed to forecast movies revenues with the analysis of their characteristics. In his research, Litman considered genre, release date, Motion Picture Association of America rating (G, PG, R and X), presence in the cast of a superstar, nominations and winnings at the Academy Awards and release company (major or independent). Litman and Khol (1989) and Litman and Ahn (1998) replicated and extended the same empirical model. Wallace, Seigerman and Holbrook (1993), studying a sample of 1687 movies, expanded the model by focusing on the effect of reviews. Sacranie (2010) import this approach to the video-game market, trying to predict the number of sales of video-games with the decomposition of their particular attributes. Working with a sample of 100 random console games, Sacranie considered as independent variable: review, console, genre, exclusivity, sequel. Despite some interesting results, little is still known about what drives the demand for video-games, especially if compared with other fields of entertainment such as movies (e.g. Hadida 2009) and television (e.g., Hennig-Thurau, Fuchs and Houston 2013).

5. EMPIRICAL MODEL

This quantitative research wants to address how the genre and the demand for console video-games changes with the advancement of technology. In order to do so, it takes into account the best-selling console games in the period between the 22nd November 2005 (release of the Microsoft's *Xbox 360* and beginning of the seventh generation of home consoles) and the 27th February 2016. The focus will be only on physical distribution. The dataset consists of weekly observations of the ten best-selling video-games. The time period taken into account covers the seventh generation and part of the eighth. The observations regarding the best-selling games are on a global level, with China excluded. The global dimension of the investigation makes data highly meaningful and representing of a wide population of users. On the other hand, one of the main limitation of this paper is that it was not possible to identify demographics and economic indicators related to a specific territory.

Computer games were excluded from the analysis for a series of reasons. First of all, differently from consoles, computer games market is not cyclical. In other words, hardwares do not have a fixed computing power and a release date. Second, computer games are heavily influenced by digital distribution. Third, computer games are more prone to piracy and unfortunately data about piracy in the gaming industry are very hard to find (Sacranie, 2010). Obviously, the exclusion of computer games influences the results of the paper. Looking at genre, computer games demand is different from the one for console video-games. In 2014, action games were the best-selling genre in

the console market (28,2%) but struggled in the computer industry (2,5%). In the same year, strategy games represented 37,7% of the total computer sales games and only 4,1% for console games (ESA, 2015). This data, besides showing the effect of a different technological support on the type of software, suggest that the results for this research won't be accurate in the prevision of trends for typically computer-related genres (in particular, strategy and graphic adventure).

The data analysis of this paper is divided in two parts. The first one investigates the effect of technology on the type of best-selling video-games. A series of logistic regressions were run, one for each genre. A logistic regression is a multiple regression in which the outcome is a categorical variable (Field, 2009). These regressions presented two independent variables. The first predicting variable is continuous and represents the technological level of the console. The second variable is a categorical covariate indicating the presence in the game of online multiplayer functions. Each logistic regression predict the likeliness for a game of belonging to a certain genre, according to the computing power of its console and its online functions. The results of this phase will identify which kinds of game are more likely to be correlated with more advanced technology and gameplay.

The second part of the analysis investigated the demand for video-games more in depth, looking at how it changed with the shift of generation. This part consists in two multi stage regressions, one for each generation. The regressions were run with the hierarchical method, using video-games revenues as dependent variable. This method was inspired by Sacranie (2010) and by literature from the cinema field (Litman, 1989). The results of the first stage of data analysis will be used in order to make hypothesis about the generational change of the demand for different genres. In order to assess which type of predictors have more explanatory power, the independent variables were grouped in four different blocks:

- Genre;
- Video-game attributes;
- Console related technological factors;
- Network effect.

As reported earlier, two different multiple regressions were run. The first one included all the video-games of seventh generation console, while the second took into account those from the eight. Seventh generation consoles are Nintendo DS and PlayStation Portable (hand-held), PlayStation 3, Nintendo Wii and Xbox 360 (home consoles). Eighth generation consoles are Nintendo 3DS and PlayStation Vita (hand-held), Nintendo WiiU, PlayStation 4 and XboxOne (home consoles). The results of the logistic regressions were used in order to make hypothesis about the outcomes of the demand model. Demand for genres with a positive correlation with technological advancement is expected to higher for the eight generation rather than the seventh. Vice versa, demand for genres with a negative correlation with computing power is expected to decrease with the shift of generation.

Other factors will be tested other than the genre. The generation shift is in fact useful not only for controlling for technological advancement, but also to see how time changed the demand. The literature suggests in fact that the role in the market and the effect of some predictors is changing due to economic trends of the industry (e.g. exclusivity).

In the following sections will be described all the data used for the two analysis stages. The presentation of data follows the scheme of the multiple regressions, introducing its dependent variable first and the independent variables later. Genre, technological level and online functions are used also in the logistic regressions. The final variable presented (*days passed from console release to game release)* is taken into account only in the logistic regressions.

6. DATA

6.1. Dependent Variable

The dependent variable is a quantitative, continuous and unbounded variable representing revenues of the top ten weekly best-selling console games, derived from weekly sales and prices.

6.1.1. Weekly Sales

The first variable is a continuous measure representing the units of video-games sold. Almost every other empirical study about demand for video-games use one of the following two sources. The NPD group has monthly observation and covers online distribution. Unfortunately its report are too expensive and not available for students. The best alternative available, which is the one used for this paper, is VGchartz. Vgchartz's data have been used both for empirical studies (Ehrenfeld, 2011) and for advertisement (Microsoft used its numbers for the launch of *Halo 4)* (Microsoft, 2013). This user-based website presents weekly observations on a global scale (excluding China), while NPD focuses only on the US market. VGchartz describes its data collection methodology by highlighting five different steps (VGchartz, 2016):

- Surveys between end users to find out what games they are currently purchasing and playing;
- Surveys between retail partners to find out what games and hardware they are selling;
- Using statistical trend fitting and historical data for similar games;
- Studying resell prices to determine consumer demand and inventory levels;
- Consulting with publishers and manufacturers to find out how many units they are introducing into the channels.

As mentioned above, the global dimension of the data set prevents us from controlling for demographics specific to a certain territory. The other geographical issue regards the lack of data about distribution of console games in China, where the ban on these kind of goods was suspended in January 2014 after fourteen years. However, in China and South East Asia console video-games

still do not dominate the industry. In 2013, revenues from Massively Multiplayer Online (MMO), digital online games that do not imply any physical software, were 9.5 billion dollars. To get a yardstick, in the same year the US generated 2 billion dollars of revenues from MMO. Mobile games play a major role in the Chinese video-game market too, with Asia dominating the market in 2014 with revenues for 12.2 billion dollars, more than any other global region (Mikkola, 2014).

Finally, digital distribution deserves a separate discussion. The main fault of the VGchartz's dataset is the lack of informations about digital distribution. Video-game sales are moving towards the digital channel. In the final section of this paper this issue will be discussed again.

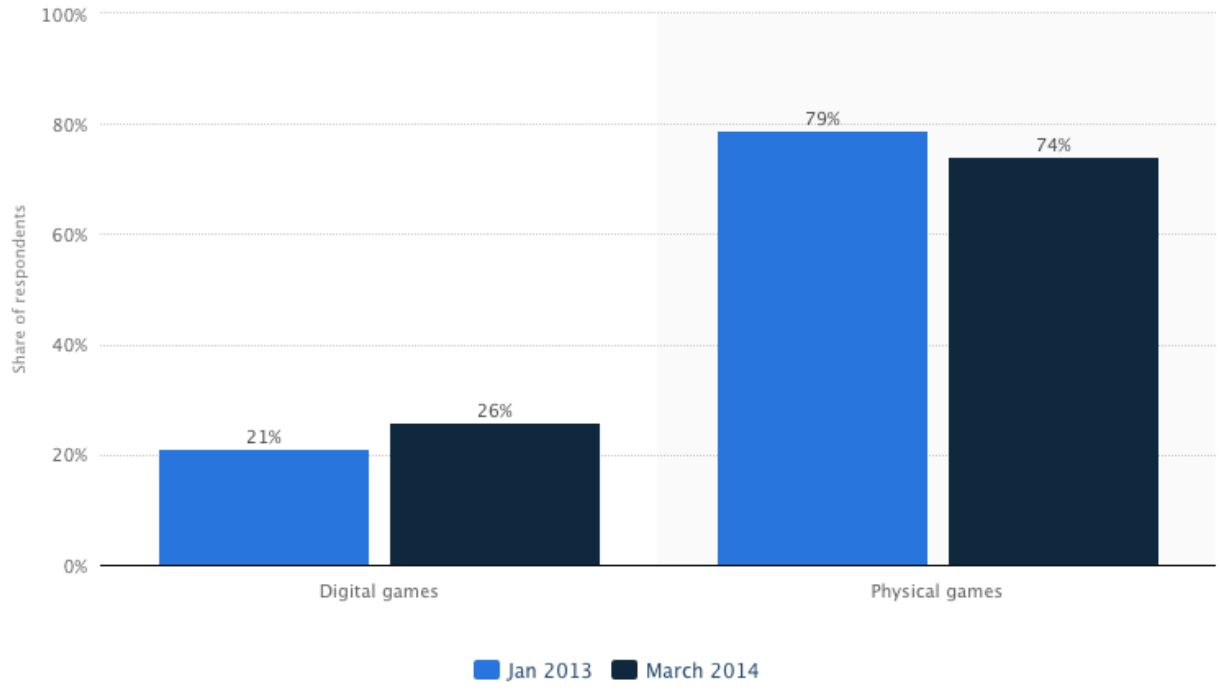

***Figure 2**: U.S. gamers who purchased games on physical or digital carriers in January 2013 and March 2014 (NPD, 2014)*

***Table 2**: Descriptive statistics for Weekly Sales*

Gen	*N Valid*	*N Missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
7th	4220	0	235697,14	131322,5	117095	406343,564	20100	9705853
8th	1140	0	223557,35	99368	71974	352004,228	4888	4057836
Tot	5255	0	232981,63	125125	117095	397118,9	4888	9705853

6.1.2. Price

Price is a continuous variable, which is problematic because of the typical trend of video-game financial value. Like many other durable goods, video-games show in fact an intertemporal price discrimination related to forward-looking customers (Nair, 2007). This means an initial higher price addressed to customers with an higher willingness to pay and a series of subsequent cuts in order to appeal those with a lower WTP. Unfortunately, it was impossible to record every single change of price, due to the individual choices of the retailers. Despite this issue, it is important to keep in mind that prices generally decrease significantly at least after one month from the release. Only a minority of the total of video-games considered in this research survived in the top ten for more than 4 weeks. It was hence decided to use the prices on the release date. The data for most of the games were provided by CamelCamelCamel, a website that tracks prices from amazon. Many other studies used data retrieved from this website (Chen et al., 2016). Camelcamelcamel register every few hours the prices for every product on sale on Amazon and trace them back to the release date price. Some video-games were not available on Amazon because of their exclusivity for the Japanese market. In those cases, the prices were retrieved from playasia.com and if necessary converted from Yen to US Dollars. Prices were hence adjusted to inflation. Due to the global nature of the sample, it was used the OECD global rate.

***Table 3**: Descriptive statistics for Price*

N Valid	*N Missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
5255	0	49,16	51,16	60,35	13,06	20,12	94,12

Prices may vary vastly. In particular, prices for hand held console games are lower than those for home console software. This is mostly due to two reasons. First of all, console video-games are more complex. PlayStation3, PlayStation 4, Xbox 360 and XboxOne games are stored on Blu-ray Discs, a format with a maximum capacity of circa 50GB. Nintendo Wii and WiiU use Nintendo Optical Discs (NOD), with a capacity respectively of 8,54GB and 26 GB. Nintendo DS and 3DS don not use discs but game cards, with a capacity of 512MB for the former and up to 4GB for the latter. PlayStation Portable and PlayStation Vita games are supported by Universal Media Discs (UMD), holding a maximum capacity of 1,8GB. This is roughly reflected in prices, with Blu-Ray games being the most expensive and game cards relatively cheap.

***Table 4**: Descriptive statistics for price of games on different support*

Support	*N Valid*	*N missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
Blu Ray	2507	0	58,63	61,39	60,35	10,02	20,12	94,16
NOD	1206	0	40,73	33,72	32,62	9,89	22,48	72,78
UMD	216	0	44,06	44,24	22,61	11,06	22,48	67,45
Cards	1326	0	39,77	39,34	33,92	7,16	22,48	72,78

The second reason for the lower price for handheld games is their development: certain handheld games in the dataset (e.g. *The legend of Zelda: Ocarina of Time*) were not created *de novo*, but were ported from console of previous generations (e.g. Nintendo 64).

6.1.3. Revenues

Revenues are the dependent variable of the linear regressions. They were obtained by multiplying *weekly sales* by inflation adjusted price.

Rev= Weekly Sales * Price

The sample in use for this research shows a strong seasonal effect, with the peak in the month of November. This time series presents in fact a seasonal component, representing a pattern repeated over fixed period of time. Van Dreunen (2011) asserts that about half of annual sales from digital games come occur in the last two months of the year. In the data set used for this research, the last two months of the year had a smaller impact, 40% of the total circa. Still, monthly fluctuations clearly play a major role.

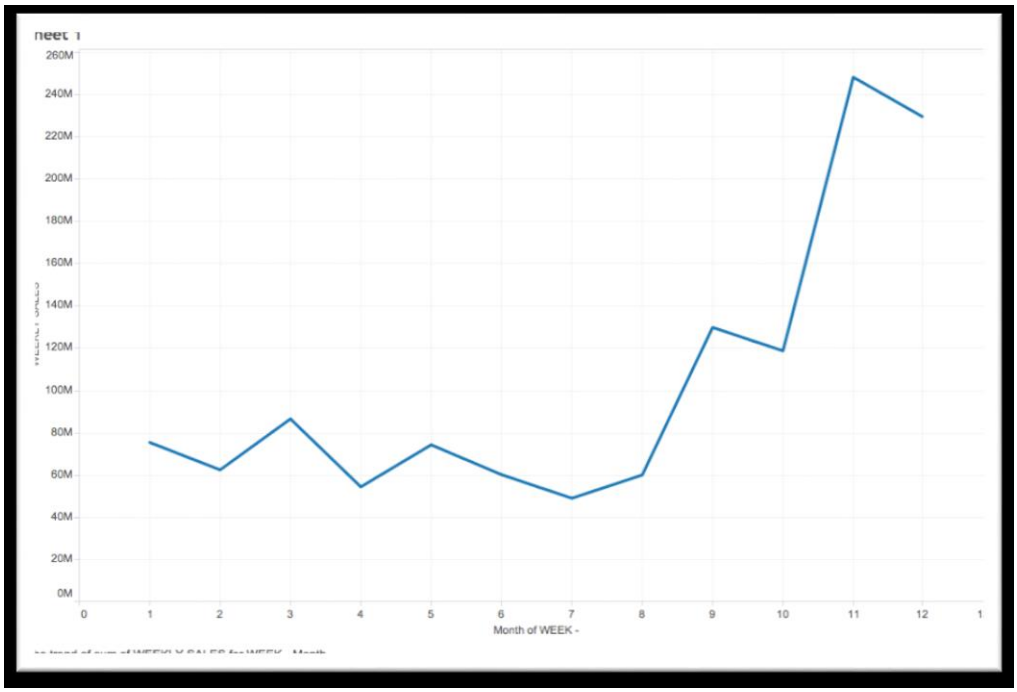

***Figure 3**: Sum of sales grouped month-to-month. Curiously, the peak is in November.*

SPSS allows the user to smooth the data through a cyclical moving average (Yaffee & McGee, 2000). Unfortunately, it was not possible to adjust the data to a weekly moving average, but only to the monthly one.

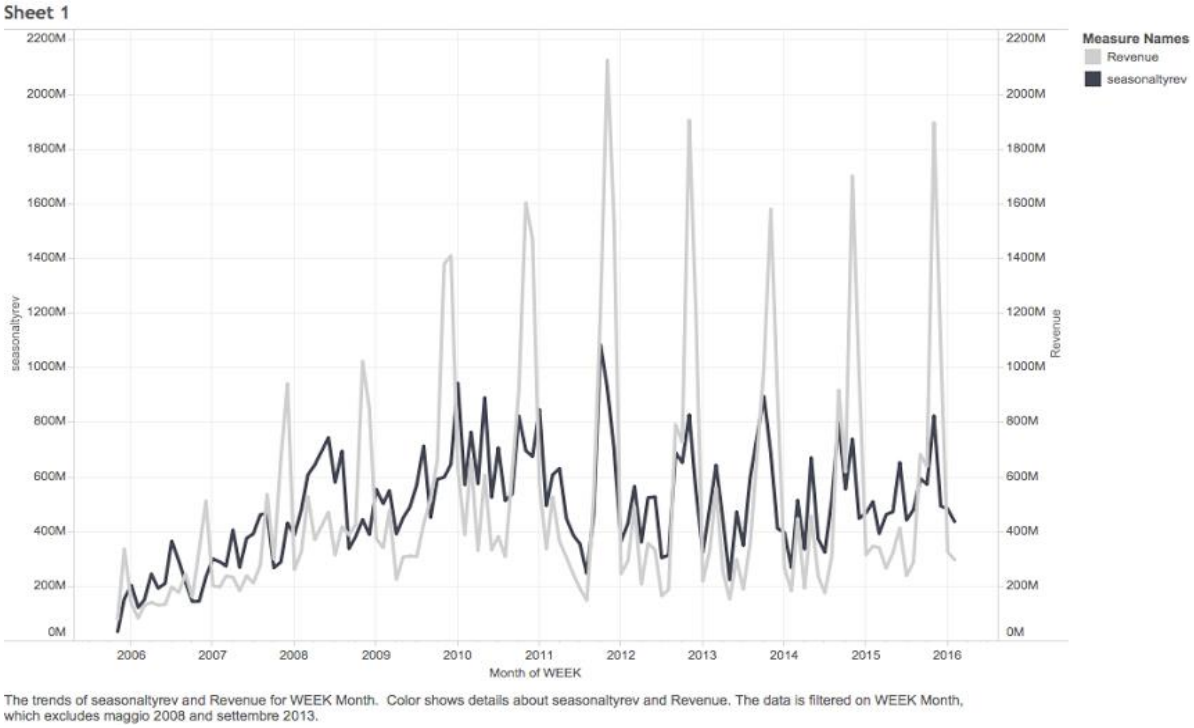

***Figure 4**: Trend of revenues (grey) and seasonally adjusted revenues (black) over time.*

The revenues for first years of the time series are sensibly lower. This is influenced by the

dominance of the market of Nintendo DS and Wii games. As stated above, games for these console were sensibly cheaper than the average. The Nintendo DS was released in 2004 and had a solid installed base by the end of 2005. Nintendo Wii was able to build a wide installed base quicker than its home console competitors, despite an almost synchronized release in the end of 2006. This is due to its penetration pricing strategy: the launch price in the U.S for the Wii was 199,99$ with 2 games included, while PS3 was priced 499.99$ and Xbox 360 399,99$ (neither of those with any game bundled).

***Table 5**: Descriptive statistics for Revenues*

	Not seasonally adjusted		*Seasonally adjusted*	
	7th Generation	*8th Generation*	*7th Generation*	*8th Generation*
N Valid	4115	1140	4115	1140
N Missing	0	0	0	0
Mean	11961100,6	12640938,4	11602881,7	11776647,3
Median	6043693,3	5313840,45	7366514,12	6981767,19
Mode	6581546,5	196654,02	5729705,08	327059,69
Std. Deviation	24903526,2	21235739,4	19110624,8	16589399,5
Min	455546,94	196654,02	655452,8	327059,69
Max	605514889	260648363	527143845	189326874

6.2. Independent Variables

6.2.1. Genre

Genres in video-games are particularly problematic, because "computer games are not just a medium, but many different media" (Aarseth, 2001). The huge dissimilarity between different products make a traditional genre analysis almost useless, or at least questionable. Metacritic, Imdb, AllGameGuide and Mobygames all present a different set of genres. Gamespot genre list includes 157 different categories. In general, there is a significant impreciseness in the concept of genre and in how it is used.

From an historical prospective, video-games genre spread from a mechanism of imitation and evolution. In order to lessen the financial risk, developers replicate the scheme of previous successful video-games, possibly enhancing it with minor innovations. A perfect example is *Doom*, the first game to spread the popularity of the First Person Shooter genre (Arsenault, 2009). Genre categories for digital games are hence liquid and hard to detect.

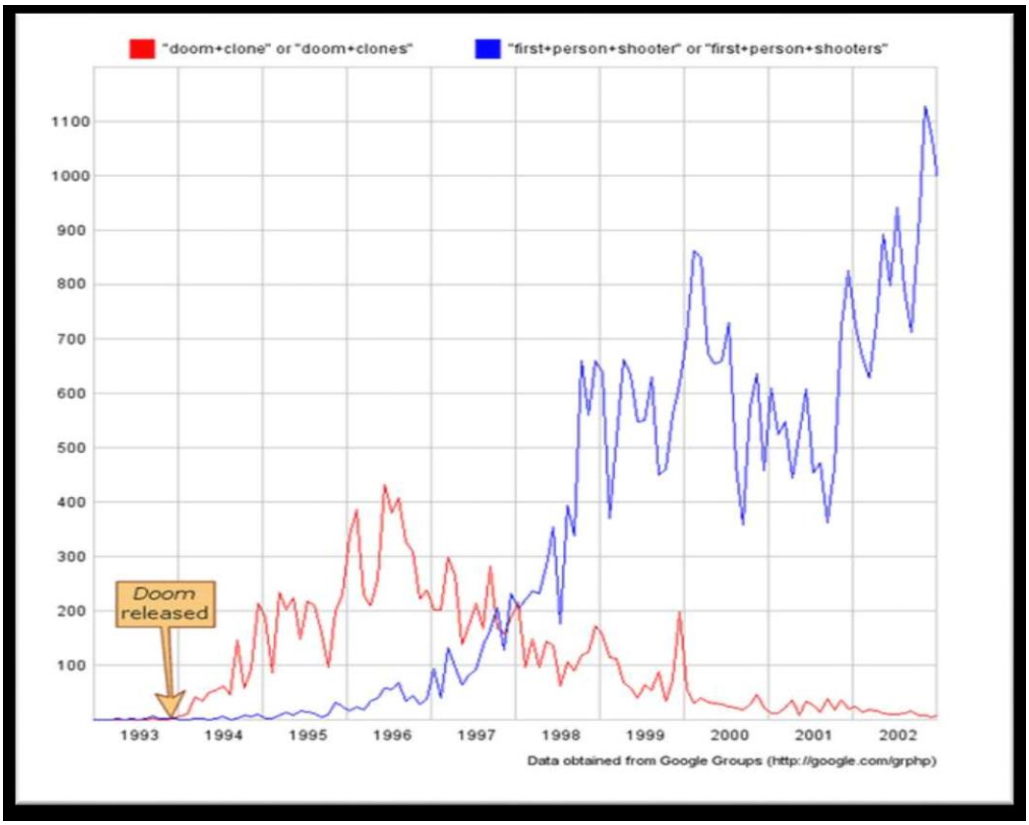

***Figure 5**: Post per month containing the phrase "doom clone" vs "first person shooter" (Arsenault, 2009)*

In order to establish the genres for this research, the Apperley (2006) approach was followed: not to put the focus on aesthetic qualities, but on the interactivity of the gameplay. These categories were retrieved from VGchartz.

The genres categorized in this research, reported in the regressions as dummy variables, are:

– Shooting: the main goal of these kind of games is to shoot opponents. The two main categories are FPS (First Person Shooter, the camera angle simulates the character's point of view) and TPS (Third Person Shooter, the camera follows the character).

– Fighting: the player controls a character who is fighting in a close combat with an opponent. The players are usually placed in an arena, or anyway in a close environment. Players have to block the opponent's attacks and master different kinds of techniques and *combos*.

– Action: all the games that are focused on physical challenges and battles, except for the *shooting* and *fighting* games. The action category is the vastest in term of different gameplays, including subgenres such as *hack-and-slash* and *beat 'em ups.*

– Strategy: the gameplay focuses on adroit thinking and tactical intelligence. Planning and forecasting possible situations is the key for victory (Rolling & Adams, 2003). The gameplay can be *turn based* or *real time.*

– Role Playing Games (RPG): derived from *Dungeons and Dragons* and other similar pen and paper role playing games (Rollings & Adams, 2003), they use the same vocabulary *(class, mana, quest...),* settings (usually fantasy, occasionally sci-fi or generic adventure) and gameplay. The player can make choices that influence the continuing of the adventure. Because of that, storytelling always plays an important role.

– Sports: digital games that simulate sports. The focus can be on the practice of the sports themselves (*Fifa, Madden NFL...)* or on the strategic side of sports management (*Football Manager*). Racing games and driving simulators are included in this category.

– Life Simulation: video-games that simulate everyday life. They can revolve around relationships between individuals or concern the direction of an ecosystem (Adams, 2013).

– Rhythm: digital games that concern mainly the movements of the player and the sense of rhythm. In the rhythm games, the player has to follow the beat in the background through particular buttons combinations (*The Idolm@ster)*, dance (*Just Dance)* or musical instruments simulations (*Guitar Hero III)*.

– Platform: the player has to jump on suspended platforms, step around obstacles and occasionally solve riddles and puzzles in order to approach the following level.

– Minigames: compilations of different kinds of short games, usually smaller and less complex than the average. In this category are consider also the games that involve the physical movement of the player (*Wii Party*, *Wii Sports Resort*).

***Table 6**: Distribution of genre on all the observations*

Genre	*N*	*Percentage*
Shooting	842	16,00%
Fighting	192	3,70%
Action	1035	19,70%
Strategy	56	1,10%
Role Playing Games	528	10,00%
Sports	759	14,40%
Life Simulation	328	6,20%
Rhythm	173	3,30%
Platform	417	7,90%
Minigames	925	17,60%
Tot	5255	100,00%

Out of 5255 valid observations, the number of single games retrieved was 1362. Minigames

represent the biggest share of the market, with 17,60% of all the games in the dataset belonging to this category. However, only 3,30% of the whole titles were minigames. The success of this genre has in fact derived from the presence of a small number of superstars that have been in the top ten chart for long periods, with an average of 20,5 weeks each. On the contrary, action games showed an high volatility, with an average of time spent in the top ten chart of only 2,8 weeks.

Table 7: *Distribution of genre on single games*

Genre	*N*	*Percentage*
Shooting Games	235	17,30%
Fighting	88	6,50%
Action	364	26,70%
Strategy	36	2,60%
Role Playing Games	197	14,50%
Sports	237	17,40%
Life Simulation	33	2,40%
Rhythm	57	4,20%
Platform	70	5,10%
Minigames	45	3,30%
Tot	1362	100,00%

6.2.2. Video-games attributes

The variables described in this block regard characteristics of the games not related to technological advance, but only to the software itself.

6.2.2.1. Review

The first independent variable taken into account, following the work of Sacranie (2010), is the aggregate review score. This variable is quantitative and continuous. Many website make an average of the review scores that a video-game has received on a scale from 1 to 100. In this case, the aggregate scores come from Metacritic. Metacritic aggregates reviews from newspapers, websites and trade publications. The final score is the result of the weighted average of all the reviews, in which more importance is assigned to certain critics or publications. Unlike for the *metascore* of music and movies, the score for video-games is not normalized. The review score is missing in the case in which it was not possible to collect at least four reviews.

***Table 8**: Descriptive statistics for Review.*

Gen	*N Valid*	*N Missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
7th	3778	447	80,44	82	80	9,34	32	97
8th	1030	110	81,61	83	81	8,58	46	97
Tot	4808	557	80,73	82	80	9,212	32	97

It is important to highlight how video-games reviews usually do not take into account only the quality of the video-game, but also its price. In order to assess the relation between price and reviews, the bivariate correlations between price and reviews for different type of consoles were checked. For home console games the Pearson correlation coefficient is ,251 and the correlation is significant at the 0.01 level (2-tailed). This indicates that the more expensive a game is, the higher its review. Game supplier quality assessment is hence correct and reviews might indicate in an accurate way the value for money of games. On the contrary, handheld games weak negative correlation (- ,003) is not significant (see Tab. I in Appendix).

6.2.2.2. Age

In order to assess the target age of the users, it was adopted the PEGI (Pan European Game Information) system. This system does not represent the difficulty of the game or the skills necessary to play it. If anything, it stands for the suitability of the content of the game for a certain age group. The PEGI was considered the best fit because of its good distribution and for the accessibility of information, which are available on multiple websites. Some Japanese video-games do not have a PEGI rating because of their unavailability on the European market. For these video-games, the CERO value (Computer Entertainment Rating Organization) was commuted into the relative PEGI value. Age is a quantitative and continuous variable.

***Table 9**: Conversion system: from CERO to PEGI*

PEGI	3	7	12	16	18
CERO	A	B	C	D	Z

There is a clear trend in the last ten years of observations, with video-games demand shifting towards more adult content.

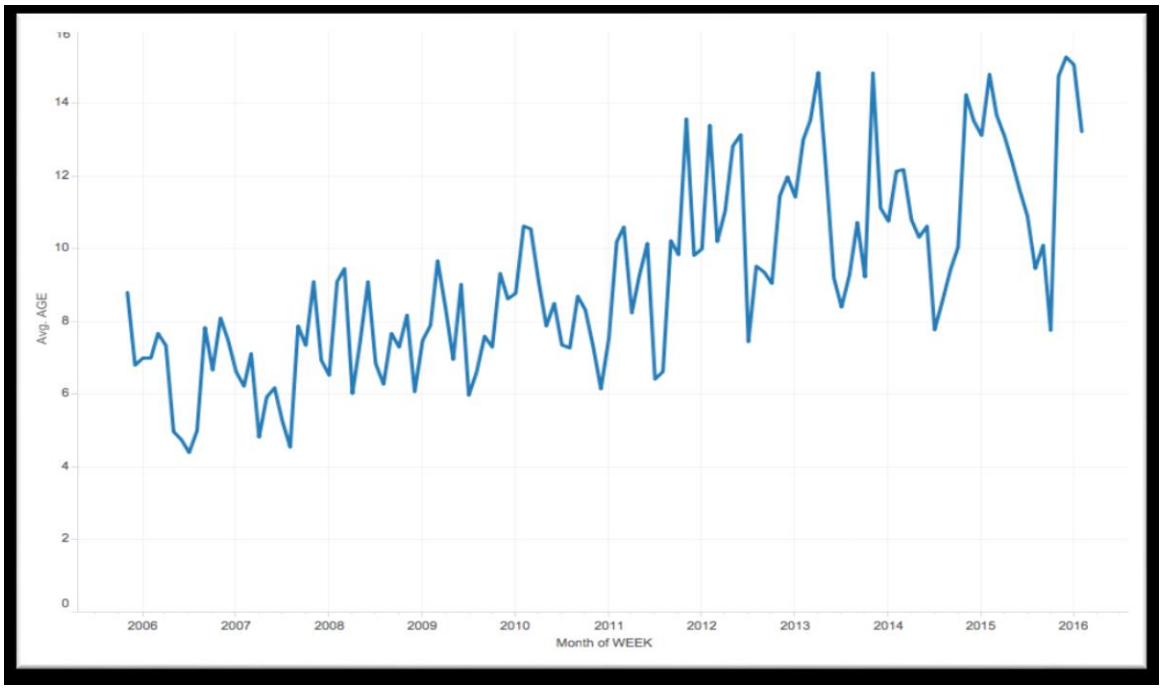

***Figure 6**: Monthly average age content of the dataset.*

***Table 10**: Descriptive statistics for age*

Gen	*N Valid*	*N Missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
7th	4114	1	8,65	3	3	6,55	3	18
8th	1140	0	10,75	12	3	6,31	3	18
Tot	5254	1	9,11	7	3	6,55	3	18

6.2.2.3. Exclusivity

A dummy variable was created in order to identify exclusive video-game. Two different kinds of exclusivity can be detected. The first one regards video-game which are exclusive to a certain console. The second one is instead relative to the exclusivity to a certain console developer. Three major developers were considered:

– Sony: PlayStation 3, PlayStation 4, PlayStation Portable, PlayStation Vita.

– Microsoft: Xbox 360, Xbox One, Microsoft Windows.

– Nintendo: Nintendo DS, Nintendo 3DS, Wii, Wii U.

While every video-game which is exclusive to a certain console is also exclusive to a certain developer, the contrary is not always true. *Super Smash Bros.*, for example, is a Nintendo exclusive (so it is a developer exclusive), but not a console exclusive (it was release for 3DS, Wii and Wii U). Obviously, these two categories often overlap. In order to avoid multicollinearity, in the regression only exclusivity to a developer is used as an independent variable.

In the time span between 1989 and 2009, non-exclusive games rose from 13% to almost 40%

(Corts & Lederman, 2009). The trend for exclusive in best-selling games confirm the literature. Nintendo is the only developer that still rely consistently in exclusive games, both for handheld home consoles.

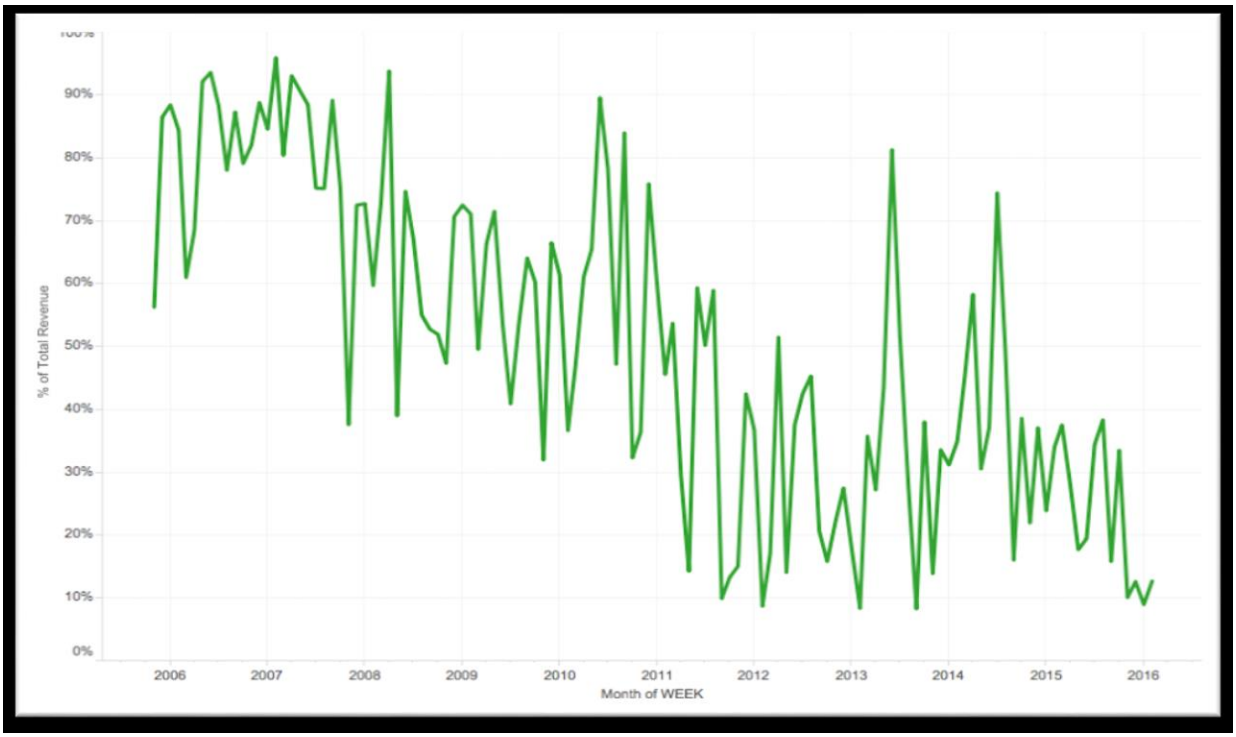

***Figure** 7: Share of the market for Developer Exclusive games in the dataset.*

***Table 11**: Descriptive statistics of single observations for exclusivity*

Tab.11: Descriptive statistics of single observations for exclusivity

		7th Generation		*8th Generation*		*Tot*	
		N	*%*	*N*	*%*	*N*	*%*
Console	*Exclusive*	2225	54,10%	548	48,10%	2773	52,80%
	Not exclusive	1890	45,90%	592	51,90%	2482	47,20%
	Total	4115	100,00%	1140	100,00%	5255	100%
Developer	*Exclusive*	2288	55,60%	585	51,30%	2873	54,70%
	Not exclusive	1827	44,40%	555	48,70%	2382	45,3%
	Total	4115	100,00%	1140	100,00%	5255	100%

6.2.2.4. Sequels

The following dummy variable indicates if the video-game belongs to a pre-existing gaming franchise. In other words, this dummy variable labels sequels. Sequels are identified as games that share narrative and contain elements from another existing game. Often they are grounded on similar gameplay *(The Sims 3*) or on the same characters (*Uncharted 3).* Prequels (e.g. *Yakuza* 0) are included

in this category too. In sports games, often titles are annuals sequels with improved graphics and new teams (*Fifa 2010).*

The literature suggests that, with the constant growing of the industry, the development of sequels is a growing phenomenon (Sacranie, 2010). This trend is respected in this data set, with an higher percentage of sequels in the eight generation than in the previous. The proliferation of follow-ups is mostly due to the increasing costs of game production (Tatatsuki, 2007). Publishers are getting less and less risk taking and companies want to stick to what they know best, and this often means successful franchises. There is a clear benefit to the developers, that can determine whether a game might satisfy or not the demand. On the other hand, consumers are experiencing a general lack of innovation. This logic is derived from the Blockbuster Theory, usually applied for the movie industry (Vany, 2004).

Table 12*: Descriptive statistics for sequels.*

	7th Generation		*8th Generation*		*Tot*	
	N	*%*	*N*	*%*	*N*	*%*
Exclusive	2225	54,10%	548	48,10%	2773	52,80%
Not exclusive	1890	45,90%	592	51,90%	2482	47,20%
Total	4115	100,00%	1140	100,00%	5255	100%

6.2.2.5. License

This variable is categorical dichotomous, regarding whether the video-game is an adaptation from another medium. All the video-game adapted from another medium are based on a license (Sacranie, 2010). In a similar way as for sequels, in order to lower risks developers tend to use content already known to the users. Games like *Batman: Arkham Knight* or *Star Wars: the Force Unleashed* present a narration already familiar to the user. The most common licensed games are those adapted from comics, with the types of different mediums observed ranging from books (*The Witcher 3: Wild Hunt)* to action figures (*Warhammer 40000: Space Marine).* Similarly as for sequels, licensed games have been widely used in the last years and their market share is growing. However, quality of video-games based on licenses, especially those from movies, has always been recognized as generally low. JJ Abrams, director of *Star Trek Into Darkness,* criticized harshly the video-game based on his film, implying a negative effect on the movie, which might be investigated in future researches (Crasstalk, 2013).

"*To me the video-game could have been something that actually really benefited the series and was an exciting, fun game with great gameplay. And instead it was not (...), it got universally panned and*

I think that it was something without question that didn't help the movie and arguably hurt it".

One of the possible reasons of the low quality of this kind of video-games is the different pace of production of these two industries, with Hollywood working faster than the video-game market. Another reason is that usually licenses are bought by minor developers. Contracts between licensor and licensee are usually designed as follows: a royalty percentage paid to the licensor (typically between 10% and 15%) with a warranty from the licensee of a minimum guarantee, usually depending on the size of the developing house (Chisholm, 2007).

***Table 13**: Descriptive statistics for licensed games*

	7th Generation		*8th Generation*		*Tot*	
	N	*%*	*N*	*%*	*N*	*%*
Licensed	268	6,5%	110	9,6%	378	7,2%
Not licensed	3847	93,5%	1030	90,4%	4877	92,8%
Total	4115	100,00%	1140	100,00%	5255	100%

6.2.2.6. Major games

Following empirical research in the cinema field (Sochay, 1994), the last categorical variable regarding video-game attributes is whether the game was released by a major publisher. As stated before, for this kind of games often is used the expression "AAA Games", in order to identify that the game was highly financed, tested and approved. Major publishers considered in the dataset are: Sony, Microsoft, Activision, Ubisoft, Namco and Electronic Arts (NPD, 2014).

The eighth generation presents an higher percentage of AAA games. This might be due to the fact that some independent developers moved towards the less costly digital games online.

***Table 14**: Descriptive statistics for major games*

	7th Generation		*8th Generation*		*Tot*	
	N	*%*	*N*	*%*	*N*	*%*
Major	967	23,5%	380	33,3%	1347	25,6%
Not major	3148	76,5%	760	66,7%	3908	74,4%
Total	4115	100,00%	1140	100,00%	5255	100%

6.2.2.7. Online Multiplayer

Finally, the last categorical dummy variable identifies video-games that allows the player to compete online. This category will be considered as independent variable both within the analysis of technology and genre and within the investigation about the demand. Many games present "social" functions, the possibility of exchanging gifts with other players or allow the user to see online

statistics. However, only video-games featuring a significant and possibly competitive online multiplayer mode were included in this category.

As expected from the literature, a clear upward trend in market shares is present in the dataset.

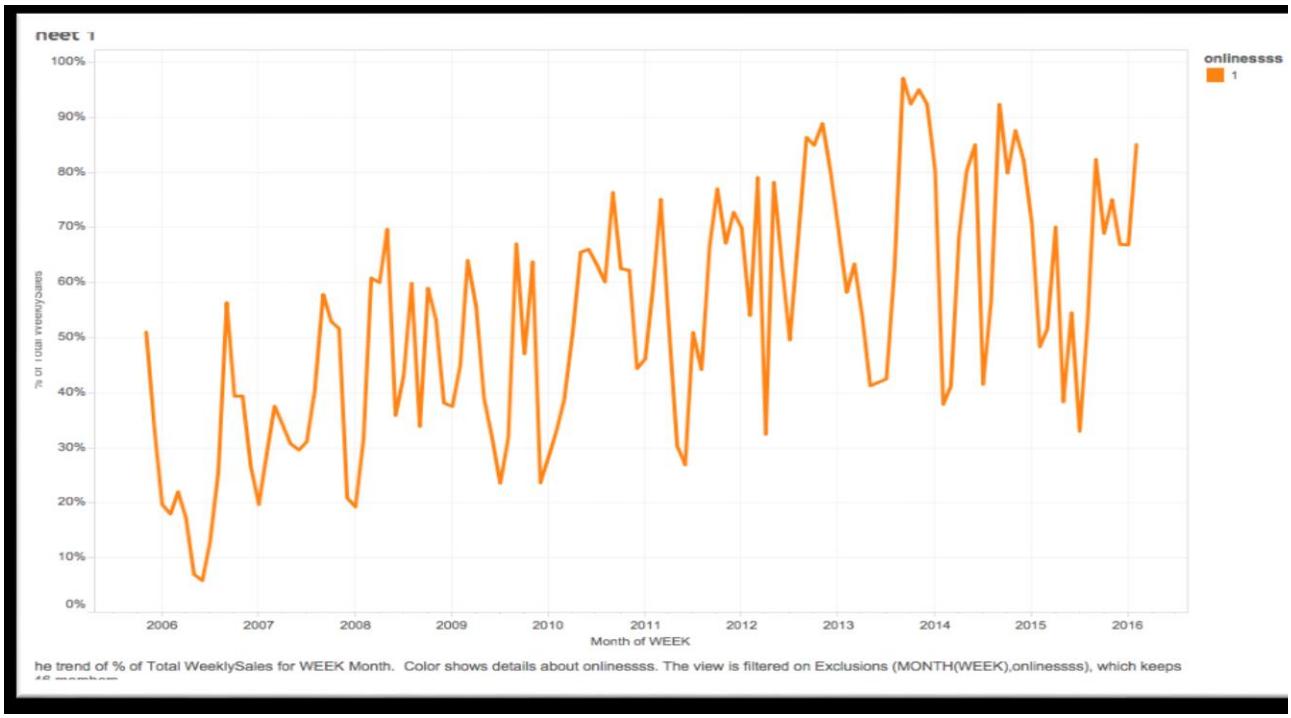

***Figure 8**: Sales share for online best-selling online games*

***Table 15**: Descriptive statistics for online games*

	7th Generation		*8th Generation*		*Tot*	
	N	*%*	*N*	*%*	*N*	*%*
Online	1990	48,40%	679	59,6%	2669	50,8%
Not online	2125	51,6%	461	40,4%	2586	49,2%
Total	4115	100,00%	1140	100,00%	5255	100%

6.2.3. Console Related Technological Factors

The variable included in this section will be used in both of the stages of the analysis. First of all, for every video-game in the data set was identified the relative console and was created a dummy variable relative to the type of hardware, home console or handheld device. The next variable included in the model is relative to the technological advancement of the console. This variable is continuous and represent the computing power of each console. Identifying the measure that fits best the calculation power of each console is problematic. This is due to the fact that the only way to assess the power of a console is to observe the whole system of components and machineries. A console engine is in fact complex and composed by many parts. Since the number of bit has become an

outdated way to comprehend video-games (this value is now included in the CPU), three of the most important values in order to assess the power of modern consoles are CPU, GPU, memory. The main indication of power for the former two is the clock speed, measured in Megahertz. Memory is instead measured in bytes. The CPU (central processing unit) carries out the instruction for the basic functions of the computer. In other words, the CPU runs the operating system of the console. The GPU (graphic processing unit) is responsible for the creation of images on a display or a screen. The memory, or RAM, reads and writes data stored temporally (Heider, 1994).

As mentioned afore, unfortunatley one element alone is not enough to assess the power of a console. The CPU of *PlayStation 4* has a lower clock speed rate than the PlayStation 3 one. This is an issue: graphic, audio and memory performance are obviously better for the PS4. CPU is hence not the best way to represent the technological level. GPU clock speed rates and memory storage are in general a better explanation for the console efficiency. Nintendo DS however lacks of a GPU. For evaluating its graphic performances, it was considered the clock speed of one of its CPU processors, the one relative to gameplay mechanism and video rendering. These information were retrieved on different websit, namely: IGN, Gamasutra, technewsworld, nowgamer, geek.com.

***Table 16**: Technical specifications for seventh generation consoles.*

Console	*Release date*	*Type*	*GPU*	*CPU*	*Memory*
Nintendo DS	21/11/04	Handheld	67 MHz	33 MHz	16 MB
PlayStation Portable	12/12/04	Handheld	166 MHz	333 MHz	32 MB
Xbox 360	22/11/05	House	500 MHz	3200 MHz	512 MB
PlayStation 3	11/11/06	Home	550 MHz	3200 MHz	512 MB
Wii	19/11/06	Home	243 MHz	729 MHz	88 MB

***Table 17**: Frequencies of 7th generation consoles.*

Console	*N*	*%*
Nintendo DS	900	21,90%
PlayStation Portable	172	4,20%
Xbox 360	1013	24,60%
PlayStation 3	903	21,90%
Wii	1127	27,40%
Tot	4115	100,00%

***Table 18**: Technical specifications for eighth generation consoles.*

Console	*Release date*	*Type*	*GPU*	*CPU*	*Memory*
Nintendo 3DS	26/02/11	Handheld	268 MHz	233 MHz	128 MB
PlayStation Vita	17/12/11	Handheld	444 MHz	2000 MB	512 MB
Wii U	18/11/12	Home	550 MHz	1240 MHz	2000 MB
PlayStation 4	15/11/13	Home	800 MHz	1600 MHz	8000 MB
Xbox One	22/11/13	Home	853 MHz	1750 MHz	8000 MB

***Table 19**: Frequencies of 8th generation consoles.*

Console	*N*	*%*
Nintendo 3DS	426	37,40%
PlayStation Vita	44	3,90%
Xbox One	174	15,30%
PlayStation 4	417	36,60%
Wii U	79	6,90%
Tot	1140	100,00%

6.2.4. Network Effect

All the data discussed in this section were retrieved on VGchartz. Following the work of Gil and Warzynski (2015), these two variables represent a simplified methodology to assess the impact of console sales and installed base on the success of a video-game. Yearly data were the best option available online.

- Yearly console sales: the presence of a positive association between the number of console and the number of video-games sold would indicate indirect network effects (Katz & Shapiro, 1994).
- Installed base: in the presence of positive correlation between installed base and video-game sales, direct network effect would emerge (Katz & Shapiro, 1994).

These two variable will also control for the results of the model.

6.2.5. Days passed from console release and game release

As stated before, this variable will only be taken into account in the logistic regressions, within the analysis of the relation between genre and technology. This variable will identify how video-game releases change, in term of genre, through the life cycle of a console. Eighth generation is not over yet, hence its descriptive results are lower.

***Table 20**: Descriptive statistics for Days passed from console release and game release*

Gen	*N Valid*	*N Missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
7th	4031	84	1215,17	1059	268	920,453	0	3737
8th	1132	8	657,64	621	368	385,343	0	1823
Total	5163	92	1092,93	871	268	864,404	0	3737

7 DATA ANALYSIS AND DISCUSSION

7.1. Transformation

First of all, every variable was tested for normality and homoscedasticity. The latter assumption was always found to hold valid. Normality was not always proved. In particular, *Revenue* showed a positive skew and unequal variance. As suggested by Field (2009), the set of numbers was hence transformed by applying a log transformation.

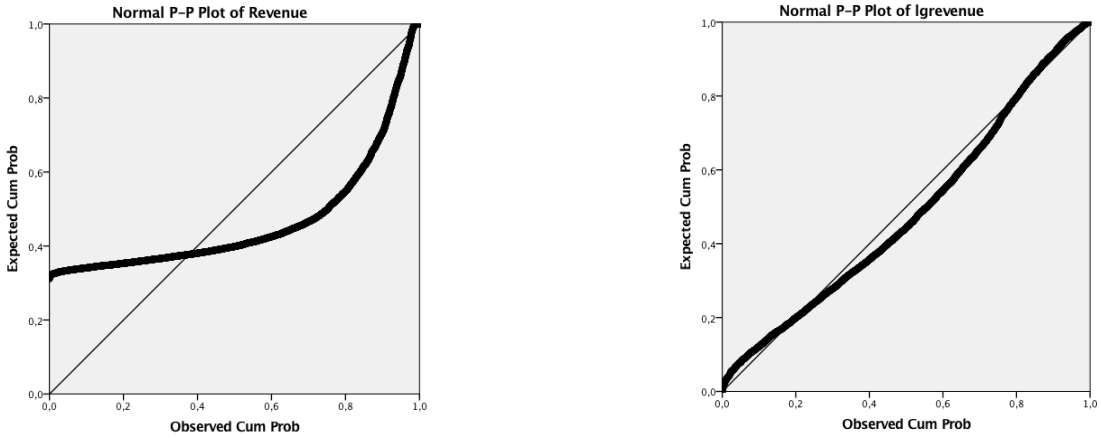

***Figure 9**: P-Plots for revenue (left) and Log10 revenue (right)*

These graphs are the P-P plots (probability – probability plot) for *Revenue* before and after the transformation. They plot the cumulative probability of a variable against the cumulative probability of a particular distribution (in this case the normal distribution) (Fields, 2009). The second plot, relative to the transformed variable, is clearly a better fit to the normal distribution.

***Table 21**: Descriptive statistics for Log10 Revenue (seasonality adjusted).*

Gen	*N Valid*	*N Missing*	*Mean*	*Median*	*Mode*	*Std. Deviation*	*Min*	*Max*
7th	4115	0	6,8848	6,8673	6,76	0,35756	5,82	8,72
8th	1140	0	6,8978	6,8459	5,51	0,36937	5,51	8,63
Total	5255	0	6,8877	6,8622	6,76	0,36016	5,51	8,72

7.2. Logistic regressions: technology, online and genre

As stated before, in this phase we want to investigate the relation between the genre of best-selling video-games and technology, without taking the demand into account. In this case, the variable used to assess technology is GPU. This is due to its smaller values. The coefficients of logistic regression represent in fact the change in the logit of the outcome variable associated with a one-unit change in the predictor variable (Field, 2009). The results of the regressions were significant with both memory or GPU, but one megaByte of memory is not enough to influence the outcome, while one megaHertz of graphic processor speed provides solid results.

In order to interpret the results, it is important to note the difference of GPU between different generation and type of console as previously highlighted in *Tab. 16* and *Tab. 18*.

Besides computing power, were taken into account also the possibility of playing online and the number of days passed from console release and the video-game launch.

The equations for the logistic regressions are:

EQ.1 **y = 1 (genre) if β0 + β1(GPU) + β2(Online) + β3 (time passed) + E > 0;**
y = 0 (not genre), otherwise;

where β3 (time passed) is the coefficient for "*days passed from console release to game release"* and E is an error distributed by the standard logistic distribution.

In the following tables was reported also the odds ratio, that can be interpreted as the change in odds. If the value is greater than one, the odds of the outcome occurring increase. Vice versa, with a smaller value the odds for the outcome occurring decrease (Field, 2009). Together with the odds ratio was reported its confidence interval. Each β is reported with its own P value, formatted as follows:

*** $P \leq 0{,}001$

** $0{,}001 < P \leq 0{,}01$

* $0{,}01 < P \leq 0{,}05$

ns $P > 0{,}05$ (not significant)

Finally, in the following tables were reported also the results of the Cox & Snell and the Nagelkerke tests, both indicating the significance of the model

7.2.1. Technology and Action Games

***Table 22**: Results of the logistic regression on action games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 3,311 ***			
GPU	,005 ***	1,004	1,005	1,005
online	- 1,381 ***	,212	,251	,298
Time passed	,001 ***	1,000	1,001	1,001

R^2: ,139 (Cox & Snell) // ,220(Nagelkerke)

Action games are positively correlated with GPU and time passed from console to game release, but negatively correlated with online multiplayer. With an increase of 1 MegaHertz of clock speed of the Graphic processor, the odds of a game of being action increase for 1,004. The odds of a game which present online multiplayer to be action are 1,381 lower than those for a game that do not present online features.

The negative effect of online multiplayer functions might be due to the narration characteristics of action games. The most successful action games in the dataset (*God of War 3, The Last of Us*) present instead a complex, semi-rigid plot and multifaceted fixed characters. Conversely, in the most online played games, the user takes the role of no-faced characters (*Call of Duty*), sports team (*Fifa)* or extremely customizable figures (*World of Warcraft*). In online games, competition is the core and plot is often only marginal.

The weak positive correlation with time passed from console to game release indicate that successful action games are most likely developed a significant amount of time after the release of the console.

7.2.2. Technology and fighting games

Table 23*: Results of the logistic regression on fighting games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 5,121 ***			
GPU	,001 *	1,000	1,001	1,001
online	2,086 ***	4,882	8,055	13,289
Time passed	,000	1,000	1,000	1,000

R^2: ,028 (Cox & Snell) // ,101(Nagelkerke)

Fighting games present a modest positive correlation with technological advancement and a rather strong positive one with online multiplayer. Fighting games, since its earliest arcade days, had in fact one of their core features in competition between players (Kent, 2010). The time passed from console release to game release is not significant.

7.2.3. Technology and minigames

***Table 24**: Results of the logistic regression on minigames.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	,666 ***			
GPU	- ,002 ***	,998	,998	,999
online	- 4,503 ***	,006	,011	,022
Time passed	- ,001 ***	1,000	1,000	1,000

R^2: ,239 (Cox & Snell) // ,483(Nagelkerke)

Minigames are negative correlated with computing power and online features. As stated above, the results were expected due to the nature of these games, which are less complex and more simple than average. The result regarding the time passed from console to game release indicates that minigames tend to be released in an early phase of the generation cycle.

7.2.4. Technology and platform games

***Table 25**: Results of the logistic regression on platform games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- ,711 ***			
GPU	- ,004 ***	,995	,996	,997
online	- ,982 ***	,282	,375	,498
Time passed	,000 ***	1,000	1,000	1,000

R^2: ,078 (Cox & Snell) // ,184 (Nagelkerke)

Platform games are negative correlated with GPU clock speed and online features. These two results were predictable. Many platform games in the dataset use 2D graphics (*Yoshi's New Island*) and the majority is designed for handheld consoles (67,89%). The time passed from console release to game release is not relevant.

7.2.5. Technology and role playing games

***Table 26**: Results of the logistic regression on RPG.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 1,694 ***			
GPU	- 0,05 ***	,994	,995	,996
online	,367 ***	1,168	1,443	1,784
Time passed	,001 ***	1,001	1,001	1,000

R^2: ,112 (Cox & Snell) // ,256 (Nagelkerke)

RPG show a negative correlation with graphic processor power. This is due to the fact that in this category were not included action RPG games, that feature a strong focus on combat and action. On the contrary, games in this category usually present a simple turn-based combat system (*Pokèmon, Final Fantasy*). Online playing is one of the most important characteristics of RPGs and as expected shows a positive correlation. One of the most successful sub-genres of role playing games is in fact Massive Multiplayer Online RPG (MMORPG), where players build their own avatar and interact with other user in big online servers.

The model shows also a weak positive correlation with the time passed between the release of the console and the release of the game.

7.2.6. Technology and rhythm games

***Table 27**: Results of the logistic regression on rhythm games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 3,455 ***			
GPU	- 0,002 **	,998	,998	,999
online	- 18,708	,000	,000	,000
Time passed	,001 ***	1,000	1,001	1,000

R^2: ,069 (Cox & Snell) // ,145 (Nagelkerke)

Similarly to minigames, rhythm games graphics usually present an essential interface and minimalist gameplay. Correlation with graphic power is in fact negative. Online multiplayer is particularly negatively correlated and not significant, but almost no rhythm game present online functions. It is also present a weak positive correlation with *time passed.*

7.2.7. Technology and shooter games

***Table 28**: Results of the logistic regression on shooter games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 5,306 ***			
GPU	,004 ***	1,004	1,004	1,004
online	1,957 ***	5,555	7,082	9,027
Time passed	,000 ***	1,000	1,000	1,000

R^2: ,196 (Cox & Snell) // ,332 (Nagelkerke)

Shooter games present a positive correlation with both graphic performances of the console and online multiplayer functions. These are in fact two of the main reasons behind the success of this kind of games: a graphic war between different developing houses in order to get the most realistic simulation and a functional war in order to get the wider number of online players and the best online functionalities (Jansz & Tanis, 2007). *Time Passed* do not have any effect on the outcome.

7.2.8. Technology and simulation games

***Table 29**: Results of the logistic regression on simulation games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 1,538 ***			
GPU	- ,004 ***	,995	,996	,996
online	- ,584 ***	,422	,558	,737
Time passed	,000 ***	1,000	1,000	1,000

R^2: ,043 (Cox & Snell) // ,113 (Nagelkerke)

Simulation games present a negative correlation with graphic power and online features, due to the simplicity of their gameplay and their graphic interface. The time passed from console release to game release is not significant

7.2.9. Technology and sport games

***Table 30**: Results of the logistic regression on sports games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 2,851 ***			
GPU	- ,001 ***	,999	,999	1,000
online	2,775 ***	12,407	16,034	20,721
Time passed	,000 ***	1,000	1,000	1,000

R^2: ,130 (Cox & Snell) // ,231 (Nagelkerke)

Sport games present a weak negative correlation with the performances of the graphic engine and a strong positive correlation with online multiplayer. If a game presents online multiplayer features, its odds of being a sport games increase for 16,034 times. The time passed from console to the game release do not have any effect on the outcome

7.2.10. Technology and strategy games

***Table 31**: Results of the logistic regression on strategy games.*

		95% CI for odds ratio		
	β	*Lower*	*Odds Ratio*	*Upper*
Constant	- 4,644 ***			
GPU	- ,002 ***	,996	,998	1,000
online	- ,767 ***	,207	,465	1,045
Time passed	,001 ***	1,001	1,001	1,001

R^2: ,003 (Cox & Snell) // ,036 (Nagelkerke)

Most of the strategy games in the dataset are computer games. Because of this, the R^2 for this regression is quite low. However, the results present a negative correlation with both processing power and online multiplayer. The weak coefficient regarding the time passed from console to game release indicates that strategy games tend to be released in a rather late phase of the generation cycle.

7.2.11 Discussion of the results

These regression yielded some valuable results. First of all, not necessarily games with better graphic quality are also with online multiplayer. In some cases, in particular sports game and RPG, being connected online with other players is more important that the mere level of virtual simulation.

The computing power of consoles is always significant in determine the likeliness of the genre

of video-games. In particular, action, fighting and shooter games are positively correlated with the technological level of the hardware. These categories are expected to require an higher level of graphic simulation. It is hence possible to speculate that this genres will benefit of the evolution of consoles and of electronic games in general.

With the exception of rhythm games, also online capabilities are always a significant predictor for genre. Fighting, RPG, sport and shooter games are most likely to present this feature. With the growing relevance of online gaming, the demand is expected to shift even more significantly towards these genres.

Finally, the time passed between the release of the console and the release of the game never has a strong impact on the output. A possible explanation for this is that the long time spent for game development allows firms to schedule the launch of different games in order to always diversify the supply.

With the results obtained in this section, it is possible to make expectations about the results for genre in the next data analysis phase.

7.3. Linear Regressions: analysis of the demand for different generations

In this section the focus will shift on the preferences of the consumers. Two linear regressions will be run, one for each generation, in order to assess how the demand changed. The equation used for these regressions is a simple demand model, with the dependent variable and the independent variables illustrated above in the *Data* section.

EQ. 2 $\mathbf{Revenues = \beta_0 + \beta_1\,(Genre) + \beta_2\,(Video\text{-}game\ attributes) + \beta_3\,(Console\ related\ factors) + \beta_4(network\ effect)}$

with $\boldsymbol{\beta_1}$ representing the sum of the coefficients of each genre, $\boldsymbol{\beta_2}$ including the coefficients for reviews, sequel, price, age, license, exclusivity and major games, $\boldsymbol{\beta_3}$ including the coefficients for online multiplayer, technological level and type of console, $\boldsymbol{\beta_4}$ including the coefficients for installed base and yearly console sales.

One of the genres had to be dropped from the regression, so minigames were omitted and used as reference group. The variable used to assess technological advancement in this case is memory, due to the bigger variance between values.

7.3.1. Independent Variables Table: expectations

***Table 32**: Results expected from the multilinear regressions*

Variable Name	*Type*	*Expected Sign*	
		7th	*8th*
Action	Categorical Dichotomous	?	?
Fighting	Categorical Dichotomous	<	>
Platform	Categorical Dichotomous	>	<
RPG	Categorical Dichotomous	?	?
Rhythm	Categorical Dichotomous	>	<
Shooter	Categorical Dichotomous	<	>
Simulation	Categorical Dichotomous	>	<
Sport	Categorical Dichotomous	?	?
Strategy	Categorical Dichotomous	>	<
Reviews	Continuous interval	+	+
Sequel	Categorical dichotomous	+	+
Inflation Adjusted Price	Continuous interval	?	?
Age	Categorical interval	<	>
License	Categorical dichotomous	+	+
Exclusivity to one developer	Categorical dichotomous	<	>
AAA Games	Categorical dichotomous	+	+
Multiplayer Online	Categorical dichotomous	+	++
Technological Level	Continuous interval	+	+
Type of console	Categorical dichotomous	?	?
Installed Base	Continuous interval	+	+
Yearly Console Sales	Continuous interval	+	+

Due to the opposite results for GPU and online multiplayer, there is no clear expectation for action, RPG and sport games. According to the descriptive statistics presented above, the coefficient of *age* and *exclusivity* is expected to be increasingly positive for the eighth generation. Finally, because of the development of online networks (Zaluzny, 2014), multiplayer capabilities are expected to be increasingly positive for the eighth generation. There are no clear expectations about the effect of different type of console (handheld or home console).

7.3.2. Results

The regressions were performed in four stages. The summary of the model is useful to understand which block represent a better predictor to assess video-game revenues. Model 1 includes only the genre dummy variables. Model 2 adds the video-game attributes. In model 3 are contained

also the console related technological factors. Model 4 adds the network effect variables.

***Table 33**: Model summary (linear regressions)*

	7^{th} Generation				8^{th} Generation			
Model	*R*	*R Square*	*Adjusted R Square*	*R Square Change*	*R*	*R Square*	*Adjusted R Square*	*R Square Change*
1	,342	,117	,115	,117	,337	,114	,106	,114
2	,504	,254	,251	,137	,440	,193	,181	,080
3	,537	,288	,285	,034	,444	,197	,182	,003
4	,573	,328	,325	,040	,449	,202	,185	,005

For both the generations, genre and video-game attributes are the most significant predictors. Approximately, 11,5% (seventh gen) and 10,6% (eighth gen) of the variance in the dependent variable can be explained by the different genres. The second stage of the regression show how video-game attributes account roughly for 13,7% (seventh gen) and 8% (eight gen) of the accuracy. Technological factors and network effects have weak explanatory power, in particular in the regression for the eighth generation.

The cumulative R^2 is ,325 (seventh) and ,185 (eighth), making the model a fairly good predictor of revenues.

The results of the regressions are detailed in the next table, with the significance reported in the same design as *Tab. 21 – Tab. 30.* B is the unstandardized coefficient and SE its Sd. Error. B is the standardized coefficient. See Tab.III in Appendix for the other three stages of the regression.

***Table 34**: Coefficients of the multilinear regression*

	7th Generation			*8th Generation*		
	B	*SE*	*β*	*B*	*SE*	*β*
(Constant)	5,848***	,064		5,929***	,222	
Action	,005	,033	,005	,172	,095	,207
Fighting	,018	,041	,663	,251*	,100	,154
Platform	-,067**	,024	-,049	,168	,093	,141
RPG	,068*	,030	,053	,194*	,094	,170
Rhythm	-,020	,036	-,010	-,023	,148	-,006
Shooter	-,013	, 038	-,013	,263**	,096	,281
Simulation	-,119***	,025	-,082	,186	,101	,034
Sport	-,155***	,025	-,153	,199*	,097	,194
Strategy	,199***	,062	,047	,156	,156	,034
Age	-,005*	,002	-,089	,005	,004	,094
Review	,003***	,001	,088	,002	,001	,053
Sequel	-,022	,013	-,026	-,045	,035	-,040
Exclusive	,062***	,016	,085	,020	,040	,027
Price	,013***	,001	,499	,014***	,002	,406
AAA	-,020	,015	-,023	,016	,030	,019
Licensed	-,045	,024	-,028	,054	,040	,042
Handheld	-,286***	,025	-,342	-,096	,091	-,061
Online	,037*	,015	,052	-,014	,029	-,018
GPU	-3,54E-5	,000	-,018	,000	,000	-,245
Installed base	7,652E-10***	,000	,065	-1,448E-9	,000	-,055
Yearly console sales	1,465E-8***	,000	,290	5,401E-9*	,000	,074

7.3.2.1. Genre

The regressions yielded some important results. The two genres that reported a stronger effect in the eighth generation are shooter and fighting games. In the previous logistic regressions these two genres were the only ones to show a positive correlation with both graphic processor power and online capabilities. In the seventh generation, fighting games did not influenced the outcome, while in the eighth generation their effect on revenues is significant and rather strong, with an unstandardized Beta of ,251. While in the seventh generation the difference between a fighting game and a minigame (the reference category) was not significant, in the eighth generation fighting games perform sensibly

better. The demand seems to be sensible to the positive correlation between fighting games and technology showed in the previous stage of data analysis. In the same way, shooter games perform significantly better in the eighth generation, confirming the previous consideration about technology and genre. The value is rather strong for shooter games too, that present an unstandardized beta of ,263.

It is interesting to look at those genres that in the previous stage resulted ambiguous, such as RPG, sport and action games. Action games were positively correlated only with higher graphic performances. In this case, the value of the unstandardized beta was not significant for each of the two generations. It has to be however noted that the value in the eighth generation was weakly non-significant (p=0.07). RPG and shooter games results seems to confirm the growing importance of online multiplayer. Role playing games were positively correlated with outcome in both the generation, yet the beta in the eighth generation is higher. Sport games beta shifted instead from negative to positive with the turn of generation.

Simulation games, that showed a negative correlation with both online capabilities and computing power of the graphic engine, shifted from significantly negative to not significant. Strategy games shifted instead from a rather strong significant beta in the seventh generation to not significance. Rhythm games resulted not to be significant in order to determine the revenues.

7.3.2.2. Video-game attributes

In the seventh generation reviews showed a weak positive correlation with the revenues. However, the relation between the two variables turned out to be not significant in the eighth generation. This might be due to the growing relevance of user reviews, such as those on Amazon or on social media. Institutional reviews are in fact often considered too biased and not relevant. On metacritic there are two scores: one for the magazines and one for the users. The discrepancy between these two values is frequently very large. One of the most revealing examples in this sense is the case of THQ, a developing house whose shares sank in March 2011 after the publication of *Homefront.* Despite the rather good press coverage and a decent metascore of 71, the title turned out to be a massive fiasco, earning a 54 user score (Forte, 2013).

While in the seventh generation exclusive games influenced significantly the output, in the eighth generation they result to be not significant. Not only the share of exclusive games is decreasing, but those which are still in the market are not particularly successful. In this line of thought, it seems fitting to predict that exclusive games will continue losing their market share and publishers might have less interest in developing more of them.

As expected from the descriptive analysis of data, age impact changed with the turn of generation. In the seventh gen it had a negative effect on the outcome. This means that games designed for a more mature audience tended to earn lower revenues. This effect disappears in the

eighth generation, where age gives no significant result. This might mean that in the last years the younger gamers switched platform, moving towards smartphones and tablets.

Sequels, AAA games and licensed games are not significant in order to determine the output. However, the latter have an almost significant (p=0,053) negative correlation with revenues in the seventh generation.

Finally, results for price are interesting. The result is in fact positive and significant for both the generations, moreover with a similar coefficient. Video-games show hence a good value for money, with revenues increasing with an higher price. It might be interesting in future researches to investigate for which genre the value for money is higher.

7.3.2.3. Console related technological factors

Online multiplayer capabilities are positive correlated with revenues in the seventh generation, but the correlation in the eighth generation is not significant. According to the results described in section 7.3.2.1., where genres correlated with online multiplayer showed a positive relation to the outcome, we would expect this feature to be more strongly positive in the latter generation. This result is puzzling, but there might be a reason. The positive correlation in the seventh generation might be due to the relative novelty of this feature. Not all the video-games presented the possibility of playing online and those who had it benefited of the interest of consumers. During the eighth generation, the percentage of games with online capacity grew. Many games developed it in order to follow the new dominant design, even if it was not necessary to fulfill the demand. When we look at the results in the section 7.3.2.1. we have hence to keep in mind that it is not the online multiplayer *per se* the driver of success, but the improvement of online multiplayer applied to certain genres.

Handheld console games showed a negative correlation with revenues for the seventh generation, but this effect disappeared in the eighth. Technological advancement had no effect for both the generations, meaning that, during the same generation, a game release on a specific system will not have an effect on revenues.

7.3.2.4. Network effects

In the seventh generation, both yearly console sales and installed base resulted positively correlated with revenues, proving that video-games show both direct and indirect effects. In the eighth generation, yearly console sales resulted positively correlated (indirect effects), while the installed base was not significant. This might be due to the fact that the analysis was made in the middle of the generation, when the installed base is still supposed to grow.

7.3.2.5. Independent variables table: results

The following table has to be compared with Tab. 31. It summarizes the results *ex ante* of the linear regressions. The symbol (~) indicates that the beta coefficient is not significant.

***Table 35**: Coefficients linear regressions*

Variable Name	*Type*	*Coefficient*	
		7th	*8th*
Action	Categorical Dichotomous	*(~)*	*(~)*
Fighting	Categorical Dichotomous	*(~)*	+
Platform	Categorical Dichotomous	-	*(~)*
RPG	Categorical Dichotomous	+	++
Rhythm	Categorical Dichotomous	*(~)*	*(~)*
Shooter	Categorical Dichotomous	*(~)*	+
Simulation	Categorical Dichotomous	-	*(~)*
Sport	Categorical Dichotomous	-	+
Strategy	Categorical Dichotomous	+	*(~)*
Reviews	Continuous interval	+	*(~)*
Sequel	Categorical dichotomous	*(~)*	*(~)*
Inflation Adjusted Price	Continuous interval	+	+
Age	Categorical interval	-	*(~)*
License	Categorical dichotomous	*(~)*	*(~)*
Exclusivity to one developer	Categorical dichotomous	+	*(~)*
AAA Games	Categorical dichotomous	*(~)*	*(~)*
Multiplayer Online	Categorical dichotomous	+	*(~)*
Technological Level	Continuous interval	0	*(~)*
Type of console	Categorical dichotomous	-	*(~)*
Installed Base	Continuous interval	+	*(~)*
Yearly Console Sales	Continuous interval	+	+

7 DISCUSSION AND CONCLUDING REMARKS

Video-games evolution is constant. Technological advancement is improving the level of simulation and it is creating a continually increasing network between the users. This paper yielded some valuable results and answered, even if partially, to the research questions: how do technological change affects the type of games and the demand for them.

First of all, this study proved that certain genre have a stronger bond with the current technological level. Shooter and fighting games are correlated with both online features and power of the console graphic engine. Furthermore, both of these genres are positively driving the demand of the current generation. This result might indicate that the type of console games developed in the future will be

even more in this direction, causing an increase of the competition. Moreover, it has to be noted that these two genres constitute the core of the widely debated field of violent video-games (Anderson & Bushman, 2001).

With the exception of action games, all the other genres are negative correlated with the computing power of the console. This does not mean that they are going to disappear. First, it is important to remember that this paper focused exclusively on console games. Platform, simulation and minigames are in fact moving to other supports, such as smartphones and tablets, and in certain cases obtaining highly remarkable results. *Candy Crash Saga*, a mobile minigame that trace the gameplay of the classic *Bejeweled*, is probably the best example: it earned more than one billion dollars in 2014 alone (Dredge, 2015) and it is still played by millions of people. Second, video-games genre is a fluid concept and it is impossible to forecast its evolution. In the future, the most successful shooter games might integrate simulation element and the best-selling video-game might be an hybrid between a fighting and a platform game. The results of the regression are hence a snapshot of the market, but more check-ups of the industry are desirable for the future. In particular, it would be ideal if the analysis would include not only the best-sellers, but all the games. A second aspect that future researches should take into account is the phenomenon of secondhand games. Their market is huge, estimated to be around 2 billion dollars in 2013 (Trautman, 2014). It is difficult to trace this kind of transactions, but their effect is important not only to determine the demand, but also for the willingness to pay of consumers. When gamers buy a new game for 60$ know in fact that they might sell it back to the store for 30$. Isihara and Ching (2012) proved that if secondhand games would disappear from the market, the average profit per game would decrease by 10%. Finally and probably most important, next researches should focus on digital distribution. Platform like Steam or GOG.com are completely changing the industry, and it is presumably clear that the biggest challenge for the ninth generation of console games will be their competition. As for now, data about digital distribution are not available online. However, arstechnica.com and the Russian blogger Sergey Galyonkin developed steamspy, a tool that can give good approximated data about online gaming. Currently, steamspy is developing a function to track digital sales. Scholars interested in this matter should take it into consideration for their data mining.

In conclusion, this research showed more important findings. The most interesting regards online multiplayer. All the genres that showed a correlation with online capabilities (RPG, Sport, Shooter and Fighting) significantly increase the value for revenues in the eighth generation. Moreover, these are the only genres to have whichever positive effect. Online interaction is fundamental for gaming right now, probably even more than the level of graphics. The meaning this holds for publishers seems obvious: focus more on online functions. Still, it is important to highlight that the positive effect of online games is strictly related with genres that typically correspond with this kind

of gameplay.

Sequels have no impact on the revenues for both the generations, but developers keep on focusing on them because of the lower risks. The discourse for licensed games is slightly different. They neither have a significant impact in both of the generations. Sacranie (2010), whose results regarding licensed games reflected those in this paper, suggested that publishers keep on investing in these games because they are cheap enough to produce and can lead to an easy profit. This is the last important aspect that this paper is missing. Games have different costs and information about their budget are often hard to find. Still, in the future the supply side (including advertisement) will need to be more in-depth investigated. The production story of games is often complex and convoluted, but sometimes is really just a matter of creativity. *Minecraft*, one of the best sellers in the data-set, was designed from one person alone and became a huge independent success before being bought from Microsoft for $2,5 Billions (Peckham, 2014). Hoping that switching the focus on the supply will find the recipe for such a success is out of question.

8 REFERENCES

Aarseth, E. (2001). Computer Game Studies, Year One. *Game Studies*, vol. 1, issue 1 (July). [Online] Available at: http://gamestudies.org/0101/editorial.html

Adams, E. (2013). Fundamentals of game design. Pearson Education.

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video-games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological science*, 12(5), 353-359.

Antonelli, P. (2013). Perche ho portato Pac-Man al MoMA [Video File] Retrieved from https://www.ted.com/talks/paola_antonelli_why_i_brought_pacman_to_moma?language=it

Aoyama, Y., & Izushi, H. (2003). Hardware gimmick or cultural innovation? Technological, cultural, and social foundations of the Japanese video-game industry. *Research policy*, *32*(3), 423-444.

Apperley, T. H. (2006). Genre and game studies: Toward a critical approach to video-game genres. *Simulation & Gaming*, *37*(1), 6-23.

Arsenault, D. (2009). Video-game genre, evolution and innovation. *Eludamos. Journal for Computer Game Culture*, *3*(2), 149-176.

Chen, L., Mislove, A., & Wilson, C. (2016, April). An Empirical Analysis of Algorithmic Pricing on Amazon Marketplace. In *Proceedings of the 25th International Conference on World Wide Web* (pp. 1339-1349). International World Wide Web Conferences Steering Committee.

Chisolm, D. (2012). How does video game content licensing work? [website] Retrieved from https://www.quora.com/How-does-video-game-content-licensing-work

Clements, M. T. (2004). Direct and indirect network effects: are they equivalent?. *International Journal of Industrial Organization*, 22(5), 633-645.

Cohen, S. (1984). Zap!: The Rise and Fall of Atari. McGraw-Hill Companies.

Corts, K. S., & Lederman, M. (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.

Crasstalk (2013) Why Movie Tie-In Video Games Suck. (n.d.). Retrieved June 08, 2016, from http://crasstalk.com/2013/09/why-movie-tie-in-video-games-suck/

DeMaria, R., & Wilson, J. L. (2003). High score!: the illustrated history of electronic games.

Dredge, S. (2015). Candy Crush Saga players spent £865m on the game in 2014 alone.

Eby, M. (2011). 10 Artists Who Use Video Games as Their Medium.

Ehrenfeld, S. E. (2011). *Predicting video-game sales using an analysis of internet message board discussions* (Doctoral dissertation, San Diego State University).

Entertainment Software Association (ESA) (2007). Facts and research: Game player data. Retrieved August 16, 2007, from http://www.theesa.com/facts/gamer_data.php

Entertainment Software Association (ESA) (2007) Essential facts about the computer and video-game industry: 2014 sales, demographic and usage data

Field, A. (2009). *Discovering statistics using SPSS*. Sage publications.

Forte, L. (2013). Metacritic: è un parametro affidabile per l'industria? Retrieved from: http://www.eurogamer.it/articles/2013-03-29-videogiochi-metacritic-e-un-parametro-affidabile-per-questa-industria

Furber, S. B. (2000). ARM system-on-chip architecture. pearson Education.

Gallagher, S., & Park, S. H. (2002). Innovation and competition in standard-based industries: a historical analysis of the US home video-game market.*Engineering Management, IEEE Transactions on*, *49*(1), 67-82.

Gandal, N., Kende, M., & Rob, R. (2000). The dynamics of technological adoption in hardware/software systems: The case of compact disc players. *The RAND Journal of Economics*,

43-61.
Gil, R., & Warzynski, F. (2015). Vertical integration, exclusivity, and game sales performance in the US video-game industry. *Journal of Law, Economics, and Organization*, *31*(suppl 1), i143-i168.
Heider, G. K. (1994). *U.S. Patent No. 5,276,863*. Washington, DC: U.S. Patent and Trademark Office.
Herman, L. (1994). *Phoenix; The Fall and Rise of Home Videogames*. Rolenta Press.
Ishihara, M., & Ching, A. (2012). Dynamic demand for new and used durable goods without physical depreciation: The case of japanese video-games.*Rotman School of Management Working Paper*, (2189871).
Jansz, J., & Tanis, M. (2007). Appeal of playing online first person shooter games. *CyberPsychology & Behavior*, *10*(1), 133-136.
Johns, J. (2006). Video-games production networks: value capture, power relations and embeddedness. *Journal of Economic Geography*, *6*(2), 151-180.
Katz, M. L., & Shapiro, C. (1994). Systems competition and network effects.*The journal of economic perspectives*, *8*(2), 93-115.
Kent, S. (2010). The Ultimate History of Video-games: from Pong to Pokemon and beyond... the story behind the craze that touched our li ves and changed the world. Three Rivers Press.
Kindleberger, C. P. (1983). Standards as public, collective and private goods.*Kyklos*, *36*(3), 377-396.
Landsman, V., & Stremersch, S. (2011). Multihoming in two-sided markets: An empirical inquiry in the video-game console industry. *Journal of Marketing*,*75*(6), 39-54.
Litman, B. R. (1983). Predicting success of theatrical movies: An empirical study. *The Journal of Popular Culture*, *16*(4), 159-175.
Litman, Barry R. & H. Ahn (1998). Predicting Financial Success of Motion Pictures. In B.R.
Litman, The Motion Picture Mega-Industry, Allyn & Bacon Publishing, Inc.: Boston, MA.
Litman, Barry R. & A. Kohl (1989). Predicting Financial Success of Motion Pictures: The 80's Experience. The Journal of Media Economics, 2 (1), 35-50.
Nair, H. (2007). Intertemporal price discrimination with forward-looking consumers: Application to the US market for console video-games. *Quantitative Marketing and Economics*, *5*(3), 239-292.
NPD Group, "United States." *US Market Research*. N.p., n.d. Web. 17 Feb. 2016.
Marchand, A., & Hennig-Thurau, T. (2013). Value creation in the video-game industry: Industry economics, consumer benefits, and research opportunities.*Journal of Interactive Marketing*, *27*(3), 141-157.
McWerthor, Michael "Analyzing The Accuracy Of VGChartz." *Kotaku*. N.p., n.d. Web. 17 Feb. 2016.
Mikkola, J. (2014). The Chinese Mobile Game Market.
Microsoft, Halo 4 retrocover, 2013.
OECD (2016), Inflation (CPI) (indicator). doi: 10.1787/eee82e6e-en (Accessed on 11 May 2016)
Orland, Kyle. "Introducing Steam Gauge: Ars Reveals Steam's Most Popular Games." *Arstechnica*. N.p., n.d. Web. 17 Feb. 2016.
Passerella, Robert. "Data on the Web: VGChartz vs. NPD." *OReilly Radar*. N.p., n.d. Web. 17 Feb. 2016.
Rollings, A., & Adams, E. (2003). *Andrew Rollings and Ernest Adams on game design*. New Riders.
Sacranie, J. (2010). Consumer Perceptions & Video-game Sales: A Meeting of the Minds.
Schilling, M. A. (2003). Technological leapfrogging: Lessons from the US video-game console industry. *California Management Review*, *45*(3), 6-32.
Shankar, V., & Bayus, B. L. (2003). Network effects and competition: An empirical analysis of the home video-game industry. *Strategic Management Journal*, *24*(4), 375-384.
Shapiro, C., & Varian, H. R. (2013). Information rules: a strategic guide to the network economy.

Harvard Business Press.
Sheff, D., Eddy, A., 1999. Game Over: Press Start to Continue. Vintage Books, New York.

Sochay, S. (1994). Predicting the performance of motion pictures. *Journal of Media Economics*, *7*(4), 1-20.
Takatsuki, Yo (December 27, 2007). "Cost headache for game developers". *BBC News*.
Trautman, T. (2014). Why Used Video Games Are Such a Big Business. Retrieved June 08, 2016, from http://www.newyorker.com/business/currency/why-used-video-games-are-such-a-big-business
Van Dreunen, J. (2011). A business history of video-games: Revenue models from 1980 to today. The Game Behind The Video-game: Business, Regulation, and Society in the Gaming Industry. *New Brunswick, New Jersey, USA*.
De Vany, A., & Walls, W. D. (2004). Big budgets, big openings, and legs: Analysis of the blockbuster strategy. *Asian Economic Review*, *47*(2), 308-328.
VGchartz "Methodology - VGChartz." *Methodology - VGChartz*. N.p., n.d. Web. 17 Feb. 2016.
Yaffee, R. A., & McGee, M. (2000). *An introduction to time series analysis and forecasting: with applications of SAS® and SPSS®*. Academic Press.
Wallace, W. Timothy, Alan Seigerman & Morris B. Holbrook (1993). The Role of Actors and Actresses n the Success of Films: How Much is a Movie Star Worth? Journal of Cultural Economics, 17 (1), 1-27.
Warner, B. (1996) Superbrands'97: Marketers of the year: James Whims,, Brandweek, p. S122, Oct. 7, 1996.
Williams, D. (2002). Structure and competition in the US home video-game industry. *International Journal on Media Management*, *4*(1), 41-54.
Zhu, F., & Zhang, X. (2006). The influence of online consumer reviews on the demand for experience goods: The case of video-games. *ICIS 2006 Proceedings*, 25.

9 APPENDIX

***Table 36 - Tab. I**: Pearson Correlations between price and review*

			Review	*Price*
Home console	*Review*	Pearson Corr.	1	,315***
		Sig. (2-Tailed)		,000
		N	3515	3515
	Price	Pearson Corr.	,315***	1
		Sig. (2-Tailed)	,000	
		N	3515	3713
Handheld	*Review*	Pearson Corr.	1	-,037
		Sig. (2-Tailed)		,187
		N	1293	1293
	Price	Pearson Corr.	-0,37	1
		Sig. (2-Tailed)	,187	
		N	1293	1542

***Table 37 - Tab. II**: Coefficients of the multilinear regression without seasonal adjustment*

	7th Generation			*8th Generation*		
	B	*SE*	*β*	*B*	*SE*	*β*
(Constant)	5,747***	,075		5,674***	,270	
Action	-,023	,039	-,021	,146	,115	,145
Fighting	-,101*	,048	-,044	,269*	,122	,136
Platform	-,088**	,028	-,056	,071	,114	,049
RPG	,035	,028	,024	,134	,114	,097
Rhythm	-,023	,042	-,010	-,005	,181	-,001
Shooter	-,067	,042	-,010	,197	,117	,174
Simulation	-,155***	,029	-,093	,069	,124	,034
Sport	-,214***	,029	-,184	,089	,118	,072
Strategy	,182**	,073	,038	-,108	,190	,120
Age	-,004*	,003	-,066	,003	,005	,039
Review	,004***	,001	,094	,003	,002	,053
Sequel	,010	,015	,011	,079	,042	,053
Exclusive	,040*	,019	,048	-,009	,049	-,010
Price	,015***	,001	,502	,015***	,002	,342
AAA	,031	,018	,031	,099**	,037	,100
Licensed	-,076	,028	-,041	-,016	,049	,011
Handheld	-,300***	,029	-,313	-,035	,110	-,316
Online	,047*	,018	,057	-,016	,035	-,017

GPU	,000	,000	-,054	,000	,000	-,122
Installed base	-5,529E-10**	,000	-,041	-5,043E-9***	,000	-,159
Yearly console sales	1,304E-8***	,000	,225	1,250E-8***	,000	,141

R Squared: ,299 for 7th Generation ; ,196 for 8th Generation

***Table 38 - Tab. III**: Coefficients for the first three stages of the multilinear regressions.*

	7th Generation			*8th Generation*		
	B	*SE*	*β*	*B*	*SE*	*β*
(Constant)	6,845***	,012		6,583***	,085	
Action	,141***	,018	,146	,088***	,446	,145
Fighting	,147***	,033	,073	,388***	,097	,238
Platform	-,031	,023	-,023	,160	,092	,134
RPG	,058**	,022	,045	,234**	,091	,205
Rhythm	,029	,032	,015	,071	,145	,018
Shooter	,185***	,018	,188	,491***	,089	,525
Simulation	-,330***	,024	-,227	,073	,098	,044
Sport	,040*	,018	,039	,303***	,090	,295
Strategy	,098	,065	,023	-,303	,158	,067
(Constant)	6,009***	,055		5,715***	,149	
Action	-,114***	,032	-,118	,181	,093	,219
Fighting	-,055	,039	-,027	,250**	,098	,154
Platform	-,172***	,024	-,126	,200*	,090	,197
RPG	-,075**	,026	-,059	,195*	,089	,187
Rhythm	-0,61	,033	-,031	-,049	,144	-,012
Shooter	-,117***	,036	-,119	,256**	,094	,274
Simulation	-,275***	,024	-,189	,201*	,097	,119
Sport	-,234***	,022	-,231	,197*	,092	,191
Strategy	,038	,062	,009	,206	,154	,046
Age	-,007**	,002	-,120	,004	,004	,069
Review	,003***	,001	,086	,002	,001	,052
Sequel	-,032	,014	-,038	-,041	,034	-,037

Exclusive	,057***	,015	,079	,060	,032	,080
Price	,016	,001	,605	,014***	,001	,390
AAA	,007	,016	,009	,010	,030	,012
Licensed	-,048	,025	-,030	,048	,040	,038
(Constant)	6,246	,059		5,914***	,219	
Action	-,032	,034	-,033	,170	,094	,206
Fighting	-,003	,042	-,002	,293*	,100	,147
Platform	-,087***	,024	-,063	,190*	,093	,159
RPG	,038	,031	,029	,183*	,093	,159
Rhythm	-,111	,036	-,056	-,028	,149	-,007
Shooter	-,044	,039	-,045	,256**	,096	,273
Simulation	-,157***	,026	-,108	,193	,101	,115
Sport	-,180***	,025	-,178	,227**	,096	,273
Strategy	,147*	,063	,075	,167	,156	,037
Age	-,005*	,002	-,100	,007	,004	,120
Review	,003***	,001	,089	,002	,001	,057
Sequel	-,036**	,014	-,043	-,050	,035	-,045
Exclusive	,055*	,017	,075	,016	,039	,021
Price	,015***	,001	,576	,014***	,002	,403
AAA	-,012	,015	-,014	,014	,030	,017
Licensed	-,025	,025	-,015	,051	,040	,040
Handheld	-,315***	,025	-,377	-,094	,090	-,121
Online	,038*	,016	,052	-,018	,029	-,024
GPU	-,001***	,000	,302	,000	,000	-,226