LUISS Università Guido Carli

Management and Computer Science

The video game market crash of 1983: a microeconomic perspective

LUISS Guido Carli

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Table of Contents

Foreword ***1***

Preface: a union between video game history and economics ***3***

1. Framing the period ***4***

Constructing an economic model 6

2. Technology and its judgmental role in the industry ***7***

Bringing the arcade home 8
Microcontroller applications in video game consoles 10
A microeconomic perspective – Nintendo and Epoch's decision tree 11
The programmable cartridge revolution 12
Different technologies imply different competition 13

3. The crashes ***15***

3.1 The "forgotten" video game crash of 1977 ..... **15**
A microeconomic perspective – Bertrand competition with undifferentiated economic bads 15
3.2 The "great" video game crash of 1983 ..... **17**
The marketing bubble 17
Irrational optimism and mismanagement 19
A microeconomic perspective – Oversupply 19
Loss of publishing control: unchecked competition and market oversaturation 20
Home computers as a substitute to video game consoles 21
The rise of the Japanese semiconductor industry: the chip race and the home match 22
A microeconomic perspective – SEGA and Nintendo's payoff matrix 24
The controversial chip that changed the industry 26

4. Negative externalities and the semiconductor shortage ***28***

4.1 The chip famine of 1988 ..... **28**
A microeconomic perspective – The semiconductor trade pact of 1986 28
4.2 The COVID-19 pandemic and the chip famine of 2020 ..... **30**

Conclusion ***31***

Bibliography ***33***

Additional bibliography 35

Foreword – Video games: a medium between recessions and global success

If we focus on video games, everyone will think of an image, a concept, a different context, but the most comprehensive and correct definition we would agree on is the fact that we are talking about a "medium": video games are the medium of our contemporaneity and are characterized by the degree of involvement they require from their users, since they convey content only to those who actively participate, making each player, in a certain sense, co-author of this communicative exchange.

Although video games have been affirming their relevance for decades now, the pandemic period has incredibly expanded an already enormous audience that – thanks to the forced physical isolation we faced – have found in video games a tool to get close to other people, live experiences, get excited, sometimes even survive.

Despite video games are a young medium compared to the others, they still have 70 years of history and it is no coincidence that the interest in them has overcome the initial prejudices and distances, to get to involve a varied audience that – on the academic level – is involving the most disparate disciplines: from semiotics to computer engineering, from history to economics.

From a technological and economic point of view, video games are a variegated universe full of declinations, which lends itself well to being studied and analyzed: Michele Matarrese, in this paper, not only demonstrates a great passion for the object of his study, but he also shows method and awareness dealing with the relevance of the social consequences of the events that have marked the evolutionary path of video games as an industry and market.

Choosing to analyze the recessions of 1977 and 1983 in the video game industry leading to a comparison between those years and the effects and consequences of the pandemic and the recent semiconductor shortage we faced is an approach full of interesting perspectives.

Even if the events of the latest years had an impact on our lives on the widest scale, and we are still dealing with the repercussions and consequences of it, what changes and redefinitions of the production, logistics and management structure will the experience acquired determine in the long term is an interesting and open ground to study and research. Starting from the video game industry could be a good move.

Retracing the recessions and comparing them to understand their specific aspects are all steps that bring us closer to understanding a social, cultural, and economic phenomenon as impactful as the video game medium is. Identifying 1977 and 1983 as the milestones that led to restructuring the video games industry, allows us to understand the dynamics that led to a growing success from the 90s on, to enlighten the current configuration of the sector, to clarify the indissoluble relationship existing

between technological evolution and content maturation, to explain, ultimately, how video game theory and technology is playing such a relevant role in shaping the future we are about to live.

– **Roberto Semprebene (COO, Storm in a Teacup)**

Preface – a union between video game history and economics

My strong devotion to gaming and its culture combined with my genuine interest in economics led me to write a thesis that is the result of a perfect synergy between the two. In my experimental thesis, I analyze the "great" video game console market crash of 1983, the period of the industry's worst recession. The crash has been analyzed several times in the past but mostly through a distant journalistic approach. My approach however is radically different, as I analyze the crash in a way that no one has ever done before: through the lens of microeconomics, and in detail, applying the knowledge I acquired both during my bachelor's – encompassing various subjects like Microeconomics, Management, Business Law, Marketing and even Finance – and individually, to construct a more accurate, fact-based description of the factors responsible for the crash while also providing an elaborated narrative of the events that led to that point including the lesser-known industry recession of 1977 that preceded the infamous great video game crash of 1983. My research provides an unprecedented analysis of economic theory applied to real-world business scenarios, highlighting the importance of this research is the need to debunk unfounded information through concrete examples of Microeconomics literature, filling this literary gap. I convey my knowledge using simple graphs, providing alternative and unique microeconomic insights into the historical events. Like real economists, I lay out assumptions creating a model to support my arguments. By the end of this thesis, the reader will have a clear understanding of the economic factors that contributed to the video game market crash occurred in the year 1983, a general understanding of the technology on a technicality, and a stronger familiarization with the medium and its respective industry. The end goal is to make this reading inclusive and accessible to everyone, especially to readers unfamiliar with the medium or the technical nature of the topics presented herewith. The arguments provided are the result of more than a decade of research regarding the video game industry. I try to be as objective as possible when dealing with the facts whilst also elaborating them subjectively. The thesis is structured as follows: in the first chapter I provide an overview of the players and the products in the video game home console market and lay out the assumptions creating the model that will be used throughout the thesis. In the second, I explain how the different technologies implemented in home video game consoles represented sub-markets that were not in competition with one another. The third chapter is the main chapter of the thesis illustrating the two recessions of the video game industry, and the fourth chapter serves as an extension of the third that joins the past with the present following the recent recurrence of the semiconductor shortage that arose from the Covid-19 pandemic and how it impacted the video game industry amongst others.

Chapter 1 – Framing the period

In the 1970s, the video game industry flourished. In Japan, toy manufacturer Epoch boasts 70% of the market share thanks to its commercial success, the Cassette Vision[i]. The console was so successful that cassette became synonymous for cartridge game in Japan and the term has sticked to the present day. Another company, with a background in manufacturing hand-painted playing cards – Nintendo – has begun experimenting in this new industry. Nintendo had already transitioned almost entirely to the production of toys, with some rivaling Epoch's designs that were mostly centered around baseball, Japan's most popular sport[ii]. Nintendo's first home video game consoles, the Color TV-Game[1] 6 and Color TV-Game 15 were released one week apart in June of 1977 and were highly successful and caught Nintendo with great surprise as a new potentially profitable business to get into. The Color TV-Game lineup was the outcome of a partnership between Nintendo and Mitsubishi, the latter provided the former with the technology. Nintendo had been diversifying their business operations immensely, hopping from industry to industry attempting to make it through their financial struggles[2], albeit most attempts were unsuccessful or short-lasting. Epoch, on the other hand, had already released Japan's first home video game console in 1975 – the TV Tennis Electrotennis – predating Nintendo's entry in the home console market by 2 years.

In the US, 5 years later, Atari – now industry leader worldwide with an 80% market share in North America[iii] – is dominating the home console market, with the Atari Video Computer System (VCS) selling approximately 12 million units by the end of 1982[iv]. Atari is better known for creating Pong, the world's first successful *commercial* arcade game. Pong was released to the public a decade earlier in 1972, and it quickly became a commercial sensation. Atari sought to bring Pong to the home console market in 1975 through Sears. It was another major commercial success for Atari. Magnavox, better known for manufacturing TV-sets in the 70s, released the first ever *commercial* video game console in 1972 – the Odyssey – pioneering the industry. However, due to a mixture of confusing advertising and the limitations of the hardware implemented, it failed to attract the interest of many potential consumers. The Odyssey cannot be categorized as a market failure as the system sold a discrete number of units partly thanks to Magnavox's perseverance in the market launching updated models under the Odyssey lineup until 1978, with the most commercially successful being the latest entry: the Odyssey2. Two new players in the industry, Coleco and Mattel, were about to threaten Atari's dominant position as the leader of the home video game console market. Coleco, short for Connecticut Leather Company, operated in the leather industry and had recently started producing

[1] Video games were initially called 'TV games' in Japan

[2] Nintendo risked going bankrupt several times, but the oil crisis of 1973 nearly sent the company out of business for good. The company was also forced to increase the prices for its products. Source: see additional bibliography

home video game consoles. Although Coleco was merely breaking even, home video game consoles under the Telstar brand were rapidly gaining traction in the early 70s. Mattel, on the other hand, is renowned for its strong presence in the toy industry. Mattel had released the Intellivision in 1979, a *16-bit* powerhouse[3] that allowed Mattel to claim the 2nd place in the home video game console market and that would prove a long-lasting nuisance for Atari. At the time of the Intellivision's release, there was no other system as computationally powerful on the market. Mattel took every chance to boast about the Intellivision's hardware capabilities through advertising in the form of Comparative Advertising, where they would highlight the system's superior visuals and sounds over the competing Atari VCS.

Mattel's comparative advertising, highlighting the superior visuals of the Intellivision over Atari's VCS. Source: Jeffrey, C. (2021). Intellivision: Gone But Not Forgotten. TechSpot. https://www.techspot.com/article/2210-intellivision/

Coleco would release an even more powerful and capable console than Mattel's later in August of that same year, the Colecovision. Other consoles, such as the Astrocade released by Midway[4]'s video game division 'Bally' in 1977 or General Consumer Electronics' (GCE) Vectrex in 1982, were commercially unsuccessful despite the cutting-edge hardware specifications due to considerable higher price tags and smaller software libraries.

[3] 'Bits' were often used as a benchmark to promote and sometimes compare the computational power of video game consoles. It really was mostly just marketing bluff, and other factors such as the processor's architecture proved to be much more reliable benchmarks. We will not get too technical in this thesis, so as not to bore anyone with futile technical knowledge.

[4] An amusement game manufacturer.

In the arcades, video game companies, both Japanese and American, both renowned and arising players in the arcade video game market – too many to be mentioned – were striving to push out new ambitious games to the market. The arcades were the primary place for gaming activity, they provided a gaming experience that was unmatched with that offered by home consoles and doubled as social hangouts. This thesis focuses only on the home video game market. The two markets tell a completely different story and provide two very distinct pictures of the video game industry. "Video game industry" is an umbrella term that englobes both the arcade and the home video game markets, including any form of what qualifies as a video game (e.g. computer games, handheld games, etc.). The object of the thesis focuses only on the North American home console market, but it also looks at the Japanese and European markets, including the Personal Computer and the Arcade industries.

Constructing an economic model

It is crucial to lay out important assumptions useful to back the thesis' arguments, creating a model that will serve as the mainstay of the thesis.

1) **Video game consoles are always sold at a loss**; in other words, the cost of the software subsidizes that of the hardware. There exist some notable exceptions to this rule, however, we assume this statement holds for every video game console produced throughout generations. This assumption not only holds true for the industry[v], but it also has a major impact on the profits of the producers that seek to monopolize the production and distribution of the hardware-software bundle.
2) **When two video game consoles are sold at competing prices, consumers will always prefer the most computationally powerful one**; with this assumption we contradict standard microeconomic literature of the relationship between perfect competition and perfect information. In practice, such markets typically do not exist. Rather, we assume that all consumers have access to the same information in oligopolistic competition and they can make rational consumption decisions gathering knowledge from typical sources (e.g. specialized magazines).
3) **With rapid technological advancements, economies of scale allow producing more computationally powerful consoles at competing prices**; this assumption is directly correlated with the previous one, and better products drive consumers away from less attractive ones.
4) **Brand loyalty does not exist when the market is perfectly competitive**; customers are no more sensitive to one brand than another when competing in the same perfectly competitive

sub-market. Customers see all consoles as *perfectly substitutable*, and they are totally indifferent between them. They will buy whichever one is cheaper.

5) **Industries can converge leading to indirect competition**; the rapid development of the personal computer industry that arose in the early 1970s led to a convergence with the video game industry and might have played its role in the video game crash of 1983, driving demand away from video game consoles and towards personal computers.
6) **Video game consoles are network goods**; meaning that the perceived value of a video game console increases for consumers and producers as others adopt it.

Apart from the rise of the video game medium and its billion-dollar industry in the 80s, the decade was also a period of transition for the United States[vi], and the world was rapidly changing thanks to the advancements in technology, the topic of the next chapter.

Chapter 2 – Technology and its judgmental role in the industry

Technology is a judgmental factor in the industry and plays the most important role in this thesis. The limitations of the technology available at the time seriously limited the technical capabilities of the home video game consoles on the market and hindered the work of software programmers and hardware engineers. Technology at the time was, for all intents and purposes, the most significant barrier to entry in the industry: it was the most deterministic factor that could singlehandedly prevent potential competitors from getting in the industry or drive existing ones out of business had they failed to hurry to release both hardware and software on the market equalizing or surpassing those of the most dominant players. Software, as illustrated in the next chapter, often proves to be as crucial – if not more – than the hardware itself.

The advancements in technology throughout the decades allowed incumbents to release more technologically advanced systems on the market with updated visuals and sounds to stay relevant. This meant that newer home video game systems were not in direct competition with the older ones, and this introduced the concept known as *generations of video game consoles*. Each generation is defined by different common technological features of competing game consoles released within similar time frames. Some differences may not be straightforward to grasp for a reader without a technical background, especially the subtle difference between the 1st and the 2nd generation. Let us take a step back and understand the technological aspect on a more concrete level.

Bringing the arcade home

In the 70s, the breakthroughs in semiconductor technology from the past decades were beginning to concretize and have also led to the rapid development of the medium.

All the games that could be found in the arcades during that time period were powered by Transistor-to-Transistor logic technology (TTL for short) and this essentially meant that most of the hardware was discrete (i.e. non-custom, using hardware logic) and as such the software that ran on massive printed circuit boards (PCBs) often came in the form of physical hardware circuitry with various discrete components and simple logic gates embedded in Integrated Circuits (ICs)[5]. This meant that each game ran on its own board, as different games would require a radically different hardware configuration. Since arcade machines were expensive and took up a lot of physical space, the hardware could be *scaled horizontally* rather than vertically. Essentially, to cope with the limitations of the hardware, the solution was to simply add more hardware. Obviously, the producers' intent is to always keep manufacturing costs as low as possible and consequently to maximize the utility function. When bringing video games to the living room, producers had to come to terms with reality. Since they could not scale the hardware horizontally, an alternative had to be found. Atari started developing its own custom chip that would embed the digital logic of Pong, pioneering the Pong-on-a-chip. This chip allowed Atari to shrink down the full-size Arcade cabinet down to a few on-board complementary discrete components, allowing them to release Pong to the general consumers. Atari kept their proprietary design confidential to limit competition, and Pong was expensive. General Instruments Microelectronics, well-known for designing Large Scale Integration chips, sought to release their own low-cost version of Atari's Pong-on-a-chip, the AY-3-8500. However, unlike Atari, General Instruments would sell their chips to other video game producers. This proved a major success and Coleco, among others, relied heavily on General Instruments LSI designs. General

[5] 'Integrated Circuit' is the formal name for 'chip'

Instruments attempt of riding the Pong boom was so successful the AY-3-8500 was merely the beginning of a series of LSI designs that would go on to feature different games as well.

AY-3-8500 chip. Source: Wikiwand

Despite the different play styles the newer GI LSI chips offered, the Ball & Paddle formula stuck, and for some time it seemed as though it would stay a while. Pre-existing and newly formed firms rushed to release video game consoles based around GI's chips.

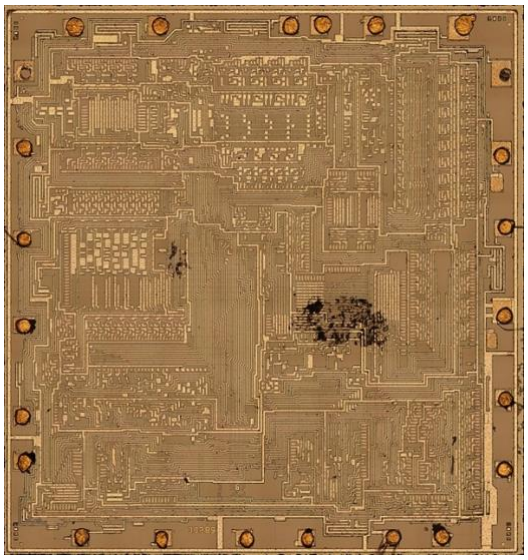
This, however, meant that the general conception of a home video game was reduced to a single image: two paddles returning a ball. Despite the economic regime resembling an imperfect competition scenario, as different products may have implemented different designs varying in play styles or even features such as colors or realistic-looking paddles, the average consumer would realistically care about only one factor: the price. We thus introduce the first microeconomic concept of this thesis: *video games as undifferentiated products.*

Video games as undifferentiated products is a concept and the sole *factor* that will directly cause the video game market crash of 1977. Technological progress and video games as undifferentiated products are inversely related: **as technological progress increases, consumers perceive video games as differentiated products.**

Other than LSI technologies, another type of component that had recently been invented, the *microcontroller unit* (MCU), integrated the Central Processing Unit (CPU), the RAM (Random Access Memory) and the ROM (Read-Only Memory). The microcontroller is - put into simple terms - a single chip computer[6]. Microcontrollers allow creating embedded systems and are typically

[6] Microcontrollers are often mistaken for microprocessors. Microprocessors are not programmable although they may embed microcode. A programmable microprocessor is a microcontroller.

implemented in black box electronic devices such as household appliances. Unlike LSI chips, where the design is imprinted onto the die[7] and cannot be altered, the microcontroller's ROM can be programmed. Another major advantage of microcontrollers is that, once programmed, their firmware is protected from retro-engineering.



AY-3-8500's die. Source: Wikimedia Commons

In the early days, microcontrollers were typically One-Time Programmable (OTP) either by the end-user via a programmer[8] or by the factory itself to save costs, while other times came with Erasable Programmable Read-Only Memory (EPROM) on board, that could be erased by exposing the window to ultraviolet light for prolonged periods of time to then be reprogrammed.

Microcontroller applications in video game consoles

The versatility offered by microcontrollers made them great candidates for video game consoles and pong-on-a-chip clones and eased the production process significantly as the challenges of commercializing new hardware pivoted towards programming the software and away from designing the hardware as it was previously done with LSI-based consoles. In Japan, Mitsubishi Electric partnered with Nintendo to provide their microcontrollers and embedded systems know-how while

[7] An unpackaged, bare chip. A die is the formal term for the square of silicon containing an integrated circuit that has been cut out of the wafer. Source: PC Magazine

[8] A programmer is a specialized tool that allows to write software or firmware to compatible chips

Nintendo provided their marketing expertise to launch a video game console, Nintendo's first, Color TV-Game 6[9].

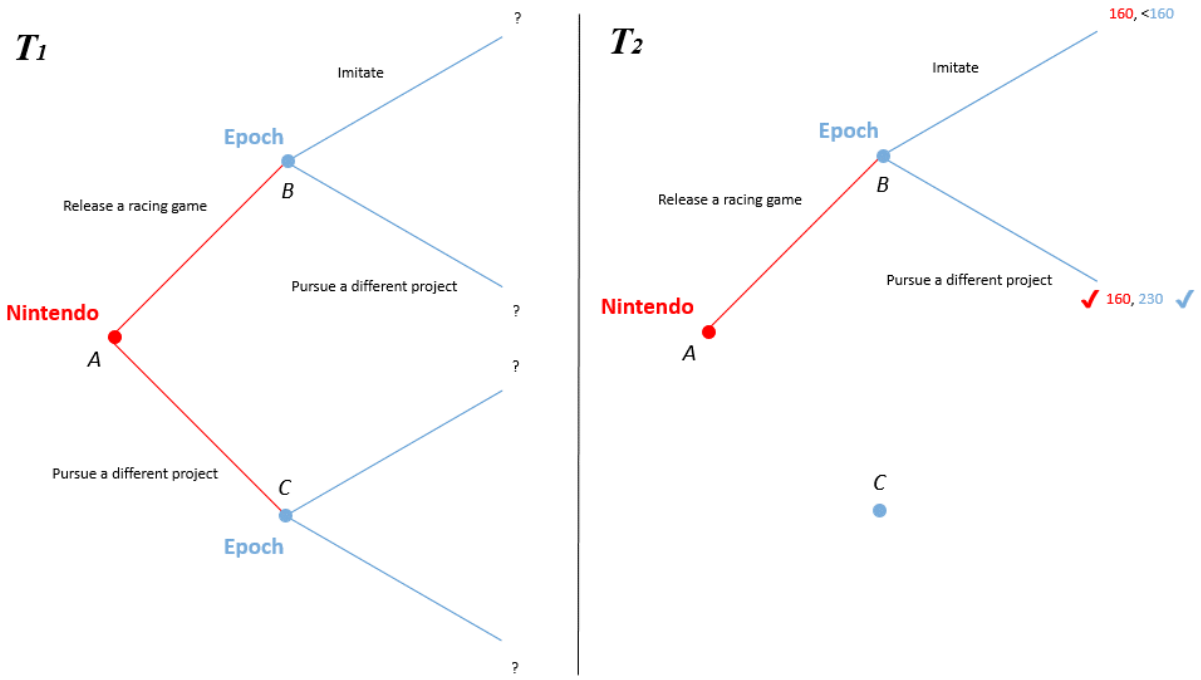
The partnership proved to be successful, and Mitsubishi approached Nintendo once more to release the next console in the Color TV-Game lineup. Nintendo's competitor, Epoch, is carefully evaluating their next move based on Nintendo's[vii]. Incidentally, the two companies operated in the market strategically resembling a Stackelberg leadership model.

Epoch also began implementing microcontrollers in their consoles following a partnership with NEC, Japan's renowned Information Technology (IT) multinational. The two companies started experimenting with new play styles that differed from the Ball & Paddle formula.

A Microeconomic perspective

Nintendo and Epoch's decision tree

Sequential game with unknown payoffs at different time intervals (Nintendo v Epoch) Source: the author



[9] Nintendo also commercialized a model with 15 game variants, the Color TV-Game 15, which reutilized the same microcontroller implemented in the Color TV-Game 6. The remaining 9 variants were simply locked out in the earlier model. This was done to encourage consumers to spend a little more to buy the apparently 'superior' model.

In this sequential game, Nintendo, the Stackelberg leader, chooses the next project. The firm moves first and decides to release at time T_1 a new entry in the Color TV Game lineup, a racing game. The firm thus picks node *B*, disconnecting node *C* from the graph. In this sequential game, the payoffs are uncertain, reflecting a realistic scenario. At time T_2 the payoffs get revealed: Nintendo's Racing 112 was a commercial failure, selling only 160K units. If Epoch decides to imitate Nintendo releasing their own version of a racing game, the firm's payoff ought to be lower than the Stackelberg leader who boasts the first-mover advantage, and because Nintendo's move proved unsuccessful, they can avoid falling into the same pitfall. Imitating the Stackelberg leader when the payoffs are lower is a dominated strategy for Epoch. The firm decided to release a different console later that same year, in 1978, the TV Baseball. The Nash equilibrium – the state where neither player can gain by a unilateral change of strategy – therefore is (160,230). A general benchmark for a successful console launch in the late '70s would be around 500k units sold. However, note that in Stackelberg competition, the firms generally compete setting the quantity, so albeit neither attempt proved successful when compared to the benchmark, Epoch might have hypothetically set the quantity lower than Nintendo.

Two years later, Epoch released the TV Vader, a space invaders clone, onto the market. Nintendo played a bold move instead. Recalling the concept of horizontally scaling the hardware in the arcade industry, Nintendo decided to release a miniaturized version of their arcade game "Computer Othello": the Computer TV-Game. The hardware reutilized the vast majority of the arcade board's components and overall architecture, which naturally made the system very costly to produce in limited quantities. The console retailed for ¥48,000, adjusting for 1980's Japan's inflation, at the current exchange rate that equals ~$530 today. The outcome, to no one's surprise, was a financial disaster.

Until then, all video game consoles released in Japan were stand-alone devices, meaning that each system was confined to the on-board design including the logic, the memory, and the play styles, with no way to expand the console's *computing power or capabilities*. Essentially, Japanese consumers would have to buy another console every time they would get tired of the game, or the hardware became obsolete. While Epoch was readying to launch the Cassette Vision in 1981, Japan's first cartridge-based, microcontroller-based video game console, the Americans had already pioneered the second generation of video game consoles.

The programmable cartridge revolution

Amongst the players competing in the market listed in chapter one, there is an important one that was left out: Fairchild Semiconductor. The semiconductor division of Fairchild was the pioneer

manufacturer of transistors and ICs. Fairchild released their video game console – the Channel F – in 1976. Its design was based around a microprocessor, specifically Fairchild's own F8 CPU. The console featured two built-in games, Tennis and Hockey, and additional games could be purchased separately as ROM cartridges. The second generation of video game consoles officially began with the Channel F since it was the first of its kind to implement both a microprocessor and ROM cartridges to expand the system's catalogue.

Yet, the Magnavox Odyssey – the first commercial video game console ever released – already allowed for interchangeable cartridges back in 1972, 4 years prior to the release of the Channel F. A fuller picture can be had when also considering Epoch's Cassette Vision.

On the outside, all three consoles read cartridges to change play styles, but *how* these systems achieve this is what differentiates them.

Inside both the Magnavox Odyssey's cartridges and the console are discrete components. The discrete components in the cartridges set different configurations which slightly alter the minimal logic the system can produce such as the height and width of the two paddles and the conditions upon collision. The experience relies partly on real world elements such as overlays that could be placed in front of the television screen.

Inside Epoch's Cassette Vision are ICs that handle how the graphics get displayed. The cartridges contain NEC's microcontroller which feature the embedded CPU, RAM, and ROM (the latter being the game data, varying from cartridge to cartridge)

Inside Fairchild's Channel F is a microprocessor (a CPU) which is capable of processing logic the same way a modern Personal Computer's (PC) would, while the processing power and bandwidth are obviously limited to the CPU's architecture and technology (in other words, a modern 64-bit CPU is not comparable with an 8-bit CPU released decades ago) and inside the cartridges is a ROM chip containing the game data exclusively.

Different technologies imply different competition

The difference between the three systems becomes obvious and it is evident they are not in direct competition with one another. Furthermore, during the Ball & Paddle boom, many competitors had already started experimenting with cartridge-based consoles based on GI's chips. These clone systems all shared the same architecture, incorporating the minimum required components to display video, including onboard complementary colorization chips to display colors, and the cartridges include the GI chip corresponding to the game.

Key takeaways:

- The Magnavox Odyssey system and cartridges implement off-the-shelf *discrete* components and as such there is no tangible competitive advantage.
- The Cassette Vision implements off-the-shelf ICs, but the cartridges contain NEC's proprietary microcontroller and Epoch's proprietary firmware (the ROM or game data). The cartridges *are* the console. The competitive advantage is the software.
- The Channel F implements a proprietary CPU architecture and complementary off-the-shelf ICs. The cartridges contain the software on a ROM chip with Fairchild's programmed game. The competitive advantage is the entire package of both the hardware and the software.
- Other GI chips-based clones implement the bare minimum off-the-shelf video generation components ICs corresponding to each game inside the cartridges. The competitive advantage in this sub-market is the price.

Notice how different the strategies of video game producers are when approaching the market. To the average consumer, purchasing a console that featured room for expandability through external media (in our case *programmable* removable cartridges) was substantial. Expandability meant that the depreciation of the enjoyment of the media – the utility generated by it – could be slowed significantly. However, when the market allows free entry due to the technology being readily available to purchase, the novelty effect wears down quickly as all products become identical to consumers, and distributors compete by offering higher rebates on their clone products.

Another remarkable aspect is that of competition and its relationship with the technology race. In other words, **there is a strong incentive for firms to innovate in the industry offering a better product to distinguish themselves in the market and the imitators**.

As new players began introducing new video game consoles featuring custom architectures, a new frontier of competition for entertainment was on the rise, and the sales of undifferentiated video game systems (Ball & Paddle and the like) began to suffer, until the market crashed.

The "forgotten" video game crash of 1977

The video game crash of 1977 is a rather silent crash, as it went unnoticed by consumers. With the implications programmable cartridges had on the useful life of video game consoles, it quickly became clear to consumers that purchasing a video game console that had no room for expandability only to repurchase another one when the current console would have fully depreciated was no longer a viable option. Consumer demand immediately shifted towards the next generation of video game consoles, or, in other words, consoles expandable through removable programmable video game cartridges. This led to a race to the bottom where players offering Pong-like game consoles began massively discounting their products in the hope of liquidating inventories.

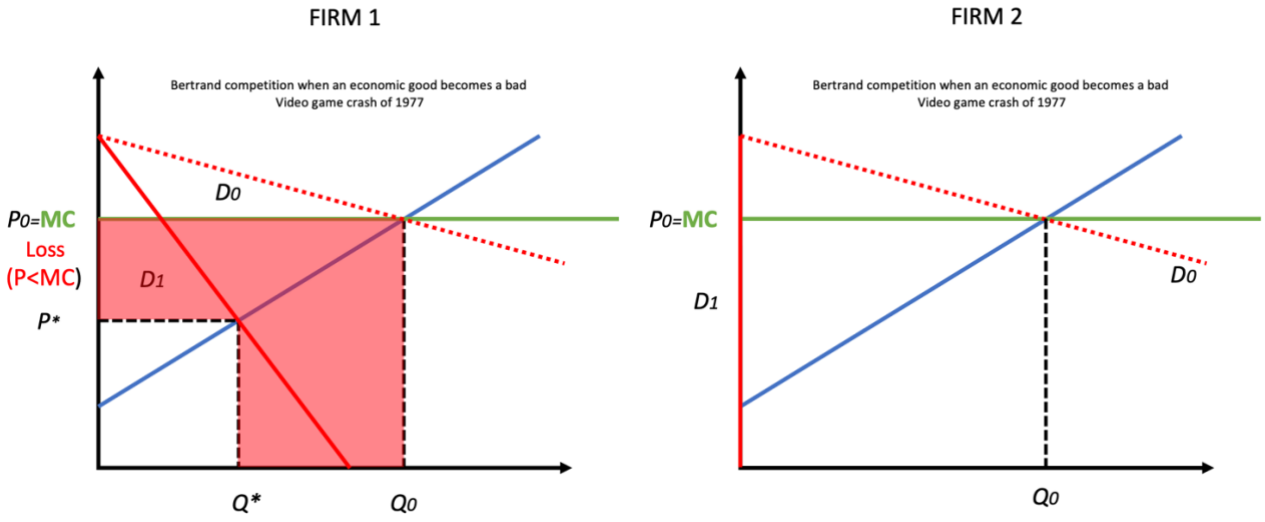
A microeconomic perspective – Bertrand competition with undifferentiated economic bads

If the assumption that video game consoles are undifferentiated holds, then the market resembled a Bertrand competition scenario. Under Bertrand competition, all products are identical, and firms compete by undercutting.

However, because products are undifferentiated, the prices will eventually reach a bedrock, depicted by the marginal cost – the cost of producing an additional unit – below which suppliers cannot afford to sell. At this level, producers break-even. The Nash equilibrium is thus expressed by the equation:

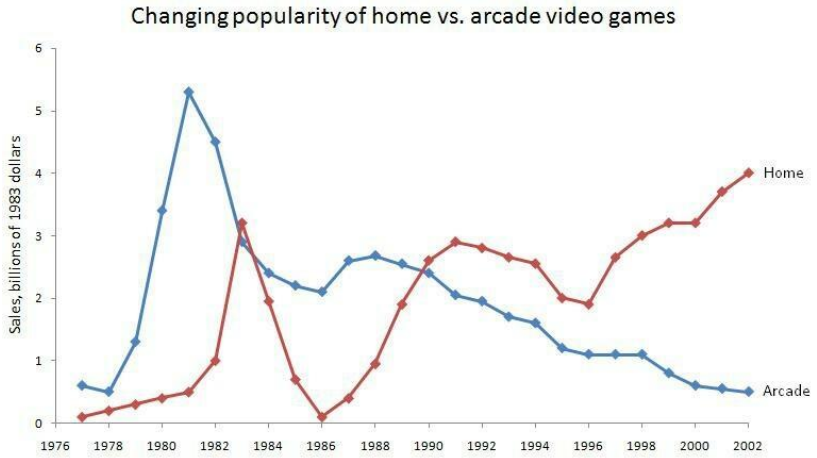
$$P=MC$$

Bertrand Competition when an economic good becomes a bad (VG crash of 1977) Source: the author



In this visual representation of the model, we narrow down the example to two players for simplicity (duopoly). Consumers purchase the cheapest game console on the market where $P_{min.}$

Firm 1 undercuts firm 2 meeting the new demand $D1$ at a loss, stealing the entire market share from firm 2. When second-generation video game consoles launched onto the market, consumers' demand for first-generation consoles dropped sharply. The sudden demand shock turned the economic good into an economic bad[10], bending the demand curve inward, and suppliers were left with no choice but to sell below marginal cost ($P<MC$). The negative demand shock caused retailers to cease stocking first-generation consoles as they took away shelf space from the next-gen consoles that were in demand with high liquidity. Nearly all players operating in the North American home console market at the time went bankrupt or left the industry. Others, such as Coleco, managed to pull through the crash with millions in losses[11]. Albeit the market corrected itself a year later, one factor that aided in the correction was the release of the coin-op hit Space Invaders by Taito in 1978[12], an active player in the Japanese arcade market that gained unprecedented attention after the popularity of their new arcade hit. Space Invaders is often cited for starting the golden age of arcade videogames[viii], and the timing of its release coincides with the surge in popularity the arcades had between 1979-1980, as indicated by the blue line in the graph below. The game was so popular that it led to an urban legend that Japan was undergoing a 100-yen coin shortage. Later research debunked this myth[ix].



Source: Williams, D. (2006) A (Brief) Social History of Video Games. In Vorderer, P & Bryant, J. (Eds.) Playing Computer Games: Motives, Responses, and Consequences.

[10] Because distributors (producers and retailers) incur warehousing and financial costs, notably the opportunity cost of shelf space for retailers.

[11] Coleco then entered the handheld market, producing several profitable electronic games before recovering.

[12] Video game manufacturers hastened to release home console conversions (ports) of trending arcade video games. The Atari VCS was the first to receive an officially licensed conversion in 1980 following the 'Space Invaders craze' and instantly became a massive sensation. Other acclaimed conversions like Epoch's stand-alone Japan exclusive TV Vader were unofficial clones that got away with slight gameplay alterations.

Nevertheless, the impact the video game crash of 1977 had on the industry is negligible as it was unilateral, only affecting the producer side of the North American home console video game market. The author advises reading the exhaustive book titled "*Before the Crash: Early Video Game History"* if one wishes to delve into the details and is interested in getting a fuller picture of the video game industry in the 1970s[x].

As for the arcades, their popularity began fading away after the 'golden era' primarily due to the rapid evolution of video game consoles, with cutting-edge technology that allowed publishers to 'bring the arcade home' distributing ports with less technological barriers and more sophisticated visuals and sound comparable to the arcade counterparts. Secondarily, the quarter in the US prevented arcade owners from monetizing the games properly, which had lobbied Washington several times to get a dollar coin, albeit unsuccessfully.[xi]

The "great" video game crash of 1983

As 1982 ended, the year appeared to be a turning point for Atari, several commercial hits for the Atari VCS published that year by world's first third-party publisher Activision include Pitfall, Kaboom, River Raid, and others, but something does not feel quite right. The final quarter closed disappointingly. Not only were Atari's revenue growth forecasts of $200M not met, but revenue had also dropped 50 percent down to $100M[xii]. Wall Street panicked, and investors rushed to sell their shares causing the stock price to plummet. In 1983, the video game market crashed (again, only this time everyone felt the shock). The crash drove Coleco, Magnavox, and Milton Bradley (MB) which had acquired GCE and the Vectrex, out of the video game industry. Mattel later sold the Intellivision brand to a liquidation company that was purchased by former Mattel Electronics Director of Marketing Terry Valeski, resurrecting the brand as INTV Corp[xiii].

To understand whether the crash was caused by demand shocks or supply shocks, one needs to take a step back to better understand what was going on behind the scenes and the implications that the technology had for the crash. The demand for video games in 1982 was at its peak with retailers, the main channel for B2C video game distribution, committing to sales of video game cartridges a year in advance. The optimism was unstoppable as it seemed as though the industry would continue to grow endlessly. But where there is growth, there ought to be a limit, and that limit was marketing.

The marketing bubble

Amongst the plethora of strategies adopted by video game producers to boost cartridge sales was to acquire licenses of other mediums – typically movies – to associate the game with, through what is known as a *tie-in*, a popular form of cross-promotion in marketing that allows the licensee to promote their work piggybacking on the recognition of the licensor's work. Atari decided to release a tie-in based on the critically acclaimed film 'E.T. the Extra Terrestrial', released in June of the same year. After negotiating the license with movie director Steven Spielberg, Atari's chairman at that time – Ray Kassar – immediately contacted Howard Scott Warshaw – who was responsible for two major commercial successes – and million-sellers – on the Atari 2600 (one being a tie-in of the movie Raiders of the Lost Ark) to promptly begin working on the project. The downside, however, was the 5-and-a-half-week deadline to get the game out to store shelves by Christmas Eve of 1982. The deadline was unrealistic considering the development time of a video game for the VCS was - on average – 6 to 9 months[xiv]. Scott Warshaw worked assiduously to deliver the game on time, and he succeeded. Albeit the game was initially a best-seller, it was quickly met by a strong backlash, causing consumers to return their copy[xv][13]. This was partly attributable to a bug[14] in the game that would sometimes prevent the player from leaving the pit they had just fallen into, causing the player to repeatedly fall back into it. Although the release of the E.T. game on the market is often naively regarded as the sole cause of the market crash by inexpert figures – implying a shock so powerful that could singlehandedly collapse an entire industry – it did nevertheless cause irreversible damage to Atari's reputation exposing the corporate's greedy upper-management policies. Atari was no stranger to bad projects, however. After acquiring an exclusive license to port the coin-op hit Pac-Man to the Atari VCS/2600 following the 'Pac-Man craze' in the arcades, Atari charged programmer Tod R. Frye to develop the home conversion. The finished product which took 6 months to complete was underwhelming[15]. Yet, despite the negative reception, roughly 8 million copies[16] were sold and the game became a best-seller for a while, but nearly half of the cartridges supplied remained unsold…

The two titles, despite being released under different constraints, both fell victim to a common mismanagement issue: over-optimism.

[13] According to Ray Kassar himself, 3.5M out of the 4M copies got returned.

[14] Computer terminology for programming error.

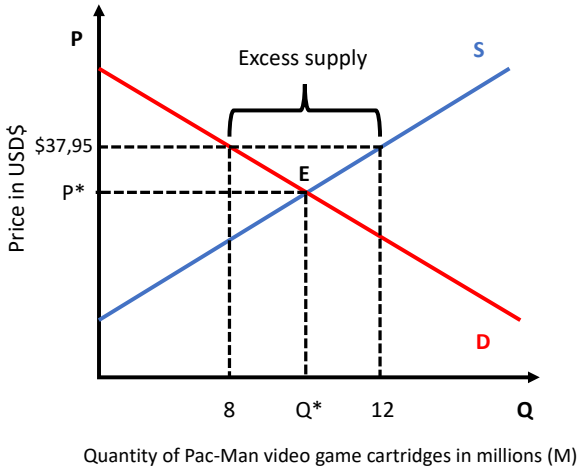
[15] This time, it was not a matter of tight deadlines but also of memory constraints and poor project decisions. (Source: see additional bibliography).

[16] The actual numbers are closer to 7.7 million.

Irrational optimism and mismanagement

Atari's management was dreadful, but most shocking were the utterly irrational financial forecasts: Atari had supplied more cartridges – 12 million copies of Pac-Man – than the total amount of VCS units sold, 10 million at the time, not accounting for all the inactive users that owned an Atari 2600 and had moved to a new video game console due to the hardware falling into obsolescence[xvi]. Sales had already slowed, but Atari was optimistic: they thought to themselves that these new games would be purchased by every owner of a VCS across North America as well as inducing new potential American consumers to buy a system and cartridge bundle, dazzled by the marketing and the popularity of the icons.

A microeconomic perspective – Oversupply



Source: the author

Atari supplied 12 million Pac-Man cartridges at $37,95 MSRP, but consumers demanded 8 million. In this example, the market is in disequilibrium. The quantity of the product supplied exceeds that of the optimal combination of quantity Q* and price P* at equilibrium E. When producers oversupply, the price drops, causing an increase in demand until the equilibrium is restored. Retailers also undercut MSRP at launch or later issued rebates to induce consumers to buy a copy. Atari VCS sales did increase with the release of Pac Man however, but only by 2 million units, adding up to a 'grand' total of 12 million VCS consoles sold.

This oversupply fiasco caused sudden shifts in the demand curve, and retailers were pressured into discounting, driving per-game revenue down to 0[17]. Atari was running out of room to store unsold

[17] Retailers perfectly depict Bertrand's competition model. Many stores across North America undercut the official list price of $37,95 at launch, while others could leverage on location-based price discrimination.

cartridges in their warehouses, and urban legends at the time claimed that Atari had buried millions of games in a landfill in Alamogordo. Atari initially denied claims of the burial as a consequence of financial distress, stating the cartridges that had been buried were 'defective'[xvii], but officials later confirmed the numbers to be around 700,000. In 2014, excavations belonging to the documentary Atari: Game Over revealed the burial had indeed happened albeit only about 1,300 cartridges got recovered. The rumors turned out to be true, and the fiasco was so impactful to the point where four decades later the video game crash of '83 appears in Microeconomics textbooks.[xviii]

Some of the cartridges recovered during the extraction (Atari E.T. Dig: Alamogordo, New Mexico). CC-BY-2.0 Source: Wikimedia Commons.

Irrational optimism is not uncommon amongst managers, but that surely cannot just be everything there is to it. Indeed, there are other smaller but impactful factors that contributed to the crash.

Loss of publishing control: unchecked competition and market oversaturation

At the beginning of the chapter, Activision was briefly mentioned for publishing many best-sellers in the VCS catalogue especially around the time the market crashed. The history behind how Activision came to be is more interesting however, as Activision's thrive was inadvertently responsible for inspiring new players to capitalize on third-party video game publishing. The term "publisher" did not really exist within the video game industry before Activision, which was founded in 1979 by Atari's game designers David Crane and Alan Miller. The two decided to quit Atari and publish games under their brand, unhappy with Atari's strict corporate policies that forbade crediting the authors of VCS games[xix]. Before Activision, Atari provided both the hardware and the software. Crane and Miller launched third-party publishing of video games, challenging Atari's monopolistic position in the industry. Atari sued Activision the following year claiming that Activision had "stolen trade secrets and violated non-disclosure agreements (NDAs)"[xx] but came out defeated after the case was settled in 1982, with Activision agreeing to pay royalties to Atari. Although Activision became renowned for the distinctive quality of their games published for the VCS, the imitators became

infamous for the exact opposite reasons, publishing a plethora of questionable games saturating the market. One company – American Multiple Industries – even started producing video games targeted to adults depicting sexually suggestive themes. Market oversaturation not only led Activision to diversify their business operations by publishing for different consoles and personal computers, but also contributed towards damaging Atari's brand image and reputation, introducing dirty competition (or *unchecked competition*).

Home computers as a substitute to video game consoles

Video game consoles were not the only platform where this media could be consumed, however. In a blog article by gaming historian Damiano Gerli, his research provides an alternative narrative on the crash of '83 through a European perspective where the crash was never felt, and the popularity of personal computers and rampant software piracy led to a different development of the European video game industry[xxi]. Personal computers were immensely popular in 80s Europe following the rise of *affordable home computers*. The ZX Spectrum released by Sinclair in 1982 later became Britain's best-selling PC[xxii], and its commercial success preceded by that of Sinclair's earlier entries such as the ZX80/81, including that of other historical players like Commodore's C64 paved the way for the home computer boom of the 1980s. Although home computers were also trending in North America and other developed nations, they never had quite the impact as in Europe in terms of reach. The distribution of software (hence video games) on cassette tapes made them incredibly cheap to manufacture as opposed to traditional programmable cartridges, for instance the British could buy a computer game for as low as £10 during the computer boom. Cassette tapes were also remarkably simple to copy and distribute, often bearing little copy protection where present, allowing cheaper (and illegal) redistribution of computer games. Additionally, the increased computing power of home computers allowed them to process video games better than the dedicated consoles could. Finally, the appealing price tag of personal computers might have led consumers to shift their consumption behavior away from video game consoles and towards PCs. Households might have hypothetically perceived PCs as a better investment than video game consoles, considering that home computers provided greater economic utility. However, home computers have historically been perceived as imperfect substitutes to video game consoles, complements rather than substitutes. Looking at the United States, perhaps then one might look at statistics to check if supporting evidence exists. Indeed, economist Maureen Boyle Gray writes in a 1992 survey for the Bureau of Labor Statistics that

households purchased personal computers primarily for their "game-playing and graphical capabilities" when they were first introduced to U.S. consumers in 1975.[xxiii]

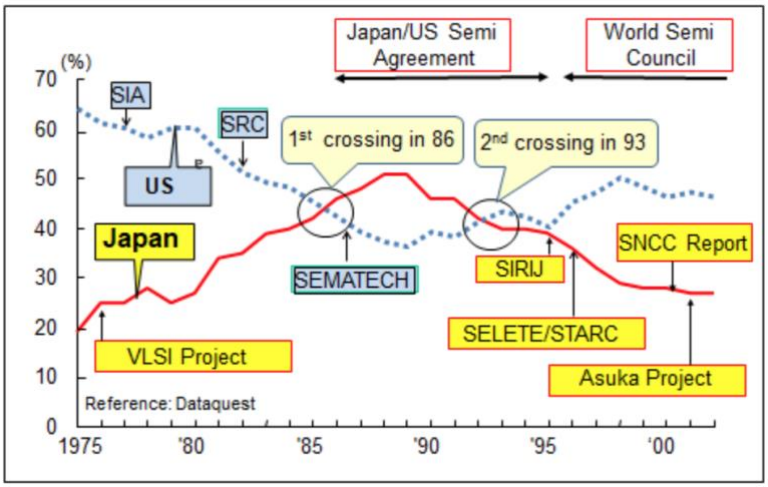
Personal computers ought to have influenced the sales of video game consoles to a degree, but to what extent it is difficult to state with certainty without numbers.

While the video game industry was undergoing a recession in the United States, the European and Japanese markets were thriving. In Europe, video game console sales were offset by those of home computers, but Japan's video game console sales remained unaffected.

The rise of the Japanese semiconductor industry: the chip race and the home match

During that period, Japan's semiconductor industry was booming. With the substantial increase in demand for consumer electronics, the Japanese government began investing heavily in the country's semiconductor industry[xxiv]. The strong government efforts led to an undefeated know-how of Japan's chip design and manufacturing, steadily reclaiming market share from the United States.

Semiconductor market share of Japan and US



Source: *Rise and Fall of Japanese Semiconductors*. (n.d.). Makimoto Library. https://www.shmj.or.jp/makimoto/en/pdf/makimoto_E_01_20.pdf

Japan soon became a new technological frontier, and many industries reaped the benefits of the efficiency boost resulting from technological progress, notably the video game industry that relied heavily on technology. Suddenly there was a radical change in the way the Japanese market leaders perceived the boundaries of technology. The incumbents at the time (Nintendo, SEGA, and Epoch)

began working assiduously on their next projects with great emphasis on R&D, which would result in three third-generation video game consoles: Nintendo's Family Computer, or Famicom for short, SEGA's SG-1000 and Epoch's Super Cassette Vision, the successor to the Cassette Vision released in 1981. The Famicom and the SG-1000 were both released on July 15 of 1983 and although SEGA initially swept sales away from Nintendo – with more than double the figures they had anticipated – Nintendo still managed to outsell SEGA's SG-1000 becoming Japan's video game console market leader. Conversely, Epoch would not release the Super Cassette Vision until 1984, missing the window of opportunity entirely due to the late release date coupled with inferior hardware specifications at launch. Epoch ended up retiring from the industry following the scarce success of the SCV. Although Nintendo did come on top with a stronger brand image, porting their Arcade successes to the Famicom thus providing a more appealing and better marketed software library, SEGA's conservative publishing policy – reminiscent of Atari's – led SEGA to a publishing isolation which made them the sole publisher of software for the SG-1000. Although both firms had carefully learnt from the events of the Atari shock as not to repeat the same mistakes, what ultimately differentiated the two was the pursuit of different visions; Nintendo sought to capitalize the United States home console market as innovation in the industry had halted following the industry's recession. Nintendo initially approached Atari to have them commercialize the Famicom in the US under Atari's brand, but the deal fell through, ending up self-distributing the system test-launching first in New York in 1985 before going national in 1986. They rebranded the Famicom as the Nintendo Entertainment System (NES) and marketed it as a toy, and the more premium "deluxe set" bundled the system and an electromechanical toy robot together, dubbed R.O.B., a companion that would serve as player 2[18]. For the United States market, Nintendo's approach to publishing control was to enforce their own barriers to entry through proprietary copyrighted technology; they had developed a chip dubbed the "10NES" which acted as a 'lock' to prevent the publishing of unlicensed video games on the NES. The counterpart 'key' chip would be provided by Nintendo themselves once the publisher had been authorized and placed a minimum order of 10,000 cartridges. Nintendo embraced third-party publishers but imposed a rigid process to become a licensee; the firm forced developers into a 2-year exclusivity agreement and narrowed the maximum amount of publishable video games per-publisher to 5 a year. Receiving the seal of quality also meant following tight guidelines aimed to moderate the content of the video games published[xxv]. In a recent interview from 2020, former Nintendo of America marketing manager Gail Tilden – who was directly responsible for getting the Famicom to appeal to American audiences – discusses how marketing the NES deluxe set bundle as a toy when it was first test-launched in New York proved to be a step in the right

[18] Beyond the marketing, ROB was nothing more than a tech demo, and was only ever supported by 2 titles.

direction, and displaying the Nintendo seal of quality on the boxes to highlight the craftsmanship was another impactful move that has since stayed with the firm[xxvi].

SEGA had learnt from the mistakes of the SG-1000, releasing the SEGA Mark III in Japan rebranded as the Master System to rival Nintendo with superior hardware specifications, but the first-mover advantage and the monopolistic practices set by Nintendo once again isolated SEGA preventing the growth of the Master System's software library, limiting SEGA's market share in the home console market.

A microeconomic perspective

SEGA and Nintendo's payoff matrix

Suppose now that SEGA and Nintendo had released the Master System and the NES at the same time, eliminating the first-mover advantage. If the assumption that consumers always prefer more to less holds true, with the Master System surpassing the NES in terms of computing power[19], it would be easy to think that consumers might have preferred the Master System to the NES, considering the price difference of 'only' $20. However, software plays an important role in determining the hardware's success, and monopoly policies that restrict software publishing have a deterministic effect on the finances of competing players. Expressing the outcomes through a normal game form, where row player depicts Nintendo in red and column player depicts SEGA in blue, one can hypothesize the market share percentages of the two firms and find a Nash equilibrium.

[19] In practice, however, Nintendo heavily subsidized the cost of the NES console with its cartridges (dubbed GamePaks) to extend the lifespan of the console. The cartridges included 'mapper' chips to expand the system's memory and graphical capabilities, sometimes even sound chips to enhance the music and sound effects.

		SEGA	
		Leverage	**No leverage**
Nintendo	**Leverage**	0,100	35,65*
	No leverage	✓ 10,90 ✓	50,50

*assuming no first-mover advantage and symmetric information

Source: the author

There are three important assumptions in this game:

- With no first-mover advantage, consumers prefer the Master System for its superior computational power. Both systems hypothetically launch on the US market at the same time. The market shares are fictitious.
- Publishers seek to maximize revenues prioritizing the console with the highest market share[20]
- Either player can leverage on a two-year exclusivity policy to restrain competition

The outcomes can be presented as follows:

- If Nintendo chooses to leverage and SEGA chooses to leverage, SEGA steals the entire market share away from Nintendo. In this scenario, leveraging for Nintendo leaves Nintendo worse off. If both companies enforce a two-year exclusivity policy, publishers will rather publish only for SEGA's hardware. This strategy is said to be dominated for Nintendo. Please note that this payoff is unrealistic, and in practice Nintendo would still retain a small portion of the market share.
- If Nintendo chooses to leverage and SEGA chooses not to leverage, SEGA retains a high market share, but Nintendo now owns a 35% market share because the software houses that decide to publish for the NES will not be able to publish for the Master System for two years,

[20] Refer to assumption 6. Network effects are considerably important for the industry.

leaving SEGA with less games. Because SEGA does not impose any restrictions, publishers will still prefer publishing on the Master System first, porting their games over to the NES after the exclusivity period ends.

- If Nintendo chooses not to leverage and SEGA chooses to leverage, SEGA will retain almost the entire market share. Publishers will prefer to publish for the console with the highest market share, in this case customers prefer the Master System for its superior performance, so publishers reluctantly adapt, bearing SEGA's policies and royalties. Publishers, in practice, would rather publish for the NES, but since customers demand games for the Master System, publishers ought to meet demand, publishing where the market is. Few publishers however might port their games over to the NES after the exclusivity period ends or may be left with no choice but to publish for the NES as not to bear SEGA's royalties if the costs outweigh the benefits of a larger clientele.
- If neither firm leverages on an exclusivity agreement, publishers will diversify to maximize profits, publishing games for both consoles hence satisfying both clienteles. In the end, albeit customers prefer the Master System for its superior performance, the NES sells for $20 cheaper, so the two firms will end up splitting the market share.

The Nash equilibrium is found where Nintendo does not leverage and SEGA leverages, because SEGA will always be better off leveraging, the firm's dominant strategy. Under the aforementioned assumptions, Nintendo will be left with a small market share, inverting the real-world scenario. If considering the first-mover advantage, the game would become invalid, as the normal form game assumes both players move simultaneously.

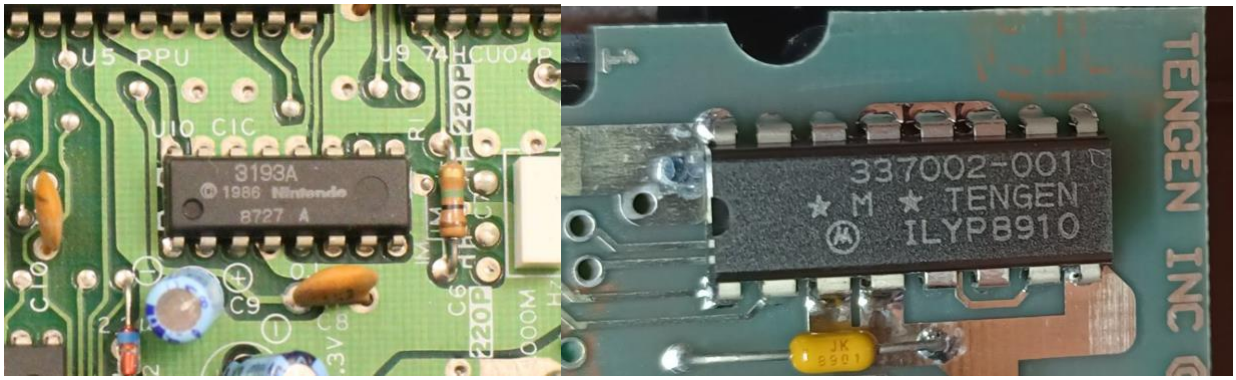
Please note that the model presented is not only verbose and fictitious but also unrealistic.

In practice, brand loyalty, marketing, and small price changes (markups or rebates when price discriminations exist) are significant factors that determine the market share of a product. It is nevertheless interesting to toy with game theory to model various scenarios and derive interesting insights.

The controversial chip that changed the industry

To circumvent Nintendo's exclusivity policy and fees, third parties developed for the NES under subsidiaries. Atari Games – now developing under their subsidiary Tengen – were particularly unhappy with Nintendo's high fees, and after illegally obtaining access to the algorithm of the

10NES[21] and reverse engineering the chip, Tengen began to manufacture their own unlicensed cartridges motivated by the stagnant low sales following the chip famine of 1988, suing Nintendo in the process for antitrust violation and unfair competition[xxvii]. Nintendo countersued Atari Games for violating trade secrets and in the end came out victorious as Tengen was ordered to cease the sale and manufacturing of their unlicensed cartridges.



Nintendo's own 10NES chip on the left, Tengen's 'Rabbit' clone chip on the right.

Sources: https://www.retronintendoreviews.com/retro/10nes-lockout-chip-basics.html, https://twitter.com/Foone/status/1418697497594056707/photo/1

The Federal Trade Commission later investigated Nintendo with the accusation of "restraining competition", Nintendo thus decided to ease their licensing restrictions a year later (notably the exclusivity policy)[xxviii] and the FTC settled with Nintendo forcing the latter to send recent NES buyers five-dollar coupons, as well as granting dealers price-setting power.

Although other firms released unlicensed games on the NES, Nintendo never utterly lost publishing control, and the 10NES chip served its purpose to shield the firm's brand image while establishing in the US market.

By the end of 1986, Nintendo had reached a market share of 65% in the home console market. Conversely, Atari's market share had plummeted, now controlling a measly 24% compared to the 80% share the company had a couple of years prior, before the crash.[xxix]

[21] Atari requested a copy of the 10NES program from the copyright office falsely claiming that the material was the subject of litigation

Chapter 4 - Negative externalities and the semiconductor shortage

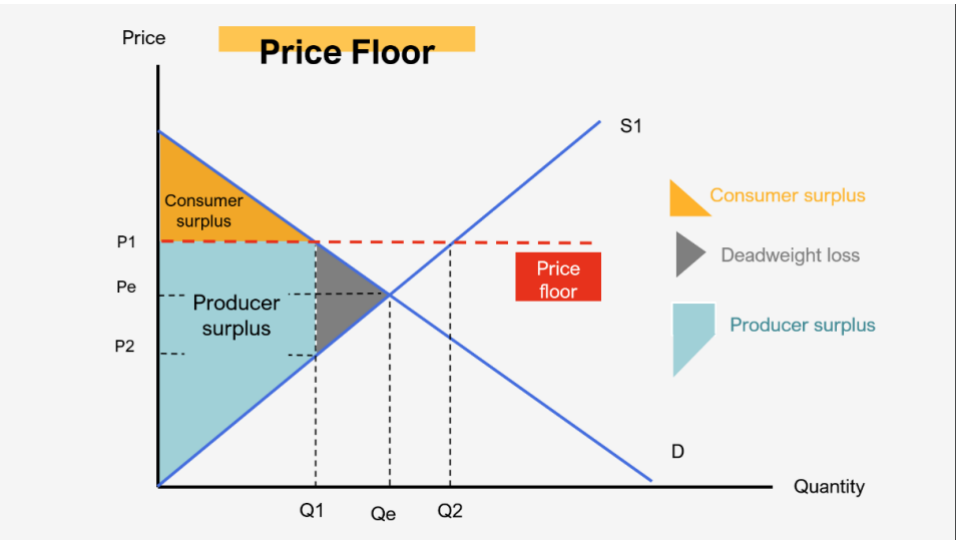
The chip famine of 1988

In 1988, just as Tengen became a Nintendo licensee, a semiconductor shortage[22] severely impacted the profits of all licensees. The shortage was the unintended result of the sanctions imposed against

Japan by the US government to stop them from "dumping"[23] their DRAM[24] chips onto the US market, which led to fewer chips supplied and a higher bedrock for minimum price, combined with the shift in production away from 256Kb chips and towards 1Mb to meet the shift in demand for higher capacity computer memory[xxx].

A microeconomic perspective

The semiconductor trade pact of 1986



Source: http://penpoin.com/deadweight-loss/

When Japan and the US signed the semiconductor trade pact in 1986, the American government aimed to save the chip manufacturers enforcing a price floor, limiting Japan's dumping of memory chips. Before the price floor, 256Kb DRAM memory chips traded at $2,60, deemed predatory by the US government. After the price floor and the sanctions, Japan exported less DRAMs, causing prices

[22] Referred to as "chip famine" in the industry.

[23] Dumping occurs when a country or company exports a product at a price that is lower in the foreign importing market than the price in the exporter's domestic market. The biggest advantage of dumping is the ability to flood a market with product prices that are often considered unfair. Source: Investopedia

[24] Short for dynamic random-access memory, a type of computer memory chip

to surge to $12,45 a chip leading to a decrease in consumer surplus. This is a rare case of a government-enforced cartel, and one that did not come without controversy. Many questioned whether this was really a case of dumping or just sheer protectionism[xxxi]. Regardless, this policy had the opposite effect of what the government intended to achieve, forcing chip manufacturers to pay higher prices thus harming their business.

The shortage had strong repercussions on Nintendo, intensified by their anti-competitive practices. The licensees had to succumb to paying a premium to get their cartridges manufactured by Nintendo in Kyoto, covering all production costs. Additionally, Nintendo enforced high quality control standards to dictate the chips suitable to be used in the cartridges. The chip shortage coupled with Nintendo's practices led some to believe that the shortage was but a hoax: Tengen accused Nintendo of faking a chip shortage to set monopoly prices. Nintendo denied any accusation of being the craftsmen of an artificial chip shortage. Looking back at this event in history more than three decades later, it appears evident that Nintendo was in fact not involved in conspiring a chip shortage. Nintendo themselves could not meet demand with the launch of their new first-party titles, namely their newest hits "Super Mario Bros 2" and "Zelda II: The Adventure of Link" (the latter due to a delay in throughput time for SRAM chips)[25] originally came in limited quantities until more chips became available.

In 1986, when the US and Japan signed the semiconductor trade pact, it might have signaled that a potential chip famine was on the horizon due to tightening export of memory chips from Japan to the US. In that time frame, Nintendo released an add-on for the Famicom in Japan known as the Famicom Disk System (FDS) which not only enhanced the system's hardware but also read games from a different format altogether: a proprietary magnetic diskette reminiscent of the more standardized floppy disks. With this add-on, Nintendo might have tried to mitigate the effects of a potential chip famine in Japan and redirect its clientele to the FDS prioritizing the new hardware for future releases of the firm's main franchises. Nintendo could afford to sell games on diskettes for as low as the yen-to-dollar equivalent of $15, since this physical media was incredibly cheap to manufacture. Diskettes could also be rewritten, and Nintendo offered a service to rewrite disks for only ¥500 (~$3) through kiosk machines. Diskettes could be a substitute for cartridges, replacing the expensive and scarce chips whilst maintaining – and enhancing – all the features that cartridges offered.[26]

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[25] The chip famine of 1988 caused a general shortage of different technologies of memory chips, including static random-access memory that was used in more ambitious Nintendo titles to save the game's progress.

[26] Despite an initial successful first impression, the FDS was ultimately a commercial failure as it failed to attract consumers due to the hardware being cheaply made and often resulting in malfunctions.

Nintendo also had one major advantage over its licensees: the company had full control over the supply of any video game released for their console, and this allowed them to strategically reallocate the available resources by reducing or halting the print of residual titles in favor of new releases, as well as bundling two or more games on the same cartridge. SEGA also got affected by the chip famine, but the effects were negligible, as the firm relied mostly on different memory chips.

The COVID-19 pandemic and the chip famine of 2020

Over the course of the past few decades, there have been several chip famines, but the most impactful one was certainly the most recent in 2020 when The World Health Organization (WHO) declared the pandemic status. By then, most workers were either working from home or became unemployed.[27] The unprecedented increase in demand for consumer electronics derived from smart working and physical isolation, aggravated by geopolitical and environmental factors such as the US-China trade ban and the severe weather conditions in Japan and Taiwan had severe implications on the supply chain, leading to the present ongoing chip famine which affected at least 169 industries according to an analysis by Goldman Sachs[xxxii], primarily impacting the automotive and consumer electronics industries.

The manufacturing of cars slowed down significantly due to a high presence of chips per-unit produced while demand for used cars increased[xxxiii].

Computer parts, specifically Graphics Processing Units (GPUs) became difficult to acquire due to rising popularity for proof-of-work cryptocurrency mining, and bots allowed scalpers to hoard GPUs from online retailers to resell at a significant three-to-four-hundred percentage points above MSRP. When the cryptocurrency market later crashed in 2022, the second-hand market for GPUs got flooded with cheap residual-life cards, inverting the supply and demand scenario.

The video game industry was also impacted by the chip famine, most notably Sony's launch of their ninth-gen console, the PlayStation 5, coincided with the ill-fated timing of the pandemic and the resulting shortage of semiconductors, causing record high demand and low supply. Most retailers could not meet demand. One major name in the video game retail business, GameStop, resorted to aggressive and deceptive forced bundling practices to elude the shortage, resulting in a €750K fine by the Italian Federconsumatori[xxxiv]. Nintendo also manufactured 20% less Nintendo Switch consoles[xxxv], and Microsoft suffered a similar fate to Sony's, minus the bundling.

[27] Many countries such as Italy set up Covid-19 redundancy fund procedures to provide temporary financial aid to their workers.

As of the release of this paper, the chip famine has not yet fully ended, but the soothing trends suggest that it is headed towards termination, with throughput time for chips and supply in the relevant industries slowly stabilizing.

Conclusion

In conclusion, after providing a quasi-complete picture of the products, the players, and the technology with microeconomic insights, it is hence possible to provide a cohesive explanation of the cause of the great video game recession. Although it is not possible to weigh the factors presented with numbers, it is not required to present a better and more objective narrative of the events.

In the late 70s and early 80s, Atari was synonymous for video games. The E.T. video game and the burial of VCS video game cartridges were not the cause but the effect of a company in financial distress, as explained by Atari's co-founder and ex-CEO Nolan Bushnell in the documentary 'Atari: Game Over'. When Warner Communications appointed Ray Kassar as the CEO of Atari Inc.in 1979 after firing Bushnell in 1978 over management conflicts, it caused a gap between the engineering and business backgrounds required to run a fast-growing IT firm such as Atari. Before Kassar, Atari was run by engineers who had a deep understanding of the technical and design challenges involved in producing and delivering video games on a schedule, and the workplace bore little resemblance to that of a typical corporate. Kassar had no background in engineering, and this new management was unfit for the company which not only alienated its employees, but also led the firm to take on risky projects backed by irrational financial forecasts blind sighted by profits, which ultimately led to the company's downfall, dragging the home console market with it, simply because Atari represented the home console market with a 70-80% market share. Unchecked competition and market oversaturation, too many different consoles and too much shovelware on the market might have influenced consumers to substitute video game consoles with home computers, motivated by superior computing power, hence better games, and overall greater utility on the dollar. Kassar's Atari naively thought consumers would fall for their marketing stunts, forgetting about the shallow products entirely. When Atari shifted their business to quantity over quality, it backfired on their brand, and consumers diverted to more appealing third-party titles such as Activision's, resulting in staggering losses for Atari. Eventually, when the stock title collapsed and panic hit Wall Street, when demand was record-low and supply record-high, video games had lost all their economic value, selling at or below marginal cost. Massive rebates got issued in an attempt to liquidate inventories, but Atari had to resort to burying the remaining cartridges in a landfill. The Europeans and the Japanese never felt

the effects of the crash: in Europe, home computers and computer games thrived, in Japan the industry was still developing in 1980 and consoles still relied on microcontrollers. Even when Nintendo first test-launched the Famicom in the US in 1985 rebranded as the NES, marketing the console as a toy, it is hard to believe that consumers really perceived the product as a toy rather than a video game, and in 1986, when the NES became available to purchase separately rather than strictly bundled, Nintendo still retained the interest of North American consumers; the firm – which had already built its brand image in the arcades – provided an enticing package of modern hardware that was fairly priced, and quality[28], regulated software. Nintendo taught Atari a lesson in barriers to entry and market capitalization, imposing strict (and unfair) practices to obtain and retain their market share at others' expense, monopolizing the home console market in the US. At last, what differentiated Nintendo from SEGA was the first-mover advantage and an aggressive market capitalization strategy, elevated by restrictive monopoly policies. Nintendo's NES against SEGA's Master System was merely the beginning of a long-lasting series of battles for market share and profits in the new video game industry made in Japan.

[28] The Nintendo seal of quality was not an absolute guarantee of quality in the case of third-party video games. For instance, LJN produced several tie-in video games for the NES which are widely considered to be mediocre and below Nintendo's standards.

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