Is there a first mover advantage in the market for Japanese video games systems?

Abstract

The market for video games machines in Japan has evolved in a series of distinct and progressive generations, each displaying the characteristics of a standards war. In such a contest, a small number of incompatible products with similar technical specifications battle to dominate the market. Economic theory would suggest that position in the order of entry has an important influence on market performance, and that the mantle of first mover carries with it a strategic advantage that can be exploited by firms. This paper empirically examines the effect that a firm's position in the order of entry into the market has upon its performance. Based on data supplied by a CESA survey on console ownership, an econometric model is constructed which tests the statistical significance of the relationship between the order of movement and market share. The results indicate that, in the market for Japanese video games systems, there are significant disadvantages associated with the first move and significant advantages associated with the second move.

Keywords: Strategic Entry Order, First Mover Advantage, Standards Wars, High Technology, Innovation, Video Games

1. Introduction

The video games market has undergone a period of considerable evolution since its origin in the 1970's. Whilst initially perceived as a market solely geared towards children, the medium of video gaming has since become a major part of popular culture. According to a 1998 survey by the Interactive Digital Software Association (IDSA), the average age of a video games player is 21, while 63% are over 18, and 29% are over 36. According to the European Leisure and Software Protection Association (2001), the video game market grosses over 60% more than total cinema box office receipts and 80% more than video and DVD rentals in the UK.

The market for video games systems has evolved in a series of successive hardware generations. In the modern era, the industry has been dominated by a highly concentrated, non-collusive oligopoly comprised of four key players: Nintendo, Sega, Sony, and more recently, Microsoft. The hugely influential work of Schumpeter (1928, 1942) identifies that there is expected to be a positive relationship between levels of industry concentration and innovation. This contention is supported by Scherer (1967), who suggests that, when taking account of the trade-off between development time and cost, oligopolistic markets are likely to experience the fastest pace of innovation. These hypotheses seem to be borne out in the market for video games systems, which could be considered to be rapidly innovating and highly technology-based. With each generation of hardware, companies will typically bring to market a single home video games machine on the market that will form the basis of sales efforts and software development. However, due to product and process innovations in the design and manufacture of these products, the shelf life for any given generation of consoles is limited. The console sector has traditionally followed cycles of approximately five years between generations, after which older machines are superseded by new technology. Each generation of consoles is perfectly superior to the previous in terms of technical characteristics and the firm's production and advertising effort shifts entirely to the new generation of hardware upon its release. Therefore, as each phase in the evolution of home video game entertainment systems is reached, previous generations are rendered obsolete. (Informa Media Group Report, 2000). According to Riley and Riley (2003), these hardware cycles are removed from the broader economic cycle, and so booms in the market for home video games systems are quite likely to occur even in periods of economic recession.

Firms looking to gain a foothold in the market for the next generation of hardware face a market where successive product innovations build heavily on the characteristics of previous models. However, within each generation, most products have broadly similar technical characteristics to each other, as there is a huge incentive for firms to operate on or near the frontier of technology

so that no one product is seen to be technically inferior to its rivals. The search nature of these goods as well as the predisposition of consumers to seek information through magazines and the internet would make any disparity in quality immediately apparent. Therefore, if hardware exhibits similar technical characteristics between competing products at each generation, and consumers possess information on performance that is approaching perfect, what could account for the differences in the sales of these consoles? This paper proposes that position in the order of entry may be a key factor in determining whether a video games machine will be a success or a failure. Conventional economic theory suggests that in a high technology industry such as this, the first firm to reach the market will, in all likelihood, come to dominate. It is also possible that any advantages accrued from the first move will remain with that firm through subsequent generations of hardware, which makes the strategic timing of entry doubly important. This paper attempts to estimate an econometric model including a dummy variable to determine if there is a significant advantage associated with a firm's position in the order of entry, as well as to identify any other significant factors that affect the sales of a video games machine, such as the quality of compatible software or price.

2: The Video Games Market

It was the 1975 release of the game 'Pong' by Atari that fathered the concept of home video gaming. The success of Pong provoked a number of competitors: seventy-five companies launched home television tennis games in 1976 (Herman, 1994). One of these was Fairchild Camera and Instrument, who released a new video games console called the 'Channel F' with additional plug in games called 'video-carts'. By 1980, a number of other firms had decided that they wanted to establish themselves as leading players in the market for video games machines. Coleco and Mattel, for example, entered the home market with the 'Telstar Arcade' and the 'Intellivision' respectively. This was the first incarnation of what was to become known as the 'console wars', where multiple firms competed fiercely against one another for market dominance (Poole, 2000). However, at this early stage, no clear market leader emerged.

This was to change when, in 1980, a Japanese firm by the name of Nintendo enjoyed huge success with the release of their 'Donkey Kong' game in arcades. They capitalised on their newfound reputation by introducing a cartridge based home console to the market in 1983. The machine was known as the Famicom (or Family Computer) in Japan, but was renamed as the Nintendo Entertainment System or 'NES' elsewhere in the world. The NES was technically more sophisticated than any previous home entertainment system, notably due to its unique 'joypad' interface and the genre defining 'Super Mario Brothers' game. Around this time, another Japanese firm, Sega, was manufacturing a console known as the Master System. In Japan, the machine was released nearly two and a half years after the Famicom. By this time, Nintendo already controlled over 90% of the market (Kent, 2001) and so, as a result, the Master System did not perform spectacularly in terms of unit sales. In the United States, however, Nintendo had not been able to create such an insurmountable advantage, and Sega was able to compete with Nintendo for dominance of the market. Ultimately, however, their attempts to usurp Nintendo's leadership position proved fruitless. Chief amongst the reasons why Sega failed was Nintendo's strategy of erecting barriers to entry - an example being the exploitation of their relationship with the company 'Worlds of Wonder' that held sway over important retailers such as Toys 'R' Us. This collusive behavior meant that Nintendo had access to many retail outlets that Sega did not. As a result, there can be little doubt that Nintendo were the victors of the first wave of the modern console wars, and one cannot ignore the possibility that this success may have come about as a result of the position held by each of the respective firms in the order of entry.

In an attempt to challenge Nintendo's worldwide dominance, Sega developed a successor to the Master System in 1989. Known as the Mega Drive (or 'Genesis' in America), the console was technically far in advance of the NES, and comparable to many arcade games of the time in

terms of quality and graphical flair. Upon its release, Sega established the character 'Sonic the Hedgehog', who was an immediate hit with consumers. Many who had been waiting to buy Nintendo's next generation of hardware instead bought Sega's machine based on the strength of the Sonic game. Nintendo subsequently released a new console to compete with Sega in November 1990, known as the Super Famicom or the Super Nintendo Entertainment System (SNES) in the West. Technically, the SNES was an improvement over the Mega Drive. The console was released in 1991 with the critically acclaimed game 'Super Mario World'. In the early days of this battle between formats, Sega held an advantage. Nintendo had a limited selection of titles for its fledgling console, whereas Sega had a library of over 500 games. Nintendo also set a high price point for its console and did not invest the same amount in marketing. At the end of 1991, according to NPD, Sega held 55% of the market, while Nintendo controlled 45%. However, the release of the game 'Street Fighter II' for the SNES by Capcom started to turn things around and served as an indicator that quality of software plays an important role in the eventual success of video games hardware. This is perhaps the most difficult iteration of console war from which to decide a clear victor. However, as the battle progressed, the persistent and superior quality of Nintendo's software allowed them to overturn Sega's early lead, and they eventually emerged the victor[1].

Sega was again first to enter the next generation of console wars, with its CD based Saturn console. Released in Japan in 1994, the console sold well thanks to its impressive technical capabilities and strong launch title in 'Virtua Fighter'. The Nintendo 64 subsequently launched in June 1996. The console was 64 bit (twice that of the Saturn), and so the quality of graphics that could be produced was superior to any other of the generation. Despite the disadvantages of a system based on cartridges, rather than the industry standard of CDs, the system was moderately successful due once again to the high quality of Nintendo software. However, the real heavyweight of this round of the console wars was a machine that would revolutionise the video game market in the same way Nintendo had with its NES over 10 years before. The Playstation was initially developed by electronics giant Sony in the early 90's as a CD expansion unit for the SNES, but was released instead as a stand-alone console in 1995. Playstation was an attractive platform for developers due to the ease for which software for the system could be programmed. In addition, Sony's strategy was geared towards aggressive marketing that helped the console achieve iconic status in the field of consumer electronics, and held particular credibility within nightclubbing culture. The Playstation was the first home console to achieve mainstream acceptance in a more adult orientated segment of the market. As a result, the Playstation console was the clear winner of this stage of the standards war[2].

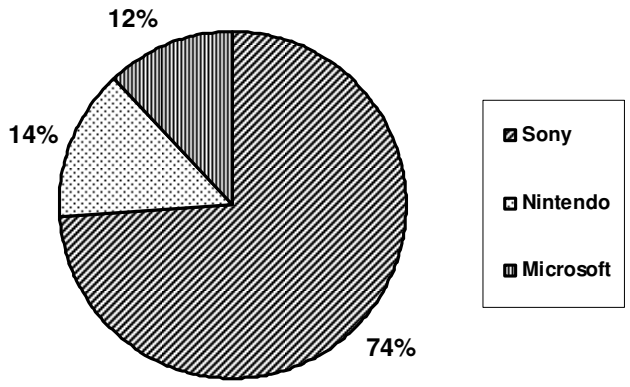
[1] This is 'Stage One' of the console wars that are empirically analysed later in the paper.
[2] This is 'Stage Two' of the Console Wars, which are empirically analysed later in the paper.

Next to the success enjoyed by Sony (and to a lesser extent Nintendo) in the previous hardware generation, it appeared that the Sega Saturn had been somewhat of a failure. However, perhaps surprisingly, Sega was quick to re-enter the market with a new product. The company released a successor 128-bit console known as the 'Dreamcast' in 1999, hoping that the product would re-establish their position in the market. Perhaps it is no accident that in this and two other generations of hardware, Sega was the first mover - indicating a very deliberate strategy to claim what is perceived to be an advantageous position in the order of entry. As a result, there was significant pressure on Sega to capitalise on the first move by increasing the installed base of both consoles and games. However, when the company experienced manufacturing problems soon after launch, this crucial factor was not fully exploited. Therefore, after a respectable launch in the US, the console took a dip in sales that continued throughout most of its life, and Sega were to pull out of the console race indefinitely in 2001. In contrast it was logical that after enjoying significant success in the previous round, Sony would plan a successor that might dominate the new generation of consoles in the same way as its precursor had. The 'Playstation 2' was a 128-bit console that utilised DVD's as a medium that could store 8 gigabytes of information on a standard disk - more than 12 times that of a CD. The console also had the advantage of Sony's massive installed customer base, market recognition and advertising clout. Released in 2000, the console sold extremely well thanks to a line up of mature games such as 'Grand Theft Auto 3'.

Following Sony's move, American giant Microsoft revealed plans that would have major repercussions in the industry. The software firm announced that it would be entering the video games console market in the week of Playstation 2's Japanese release. Unlike consoles manufactured in Japan, the X-Box was based on PC technology, and included such innovative features as a hard-drive, use of Microsoft 'Direct X' technology and broadband connectivity. The hardware specifications were in excess of any other console of the generation, and could host direct ports of PC games that would not be possible on any other console. It seems that Microsoft's strategy was very much focused on achieving technical superiority over their rivals, and to exploit the unique PC based architecture of the hardware to provide consumers with a media centre in their living room. The final entrant to this round of the console wars was the Nintendo Gamecube. The 128-bit machine was Nintendo's first to utilise discs instead of cartridges. While Microsoft and Sony were clearly aiming their product toward a more mature audience, Nintendo took a different approach and designed the machine to appeal to a wider age group, at the expense of some credibility amongst hardcore consumers. However, the high quality of Nintendo software (based on popular franchises such as Mario and Zelda) ensured a decent sized cult following for the veteran developer's console.

As this round[3] of the console wars draws to a close, it seems clear that Sony's Playstation 2 is the undisputed winner. Capitalising on the strong position of its predecessor and comparatively early entry into the market, the success enjoyed by the machine is massively in advance of any competitors. Of more interest is the battle for second place between Nintendo and Microsoft. In Japan, Microsoft is clearly struggling to penetrate a market that has traditionally been controlled by Japanese firms, while its Western attitude to games design and marketing is not helping to promote the console's unit sales. However, in the rest of the world (especially America), it seems that X-Box has pulled slightly ahead of the Gamecube. These trends are illustrated in Figure 1, which shows the worldwide market share held by each of the principal three hardware manufacturers in 2002.

FIGURE 1
Video games machine market share by manufacturer

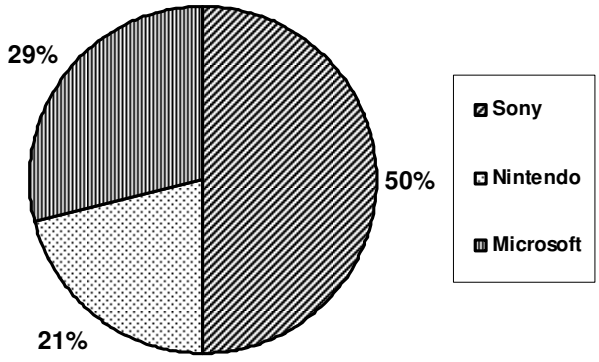


Source: Screen Digest Report (2003)

[3] This is 'Stage Three' of the Console Wars analysed empirically later in the paper.

The next upward phase will begin during 2006, with the resulting peak of sales in around 2008. The Microsoft X-Box 360 has recently reached the market, achieving the position as first mover in this generation of hardware by some clear margin. It has also been announced that Sony and Nintendo also have plans to release next generation consoles (the 'Playstation 3' and 'Wii' respectively) to battle for dominance of the market over the coming year. It will be interesting to see how position in the order of entry affects eventual success in this coming stage of the console wars. Projected figures (as illustrated in Figure 2) indicate that, while Sony will remain the dominant firm, rivals Nintendo and Microsoft will succeed in asserting a greater influence over the coming round of the standards war than they have in previous generations.

FIGURE 2
2010 projected market share by manufacturer



Source: In-Stat Report (2006)

3: Literature Review

Before testing empirically for the presence of a first mover advantage in the market for video games systems, it may first be useful to summarise the conclusions drawn by other authors on the subject of strategic positioning in the order of entry. Whenever the term 'first mover' appears in economic literature, invariably the conclusions are linked in some way to the concept of von Stackelberg equilibrium. Von Stackelberg (1934) suggests that, in a simple duopoly where one firm (the leader) makes decisions over output before the other (the follower), the leader is expected to out-perform the follower. Stackelberg equilibrium therefore implies that firms would seek the first move in order to dictate competitive terms to their rivals, and leave the follower with a proportionately smaller share of the market.

More contemporary insight from the resource-based view of economics supports this contention, suggesting that a company's market share is positively influenced by early entry (Utterback, 1994). Notable works in this area of economics include Lieberman and Montgomery (1988), who contend that a firm's place in the order of entry may be a critical factor in the explanation of how a competitive advantage is obtained. It has also been suggested that firms who are late entrants may find it difficult to imitate successful incumbents before they establish a strong market position (Mitchell, 1991). By reducing unit cost or introducing a better product, the first adopter is expected to increase their market share (Hoppe, 2000). Formalising these ideas, Coeurderoy and Durand (2002) lay out a basic framework of firm classification according to order of entry, consisting of 'first to market' companies, 'follow the leader' firms and 'late entrants'. First to market companies are uniquely able to erect 'resource barriers' in order to enjoy a sustainable competitive advantage. These include brand name, reputation, experience and relationships with suppliers. They conclude that pioneers benefit from first mover advantages so long as they are able to sufficiently protect that advantage, as early entrants face the risk that subsequent entrants may imitate or improve upon the products of incumbent firms.

While economic theory may strongly suggest that there is a first mover advantage in generic industries displaying characteristics of oligopoly, it may be prudent to briefly investigate the literature on how strategic positioning in the order of entry specifically affects high technology industries, where being the 'first mover' implies being the very first firm to bring an innovation to market (Glibert and Burnbaum-More, 1996). Most remain of the opinion that a firm who is first to market with an innovation will typically derive an advantage over rivals in a high technology industry, in much the same way as the leader is expected to hold a strategic advantage in the case of von Stackelberg equilibrium. Reinganum (1981), for example, considers a hypothetical duopoly of two identical firms, both of which have the opportunity to invest in some new

technology (the market price of which falls the longer is left before the decision to invest is made). One of the identical firms is given a first mover advantage and the other is a follower, who is allowed to make the investment only after the leader has made the decision to invest. Fudenberg and Tirole (1985) suggest that in a scenario where the investment timing is delayed, the leader always achieves the highest payoff. Thus, if neither firm knows which of them will be the first mover, the large payoffs available ensure that both firms wish to move first. This is a conclusion supported by Lippman and Mamer (1992), who suggest that in a R&D race, incumbent firms hold a distinct advantage and are more likely to win the 'race' than the challenger. Albrach (1997) even goes so far as to propose that simply being seen to be racing towards the position as leader creates the reputation of being an innovator, which impacts positively on market share. More recently, Gottinger (2006) uses unique statistical profiling indicators to conclude that the incremental returns to firms that occupy the leadership position are higher if involved in a race that is on or near the technological frontier, rather than among imitators playing catch-up.

Varian and Shapiro (1999) specifically examine 'standards wars' between similar but incompatible innovations competing to become an industry standard. They conclude that a successful strategy involves building an early lead so that positive feedback works in the firm's favour against rivals. The authors suggest that a firm needs to be aggressive at an early stage in order to build an installed customer base by finding product 'pioneers' who are most keen to try new technology and signing them up swiftly. Lockett and Thompson (2001) support these contentions and claim that, in rapid innovation industries, advances in technology create many entirely new products with short life cycles. The structure of such industries therefore depend greatly on the actions of a very small number of early movers. Lockett and Thompson also state that technical superiority may be insufficient to challenge a dominant incumbent who enjoys significant learning economies and a large customer base.

Muller's (1997) work on path dependence also indicates that the firm or firms that eventually emerge as market leaders in certain industries (those with high set up or switching costs, network externalities, buyer inertia and potential cost advantages relating to experience) tend to be those drawn from among the first to enter the industry. All of the cited industry characteristics seem apt to describe a high technology industry such as video games machines. This suggests that first mover advantages may be particularly prevalent in this case. The paper even provides a specific example in the case of video games consoles:

"To play video games on a television set, one needs a small computer that attaches to the set, and a video cassette with a particular game on it. The first game one buys costs the price of the computer (Pc) plus the price of a game (Pg). All subsequent games cost Pg. To switch to a

second manufacturer's games requires buying the second manufacturer's computer. Thus, on the margin, each game sold by the first mover costs Pc less than a similar game by the second mover." (Muller, 1997, pg. 831)

This again supports the notion that first mover advantages are significant in the market for consoles, where switching costs are relatively high. There is also some evidence to suggest that network externalities are present in this market, as video games consoles become more popular the games can be circulated and discussed in society so that a utility-enhancing 'community' of gamers build up around the product. However, a key issue to consider is Muller's interpretation of the effect that the complexity of the product has upon success derived from position in the order of entry, which suggests that there is a positive correlation between product complexity and the availability of a second mover advantage. Such complex products as video game consoles would lend themselves perfectly to this notion. Therefore, Muller's work may be interpreted to suggest that second mover advantages could be present in the market for video games systems.

Several authors support the existence of second mover advantages in a number of similar industries. It is suggested, for example, that large minimum scale investments and uncertainty about future industry demand can make pre-emptive investment an unattractive option (Porter and Spence, 1982). Gandal (2001) proposes that, in the case of the market for internet search engines, while early entrants still have an advantage, the 'pure brand effect' declines over time. The proposed model tests empirically the extent to which being the first mover establishes a long run leadership position, and uses a dummy variable to represent early entry to the market, as well as various variables reflecting the quality of the service and the age of the firm. This model concludes a positive parameter for the dummy variable attached to the first five firms to attain market dominance, but a negative parameter for the variable that measures age. He concludes that the only way for incumbents to maintain market share is continual innovation in order to stay ahead of new firms. Watanabe et al (2006) examine empirically the Japanese electrical machinery industry, and conclude that follower firms can succeed in positively contributing to innovation through the introduction of new functionality.

Perhaps criticism of the literature on early mover advantages with respect to the market for video games consoles can be directed towards the assumption that the first mover advantage would only significant at the absolute level: the incremental stage-by-stage competition experienced in this particular market is often overlooked. Market leadership can change when the leaders fail to match the progress of aggressive newcomers (Howard and Kunkel, 1993) or where follower firms are able to 'leapfrog' rivals (Owen and Ulph, 1994). This has been the case in the market for video games systems, where Microsoft and Sony's strategy of aggressive marketing and the

demonstration of technical superiority overturned the leadership of incumbents Nintendo and Sega. Varian and Shapiro (1999) support this idea, claiming that control over an older generation of technology does not necessarily confer the ability to dominate the next generation. Sony was able to successfully adopt a follow the leader policy that led them to market dominance, and were able to sufficiently protect their comparative advantage. There is evidence enough, therefore, to suggest that the first mover advantage in absolute terms, which belonged to Sega and Nintendo, may not be a significant factor in determining market leadership, while the role of follower may not be as much of a disadvantage as first thought.

4: Methodology and Data

The intention of this paper is to establish the significance and timing of a movement advantages in the market for Japanese video games consoles. Ownership rates of specific consoles, taken from the Japanese Computer Entertainment Software Association (CESA) Games White Paper (2002), are used to construct the endogenous variable. This forms the basis of an ANCOVA (Analysis of Covariance) model featuring two quantitative exogenous variables - Price and Quality – as well as a single dummy variable used to empirically test the impact on market share or various positions in the order of entry. These variables are discussed in more detail below.

The proposed model therefore takes the following form:

$$\text{`}Y_i\text{'} = \beta_0 + \beta_1 \text{`}P_i\text{'} + \beta_2 \text{`}QUAL_i\text{'} + \beta_3 \text{`}MOVE\text{'} + \mu_i \qquad (1)$$

Where 'Y_i' is the ownership rate among 1,013 respondants of the ith console, taken from the CESA Games White Paper Survey, 'P_i' is the real price in Yen of the ith console (base year 2000), '$QUAL_i$' is a measure of quality of the software available for the ith system, 'MOVE' is a dummy variable that is inserted to represent the order of entry and μ_i is the error term. Information on the construction of these variables can be found below.

Ownership Rate

Proposition 1: Video games consoles that generate the greatest market share within their generations of hardware will have the largest reported ownership rates among the 1,013 respondents in the 2002 CESA survey into Japanese console ownership.

Information on console ownership in Japan in 2001 is obtained from the CESA, which is based on a survey of hardware ownership by console type. The 1,013 respondents to the survey were asked to reveal what consoles (if any) they owned. The survey then lists what number of respondents owned each particular console.

Software Quality

Proposition 2: Video games consoles for which there is higher quality software available will have larger reported ownership rates among the 1,013 respondents in the 2002 CESA survey into Japanese console ownership.

In order to approximate the quality of each machine's software, an average of the percentage scores that each console's launch games received in internet-based critical user reviews is calculated (as archived on http://www.gamefaqs.com). From the list of these game-specific averages, a further average is taken by console in order to form a specific quality rating. A typical games review will give each game an overall percentage score out of one hundred, therefore the console-specific measure of quality will also fall within this boundary (with zero being the worst possible score and one hundred being the best). It is assumed that most consumers of video games will have access to these types of reviews through magazines and the internet, and will make decisions as to which games (and therefore which consoles) to purchase based at least in some way upon them.

Real Unit Price

Proposition 3: Video games consoles with the highest real prices will have lower reported ownership rates among the 1,013 respondents in the 2002 CESA survey into Japanese console ownership.

As the prices of individual consoles change over their lifespan at different rates and at different stages, it is felt that the only consistent means by which to compare hardware prices is to take the price at which the machine retailed at launch. Nominal launch prices were provided by the Japanese magazine 'DAI GI RIN' (2000)[4]. These nominal prices were then converted to real prices using the Japanese RPI from 1989 to 2001 (with 2000 being the base year for the purposes of inflationary indices).

Order of Entry

Proposition 4: The reported ownership rates among the 1,013 respondents in the 2002 CESA survey into Japanese console ownership will be affected by a firm's position in the order of entry. Specifically, it is proposed by this study that the first move constitutes a strategic disadvantage, while the second move confers a benefit to the appropriate firm.

Dummy variables are added to the model in order to empirically test for any benefit attached to various positions held by firms in the order of entry. The model includes three dummy variables (each entered separately) to represent three different hypothesised movement advantages that might occur. The first dummy variable (FIRSTABS) is used to signify the very first firm in the

[4] *This information was kindly translated by Takumi Suidu at the University of Osaka, Japan.*

sample to achieve market dominance. This dummy is attached to each of Nintendo's consoles, as they were the first to claim the mantle of market leaders with the NES in 1985. If this variable is not statistically significant, it will indicate that there is not an absolute first mover advantage present in the market. The next dummy variable that is included represents the very first console to be released at each iterative round of the console wars (FIRSTREL). This was granted to the Sega Megadrive, Sega Saturn and Sega Dreamcast, which were the first movers in their respective generations of hardware. If this variable is found not to be statistically significant, it will indicate that there is not a first mover advantage at the stage-by-stage level present in the market. The third and final proposed dummy variable represents the firm being the second mover within the specific hardware generation (SECOND). The statistical significance of this variable would indicate that later entrants into each round are able to observe the actions of early pioneers and create optimal strategic decisions based on information acquired from delaying entry to the market.

Table 1, below, summarises the list of variable that will be used in this study.

TABLE 1

Descriptions of model variables

Console name	Year of release	Hardware generation	Ownership (% of survey)†	Ownership absolute (of 1,013)†	First mover (relative) FIRSTREL	First mover (absolute) FIRSTABS	Second mover (relative) SECOND	Real price (2000 base)††	Quality†††
Sega Megadrive	1989	2	2.3	23	1	0	0	35834.26	7.08
Nintendo Super Famicom	1991	2	45.3	459	0	1	1	22082.01	8.95
Sega Saturn	1994	3	8.7	89	1	0	0	45436.10	6
Sony Playstation	1995	3	44.2	448	0	0	1	40406.09	7.87
Nintendo N64	1996	3	25.5	258	0	1	0	25354.96	8.05
Sega Dreamcast	1999	4	5.4	55	1	0	0	29592.85	6.35
Sony Playstation 2	2000	4	25.4	257	0	0	1	45000	7.22
Nintendo Gamecube	2001	4	6.2	63	0	1	0	25176.23	8.33

† *From CESA Games White Paper, 2002, Rate of hardware ownership survey 2001 (general public, 1,013 persons) pg.66*
†† *From Da Gi Rin, 2000 (Autumn Edition), Mainichi Communications*
††† *From Compiled from index available at http://www.gamefaqs.com*

5: Results

A comprehensive list of the results discussed in this section can be found in the appendix. Initial results focus on Model (1) outlined above, where 'FIRSTABS' is initially used in place of the 'MOVE' dummy. The results obtained from this model specification suggest a positive and non-significant correlation between both the price and quality variables and console ownership and a negative relationship between the 'FIRSTABS' variable and ownership rates. This indicates that to be the first mover in an absolute sense in the market for video games has a negative effect upon ownership rates. However, this conclusion must be tempered by the estimated coefficients for the other variables, as they either clearly contradict a priori expectations on the relationship between demand variables, or are found not to be statistically significant. The statistical summary from these model specifications indicate that each model has little explanatory power, due to a low R^2 value. The Durbin Watson Statistic for this specification is high, nearing the maximum of four. Therefore as this model demonstrates negative autocorrelation, it would prove inaccurate for forecasting purposes. As per the 't' test results, all of the variables in this model, including the constant term and the dummy variable 'FIRSTABS', are not statistically significant at the 95% confidence interval.

A formal 'F' test confirms the validity of excluding the 'Price' and 'Quality' variables from Model (1). However, the data still indicates that trends exist between ownership patterns and position in the order of entry. Hence, the model is re-specified, omitting the variables that are not statistically significant at the 95% confidence interval.

$$\text{'OWNER}_i\text{'} = \beta_0 + \beta_1\text{'MOVE'} \qquad (2)$$

The redefined model structure displayed in Model (2) includes a single explanatory variable in the form of a dummy (this type of model is known simply as an Analysis of Variance (ANOVA) model). When the 'FIRSTABS' dummy is included in place of the 'MOVE' variable in this specification, it is once again found not to be statistically significant. When the 'FIRSTREL' variable is included in model (2), which is a dummy variable reflecting the first mover at each incremental stage of the console wars, it is found that both this and the constant term are significant at or above the 95% confidence interval.

The estimated constant term from this model indicates that autonomous ownership levels lie at around 297 in every 1,013 owners while the first mover within any of the specific generations of console hardware can expect to have an ownership rate of around 241 in every 1,013 owners *less* on average than an equivalent machine released by a rival who enters the market at a later

stage. We would therefore expect the first mover at each sequential hardware generation to have a mean ownership rate of 56 in 1,013 owners (5% of the survey sample), while the expected mean ownership rate of subsequent movers is 297 in 1,013 owners (29% of survey sample). This indicates that there is not only a lack of early mover advantage in the market for home video games consoles, but a distinct and significant disadvantage arising from the first move. The evidence of this study suggests that pioneer products are able to be successfully superseded by subsequent entrants to the industry.

The F test results for this model specification indicate that it is significant at the 95% confidence interval. However, according to the Durbin Watson Statistic, autocorrelation remains a problem. Model (2) is re-run, this time including the dummy 'SECOND' in place of the 'MOVE' variable. This new dummy indicates the firm is a 'second mover' (e.g. releases the second piece of hardware at each generational level). The F value shows that the overall specification employed here is significant at the 99% confidence interval. The Durbin-Watson Statistic is also nearer to two than any of the previous models. The constant term in this model specification is just short of achieving statistical significance at the 95% confidence interval. The estimated coefficient for the constant term takes a value of 98 in every 1,013 owners (9.62% of the survey sample), while the coefficient attached to the second mover dummy indicates the ownership rate increases by around 290 in every 1,013 persons (28.63% of the survey sample) over an equivalent machine released by a rival who enters the market at an earlier or a later stage. We would therefore expect first, third and subsequent movers to experience an average ownership rate of 98 in every 1,013 console owners, while the second mover would expect, on average, 388 owners in every 1,013. This indicates that there is in fact a strategic advantage to be gained from being the second mover within each generation, and ownership rates would be lower if the console was to enter the market in any other position in the order of entry. It therefore seems that the most effective decision a company releasing a console could make is with regard to the timing of its release. The console needs to be available as the generational cycle is nearing its peak, and for the machine is 'cutting edge' when interest from consumers is highest. Releasing the console either too late or (as illustrated above) too early means that either eventual quality or reputation is compromised, or that interest has waned by the time the product reaches the shelves.

In an attempt to remove the incidence of autocorrelation present in Model (2), the natural log of ownership rates is taken in order to create a log-linear equation.

$$\ln\text{'OWNER'} = \beta_0 + \beta_1\text{'MOVE'} \qquad (3)$$

Initially, the dummy 'FIRSTREL' is used in place of the 'MOVE' variable. The F value for Model Specification 3 shows that the equation is significant at the 95% confidence interval. The Durbin-Watson Statistic is the nearest to zero that has yet encountered, meaning that the model still has a strong incidence of positive autocorrelation. The positive constant term is significant at way above even the 99% confidence interval, while the negative coefficient attached to the 'FIRSTREL' variable (-1.619) is also very close to this level of significance. Once again, the statistically significant negative coefficient for the relative first mover reinforces the hypothesis that, at each generation, pioneers can expect a lower ownership rate than subsequent movers.

Faced with these results, Model Specification (3) was then re-run with the 'SECOND' dummy variable replacing 'FIRSTREL' as an indicator of movement order. This specification displays far more robust results. The R Squared is higher than the previous mode and the F statistic shows that the model is statistically significant at the 95% confidence interval. The Durbin Watson Statistic is also nearer to two, indicating that the incidence of positive autocorrelation is heavily reduced, but not completely eliminated. The constant is significant and positive at the 99% interval, as is the coefficient attached to the dummy variable reflecting second movers at each hardware generation, taking a value of 1.662. These results support the hypothesis that ownership rates increase dramatically for the second mover.

The elasticity between two variables in a logarithmic model still be estimated, even though the model includes a dummy, by taking the natural antilog to the base e of the estimated dummy coefficient, and subtracting 1 (Halvorsen and Palmquist, 1980). These calculations generate a result of [0.198 – 1) = – 0.802 for the first mover within each hardware generation, and [5.270 – 1] = 4.270 for the second mover. This means that the ownership rate can be expected to be 80.2% lower on average for the first mover in any generation of hardware than for the expected mean ownership rates of any other position in the order of entry. The results also suggest that the ownership rate can be expected to be 427% higher on average for the second mover within any generation as compared to the mean ownership rate of consoles occupying a different position in the order of entry. Table 2 (below) summarises the most important coefficients that can be derived from the models that were estimated in this section.

TABLE 2
Key coefficients

	Model 2* (w/ FIRSTREL)	Model 2** (w/ SECOND)	Model 3* (w/ FIRSTREL)	Model 3* (w/ SECOND)
constant term	297.012**	97.600	5.496**	4.266**
'FIRSTREL' coefficient	-241.330*	N/A	-1.619*	N/A
'SECOND' coefficient	N/A	290.400**	N/A	1.662*

** (**) denotes statistical significance at the 95% (99%) confidence interval*

6: Conclusions

This study has sought to determine whether position in the order of entry into the market for video games consoles has any effect on success. The results of the study indicate that, on average, first movers lose 242 in every 1,013 potential owners, while second movers gain 242 in every 1,013 potential owners purely on the basis of their position in the order of entry. The semi-logarithmic model specifications also confirm this trend, indicating that the ownership rate for first mover consoles can be expected to be 80.2% lower than the mean ownership rate for subsequent movers, and that the ownership rate can be expected to be 427% higher than rivals for the second mover within any generation. This clearly indicates that the first move puts a firm at a competitive disadvantage, whilst the position of second mover entails quite the opposite.

Although these conclusions display a striking trend given the size of the study, it may be noted that, due to the number of observations employed here, future studies into success and failure determinants in the Japanese Video Games Industry might analyse a data set containing a larger number of observations. It would also be advisable for future studies in this area to attempt to formulate a measure of advertising expenditure that stands up to the rigor of an econometric model. It is, after all, no coincidence that every console to be branded the 'first mover' was manufactured by Sega, and two out the three of the second movers were Sony machines. Despite the limited dataset, this study has determined that there are definite trends within the video game market that relate to entry order and eventual success in terms of ownership rates - there appears to be an appreciable and positive influence arising from the second mover within any generation of hardware, and an equally significant disadvantage to the pioneer.

7. References

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8. Appendix

TABLE 3
Output from Model (1)

	coefficent	t-stat
constant term	-1482.030	-1.940
price	6.648E-03	-0.512
quality	202.127	0.607
dummy ('FIRSTABS')	-125.497	2.200
R^2	0.595	
F	1.957	
DW	1.250	

** (**) denotes statistical significance at the 95% (99%) confidence interval*

TABLE 4
Output from Model (2)

	coefficent	t-stat
constant term	-174.400	0.079
dummy ('FIRSTABS')	85.600	0.549
R^2	0.063	
F	0.403	
DW	2.650	

** (**) denotes statistical significance at the 95% (99%) confidence interval*

TABLE 5
Output from Model (2)

	coefficent	t-stat
constant term	297.000	0.003**
dummy ('FIRSTREL')	-241.330	0.500*
R^2	0.500	
F	6.006*	
DW	1.330	

** (**) denotes statistical significance at the 95% (99%) confidence interval*

TABLE 6
Output from Model (2)

	coefficent	t-stat
constant term	97.600	0.072
dummy ('SECOND')	290.400	0.007**
R^2	0.724	
F	15.760*	
DW	1.670	

** (**) denotes statistical significance at the 95% (99%) confidence interval*

TABLE 7
Output from [Log-linear] Model (3)

	coefficent	t-stat
constant term	5.496	16.000**
dummy ('FIRSTREL')	-1.619	0.028*
R^2	0.581	
F	8.306*	
DW	1.180	

** (**) denotes statistical significance at the 95% (99%) confidence interval*

TABLE 8
Output from [Log-linear] Model (3)

	coefficent	t-stat
constant term	4.266	0.000**
dummy ('SECOND')	1.662	0.022*
R^2	0.612	
F	9.472*	
DW	1.67	

** (**) denotes statistical significance at the 95% (99%) confidence interval*