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SANTA CRUZ

FADE IN:
**EXPLORING THE EFFECTS OF TECHNOLOGICAL CHANGE ON
CONSUMERS AND FIRM REVENUES IN HOME ENTERTAINMENT
MARKETS FOR FILM**

A dissertation submitted in partial satisfaction
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

ECONOMICS

by

Gabriel Pablo Axarlian

June 2015

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Tyrus Miller
Vice Provost and Dean of Graduate Studies

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Abstract

FADE IN: EXPLORING THE EFFECTS OF TECHNOLOGICAL CHANGE ON CONSUMERS AND FIRM REVENUES IN HOME ENTERTAINMENT MARKETS FOR FILM

Gabriel Axarlian

This dissertation is composed of three related works, two of which are similar in data and time span with the third being more independent in this respect. The three works focus on the nature of the film industry's adaptation to changing technologies in home entertainment markets. My analysis studies the effectiveness of new strategies as well as the effect changing technologies has had on market share of various product types.

The first work is titled, "The Introduction of Infinite Durability to an Information Good and the Decision to Buy or Rent: Evidence from the Film Industry". Home entertainment markets have seen dramatic declines in revenues over the last ten years due to the digital revolution, making new adaptation strategies of crucial importance to maintaining existing profitability. Recently, the film industry has worked with related firms to develop a standardized ecosystem for the sale and access to digital versions of their films. This system, known as UltraViolet, embodies infinite durability; the perpetual access to a purchased film across computing platforms and time. I make use of exogenous variation in the implementation of this system to study

the effect the introduction of this new feature has had on the decision to buy versus rent. My findings show that the inclusion of infinite durability creates enough value to spur increased purchasing behavior. Also, the inclusion of infinite durability creates a high degree of substitutability amongst products that include it in purchase markets. Lastly, I find evidence that the lack of inclusion of infinite durability will spur consumers to rent rather than buy.

The second work is titled, “Early to Sell, Do Revenues Rise? The Effect of the Digital Sell-Through Window on Home Entertainment Markets”. In 2012, several film studios began selling digital versions of their films 1-4 weeks before their release into physical media markets (rental and sell-through). This was an attempt to boost overall waning revenues from home entertainment. I examine the effect this has had on physical media sell-through and rental markets using a nested-logit model approach. The analysis yielded three significant results. One is that the length of the window is inversely related to its effect on the behavior of buying or renting of discs. The second is that this strategy has mainly affected the consumption behavior of disc renters to buy digital. The third result of note is that although the strategy is effective, it is not creating loyal consumers of this new method of distribution. This fact notwithstanding the strategy has increased home entertainment revenues.

The third and final work is titled, “The Long Tail Effect in Home Entertainment Rental Markets”. The long tail, theoretically, is the phenomenon that results from the availability of infinite inventory retailers which allow for niche products to have

enough of a ‘shelf life’ to find their audience. In both the academic literature and industry discourse there is a debate about the actual nature of the long tail effect. The counter view is that infinite inventory retailers simply make the more popular ‘superstar’ products even more popular, maintaining the small market share of niche products. I make use of exogenous variation in data availability to provide more insight into this puzzle. The differences in data sources allows for an analysis of the demand for films that are niche (proxied by limited theatrical release) and superstars (proxied by high production value). The main finding is that superstars appear to have gained market share in these markets. Although there is not strong evidence showing that niche consumption has gone down, this is consistent evidence that their market share certainly did not increase. Also, an examination of the relationship of the long tail effect and product substitutability yields results that paint a complex picture that cannot be generalized.

Acknowledgements

This work could not have existed had it not been for the combined support offered by my family, faculty and film industry professionals. The road to earning this degree and completing this work has been the most challenging of my life. Without these folks, all the blood sweat and tears shed to get to this point would not have been worth the sacrifice.

My family is small, being a group of immigrants from Argentina, and thus the support they offer has been crucial to my perseverance. My older brother Marcelo, has been a strong center that has often helped to level me at times of loss of balance. My little brother, Ronald, an Iraq war veteran who fought through hell to return home to us, has been a consistent reminder that no matter how bad life can get, it can always be volumes worse. My mother Nelida sacrificed quite a bit to lay key foundations for me to springboard from in order to have the ability to get to this point, and thus has my infinite love and thanks. My grandmother, Olga Catalina Salguero, who unfortunately passed away last year, will not get to see me ascend to the next stage of my life after finishing this challenging phase. She is the person that this work is primarily dedicated to. She lived a tough life, but remained strong and thus taught me to do the same. This work is also dedicated to my niece Sophia, who as a newborn has all the potential in the world. I hope to inspire her to reach for the stars with my accomplishments. Honorable mention goes to my brother's new wife Erica and her family who have been very welcoming to my small immigrant family. I love you all!

Within the economics department at UCSC there are three key figures that deserve acknowledgement. One is Dr. Nirvikar Singh, my main advisor, whose support has been invaluable. Also, Dr. K.C. Fung and Dr. Daniel Friedman have both been generous with their time and assistance. All three of these fine and distinguished individuals have played an integral role in my success that I will never be able to fully thank them for. I hope these words provide the glimmer of a start in my lifelong attempt to pay back this debt.

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1 Introduction

The film industry is part of the media sector which has been undergoing dramatic changes over the last few decades due to the digital revolution. The media industries, and the film industry in particular, are of analytical interest for a variety of reasons. The media industries in general have become an increasingly important sector of the economy over the course of the last century. Much of the leisure time spent by the average American is comprised of activities related to media. The film industry is one of many industries included under the media sector banner and is an optimal example of the way in which these industries operate. It is a useful laboratory for examining the effects that the era of digitization has had on media industries.

This paper examines three instances where the digital era has created a new set of conditions within film markets for firms to adjust to. The first work examines an attempt of the film industry to adapt to the direct sale of digital versions of content. The second work examines a related situation in which firms are playing with distribution windows with respect to digital versions of their content. The final work is broader in nature, studying the effect that the introduction of digital retailers has had on the nature of consumption of content type in these markets.

The first work is covered in detail in chapter two. Briefly, with firms attempting to figure out the best way to introduce the sale of digital versions of their films, a natural experiment was created in which five of the six major firms attempted one strategy, with the sixth abstaining for a period of over a year. I study consumption patterns in

this time period to attempt to understand the nature of consumer consumption behavior with respect to the new content type. The main reveal from this work is that combining content distribution formats yields increased revenues for films, implying that firms should be thinking more in terms of building upon current products rather than looking at old and new versions as mutually exclusive in this new era.

The second work is covered in detail in chapter 4 and examines a similar situation to the first, dealing with the way that firms have attempted to crack the code for digital distribution. Again, several of the major firms made the decision to sell digital versions of certain products earlier than their disc counterparts, while others abstained. This digital window again provided for a natural experiment that revealed consumption behavior of consumers with regard to the new distribution type. The main take away from this work is that a distribution window is an effective means of adding enough value to a product to inspire low value consumers to shift their consumption behavior to new forms of consumption, thereby increasing firm revenues.

Finally, the last work, covered in detail in chapter 4, examines the way that the introduction of digital retailers has effected the market shares of superstar products versus niche products. This is an important issue for media industries, since the choice of what type of content to produce is crucial for generating revenues. Until recently the answer to this question has been unclear. The work in this dissertation supports that idea that superstar products are becoming more prominent in market share and thus

firms should be investing more in large scale products in order to generate increased revenues in the digital era.

The rest of this chapter provides general information related to the three works. The information in each section is common to at least two of the central works in this paper. Section 1.1 briefly details academic papers that the three works in this paper are related to. Section 1.2 provides an extensive discussion of the media sector, the film industry, and the relevant markets, providing in depth context for understanding the significance of the three works. Section 1.3 details the logistics of the work horse model that is used — with small variations — throughout the three works. Finally, section 1.4 provides details on the data sources that are the primary subject of the empirical analysis throughout the three works. Any further information that falls into these sections' categories but is only specific to one of the three works is included in the respective chapter of those works.

1.1 Related Work

The three works in this document are related to a variety of research threads. Most relevant is the academic literature dealing specifically with demand for film products in home entertainment markets. All three of the works in this document are related to this research. The four most relevant papers are mentioned in section 1.1.1. Section 1.1.2 lists four of the academic papers that are most relevant from the literature dealing focusing on the decision to buy vs. rent. The first and second works in chapters 2 and 3 respectively build on these works.

1.1.1 Demand in Home Entertainment Markets

Home entertainment markets have received less academic attention than the theatrical market for films due to the dearth of available data. The primary focus in the extant literature on home entertainment markets has mainly been intended to decipher the observable components of utility that drive demand and to draw inference about their relationship to demand in the theatrical window. McKenzie (2009) and Walls (2010) focus specifically on this relationship. Brewer (2008) focuses on deciphering the nature of demand in the home entertainment markets without considering the theatrical market. Lastly, Chiou (2008) studies the seasonality of demand in the same market using a nested logit model that served as the basis for my model.

1.1.2 Buy vs. Rent

Home entertainment markets are also an ideal laboratory to study a variety of unique market phenomena resulting from the binary coexistence of the sell-through and rental markets. Varian (2000) identifies the theoretical conditions necessary to maximize profits in various related settings. Mortimer (2007) studies price discrimination in the home entertainment markets. Rao (2011), a job market paper, presents the results from an experiment to gain insight into the consumption behavior of consumers to rent versus buy. Finally, Ferri (2013), also a job market paper, performs an analysis on the intertemporal substitution in home entertainment markets due to intertemporal price discrimination.

1.2 Industry

This section provides insight into the industry that is central to this paper. Starting broadly, I provide information on the importance and nature of the media sector with respect to the overall economy in section 1.2.1. I then narrow the focus to the general importance of the film industry itself in section 1.2.2. Then in section 1.2.3 I provide specifics on the film industry's competitive structure and practices that are relevant to the works in this document. Following that, in section 1.2.4 I provide insight into the home entertainment markets of the film industry that are the focus of the three central works. Finally in section 1.2.5, I provide relevant details on the digital and disc formats that are also central to the three works in this document to varying degrees.

1.2.1 The Economic Significance of Media Industries

In general, the media industries have not been given their due attention by mainstream economists. An expert in the field, Phillip Napoli, has opined on this matter reflecting on the traditional view mainstream economists have had,

What is particularly striking about the study of media economics is that, until recently, it was an area of inquiry that was very much on the periphery of mainstream economics. This marginal status for media economics was likely the result of a number of factors. These include: 1) the fact that the economics of media industries often do not conform very well to the standard theoretical assumptions and models typically employed by economists... and 2.) That the media industries have been seen within the economics community as a somewhat marginal, frivolous area of focus. (2009:162)

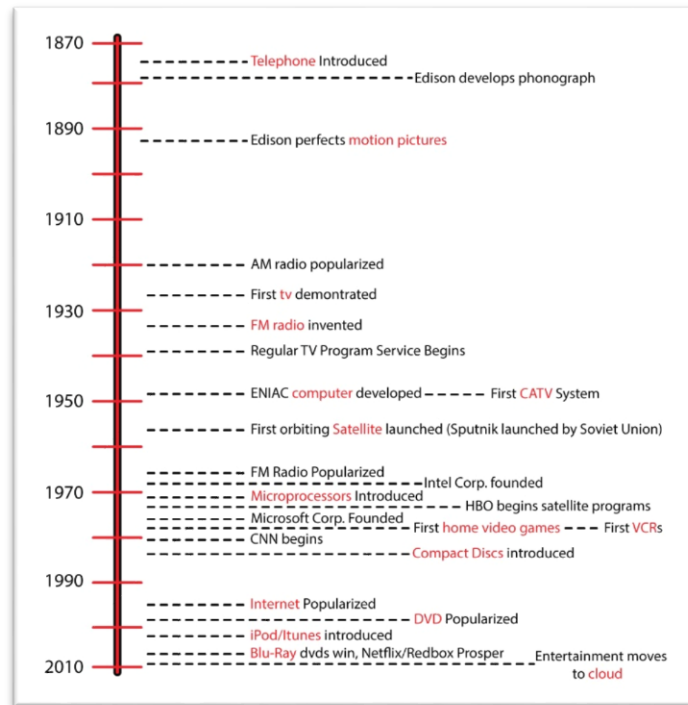
Part of the lack of conformity that Napoli is referring to in his first point is the fact that media content is of a nature that does not allow consumer behavior to be easily gauged. In part, it is because the content, as cultural goods, can provide either information or entertainment making the demand determinants difficult to pin down. "Many cultural

goods share the quality that their value for consumers is symbolic and tied up with the information of messages they convey, rather than with the material carrier of that information.”(Doyle 2013:13) Considering the entertainment content more specifically as an experience good, “...the extent to which it will please and satisfy is a subjective matter and...‘nobody knows’ how consumers will respond or what will work (citing Caves, 2000:3).”. (101)

The second reason Napoli attributes to the marginalization of this field by mainstream economists—mainly that it is seen as unimportant to the overall economy—makes sense due to the nascent nature of these industries. Coupled with the increase in leisure time that the average American has benefitted from over the course of the last century, this sector has grown in relative significance to other sectors within the economy and warrants more attention from economists. Also, since this increased labor/leisure tradeoff that is used to represent household behavior in standard economic models.

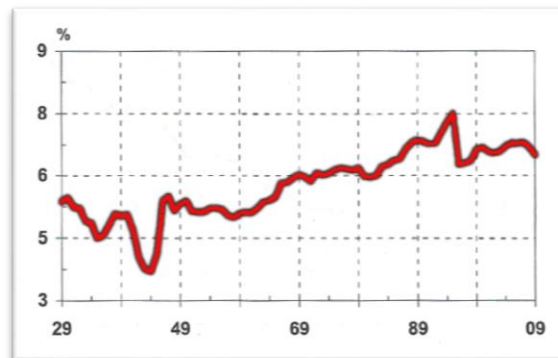
The technology that led to the proliferation of the media industries emerged mostly throughout the last century. As figure 1.1 demonstrates, motion pictures, radio, leisure time is primarily taken up by activities related to media, it further amplifies the economic significance of media industries due to the relevance they have in the industries to develop around the new technologies as well as for the average person to incorporate them into her life. Figure 1.2 demonstrates this effect as an increasing trend television, cable, satellites, the personal computer, the internet, and the digitization of

Figure 1.1 – Timeline of Significant Advancements in the Development of the Media Industries



(Source: Vogel 2011)

Figure 1.2 – Personal Consumption Expenditure on Recreation as Percentage of Disposable Income 1929-2009



(Source: Vogel 2011)

content delivery were all introduced after 1880. Once introduced, it took time for the in personal consumption expenditure (PCE) on recreation¹ as a percentage of disposable income over the better part of the last century. The increasing trend in

Table 1.1 – Time spent by adults on selected leisure activities, 1970 and 2009 estimates

Leisure activity	Hours per person per year ^a		% of total time accounted for by each activity	
	1970	2009	1970	2009
Television	1,226	1,774	46.5	42.1
Network affiliates		668		15.8
Independent stations		17		0.4
Basic cable programs		1,014		24.1
Pay cable programs		75		1.8
Radio	872	1,038	33.1	24.6
Home		363		8.6
Out of home		675		16.0
Internet		755		17.9
Newspapers ^b	218	108	8.3	2.6
Recorded music ^c	68	153	2.6	3.6
Magazines	170	72	6.5	1.7
Leisure books	65	84	2.5	2.0
Movies: theaters	10	11	0.4	0.3
home video		44		1.0
Spectator sports	3	19	0.1	0.5
Video games: home		151		3.6
Cultural events	3	6	0.1	0.1
Total	2,635	4,215	100.0	100.0 ^d
Hours per adult per week	50.7	81.1		
Hours per adult per day	7.2	11.5		

^a Averaged over participants and nonparticipants.
^b Includes free dailies.
^c Includes licensed digital music.
^d Totals not exact because of rounding.

(Source: Vogel 2011)

annually increased by nearly 60%. Media is responsible for almost the entirety of this change.

Finally, the media industries encompass a relatively significant portion of the overall economy. Media revenue as a percentage of GDP was 2.66% in 2009. Comparing it with Agricultural sector, that encompasses less than two percent, yet is

¹ The category of *recreation* in part includes activities that were part of individuals' lives before the industrial revolution such as gambling, theater attendance, amusement park attendance and sporting events spectatorship that were not greatly affected by the new media technologies

generally given quite a bit of attention from economists, it is logical that more attention should be paid to the media sector in economic research.

Perhaps the most important, interesting and challenging aspect of the media industries, as subjects for applied economic analysis, is the impact that digitization has had on them. The term *convergence* is one that is often used in the recent literature in this field and, "...stems from a migration toward common digital technologies...The term refers to the coming together, on account of shared use of digital technologies, of sectors and product markets that were previously seen as distinct and separate." (Doyle 2013:25) This industrial metamorphosis has yet to settle into a stable equilibrium posing some major challenges for the firms in these industries. "The plethora of technological advances has forced media companies to try and keep up with one another, while at the same time not knowing what technologies consumers will ultimately adapt." (Albarran 2010: 5-6) So aside from the restructuring that convergence seems to warrant for the firms in these industries there is even more uncertainty in regards to how to engage the markets they operate working in, making studying demand determinants of optimal relevance.

1.2.2 The Film Industry²

The film industry is a particularly interesting subject of focus for applied economic analysis in ways that are ideal as well as challenging. There are unique

² The information in this section is an amalgamation of the discussions included in De Vany and Walls (1996), De Vany and Walls (1997a), De Vany and Walls (1997b), Smith and Smith (1986), Casavant and Prag (1994) and Ravid (1999)

characteristics to a film product, its demand, and the availability of data which make it an optimal subject. The process by which a film is produced and distributed though, provides challenging obstacles in optimizing its potential as a subject of analysis. Most importantly, the unique history of the film industry within the United States as a subject of a major anti-trust Supreme Court decision, deserves special attention as a source of these challenges. The resulting breakup of the industry's vertical structure in 1948, yielded industry practices which created inefficiencies in the markets. Finally, the industry has been a pioneer in globalizing media giving special relevance to its international exhibition practices, which are not subject to the terms of the 1948 decision.

The general reasons why the film industry can be a valuable choice for economists to focus on speak for themselves. First of all, film is a great example of a differentiated product in conventional monopolistic competition models. Also, there are very few industries which offer a wealth of data concerning individual undertakings and thus provide a revealing look at the factors which are important to consumers in making a product choice as well. Lastly, studying word-of-mouth dynamics can shed important light on the information transmission among consumers, as well as providing valuable insights into the winner-take-all dynamics that allow profits to be highly concentrated.

The challenges to getting a clear economic understanding of film content markets are wide-ranging. Most importantly, films are complex products that are

difficult to make well. Part of this challenge is due to the duration of the production process which is long, uncertain, and uncommon in most industries (Ravid 2005:32). There is also the fact that consumers complicate demand, given that each one does not know if she will enjoy a particular film until it is seen. Another complication is that the shelf life of the theatrical run is limited and films enter and exit the theatrical market on a continuing basis, competing against a changing set of competitors. Also, the nature of distribution makes demand challenging to assess, in that content is disseminated at various times through a variety of platforms; a practice known as *windowing* which is common in media industries. For a filmic product, consumption generally begins with its exhibition in the theatrical run, in both domestic and foreign theaters, with subsequent releases in home entertainment markets, as well as via licensing arrangements with cable companies, broadcast television stations and internet exhibitors.

The domestic theatrical exhibition window is a large source of the complications involved in studying the industry which is partly attributable to the nature of its vertical structure. Prior to 1948, the major studios were able to produce, distribute and theatrically exhibit their own content. The 1948 Paramount Supreme Court decision³ led to the studios divesting from the exhibition portion of the industrial

³ There is an entire branch of literature dealing with this topic which is not directly relevant to my hypothesis, but certainly worth mentioning. These papers include De Vany and McMillan 2004 in which an event study is performed on the firms affected by the decision; Gil 2008a concludes the action was unnecessary with respect to the production processes and entry/exit; Gil 2008b studies foreign markets unaffected by the US court decree in order to draw inference about the possible effects the decision had on the domestic industry

chain. This meant selling off stakes in theaters, as well as several imposed stipulations on the nature of the contracts the studios could have with the theaters that would exhibit their films. A few stipulations of note include that rental agreements for films had to be made on a film by film basis, which meant that the practice of block booking—packaging several films into one contract—was no longer permissible. Also, films had to be licensed on a theater by theater basis on the merits of the film and the theaters

The resulting rental contracts between distributors and exhibitors have three main features. One is that a percentage of gross admission revenue is paid to the distributor. This is called the *rent* and is a minimum percentage of the revenue, which declines over the run, net of a fixed amount, known as the *house nut*⁴. A 90% rental rate will be triggered anytime the weekly box office amount exceeds the house nut by a sufficient amount. The resulting revenue for distributors is, on average, 30% of the domestic theatrical box office take (Vogel 2005:71). The second main feature of contracts specifies the length of time a film will run. Four weeks is a common amount but sometimes it can range as high as five to eight weeks. Adaptation is possible though. In the case of a *bomb*—a complete failure—distributors may permit the cinemas to end the run early. There is also a ‘holdover’ clause requiring the theater to continue a run another week if the previous week’s box office revenue exceeds a stipulated amount. If the holdover clause is not engaged, the lengthening of the run is determined by the theater owner. In the case of a successful film that does not meet the holdover clause

⁴ This is the amount of box office revenue a theater uses to maintain its facilities, staff, etc.

threshold it must yield the exhibitor higher returns than alternatives available in order to make it worth keeping on. Lastly, the third feature of the contracts is the geographical component that clears areas near a theater where the distributor will not license a film.

These contracts are the main avenue in which supply can adjust to demand in the theatrical market, since prices are generally fixed. Initially, a distributor chooses a release pattern, based on *ex ante* appraisal of demand. Beyond the initial supply, the number of viewers can grow to the capacity of the cinemas. Once the initially agreed upon length of a run is complete, the decision to extend a run embodies the supply decision. This ability to extend the run makes an almost perfectly elastic supply response possible so that price need not rise to choke off excess demand. The cost to the distributor of extending the run is the opportunity cost of booking the film at another cinema. The time pattern of the box office revenue, the number of screens showing a film, and the duration from its birth to its death contain most of the information about the interplay of demand and supply.

One last subject of related interest is the international position and practices of the U.S. film industry which are not subject to the 1948 Supreme Court decision. There are similar contractual stipulations between domestic distributors and international exhibitors, but domestic distributors are also able to own foreign theaters themselves. This is reflected in the 40% average revenue they collect from international box office venues which is ten percent more than the domestic take (Vogel 2005:71). The 10%

difference in revenues might also be attributed to some of the more unique qualities of the strategies that American film studios have undertaken globally. Given that *Hollywood*⁵ was a pioneer in globalizing media, the international marketplace for theatrical exhibition of films has special relevance. “Although the expansion of global markets may be relatively new for some media, the U.S. film industry developed global marketing techniques as early as the 1920s and continues its dominant position in international media markets today.” (Wasko 2005:27) The experience in the global marketplace has generated a variety of strategies that have proven successful. One strategy is that,

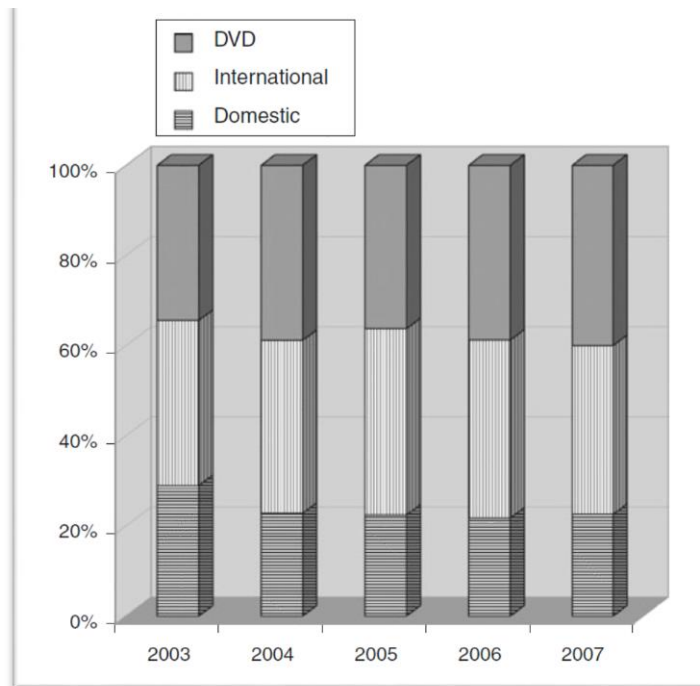
...the Hollywood majors operate globally through an export cartel, the Motion Picture Association (MPA), often referred to as ‘the Little State Department.’ The MPA is especially active in clearing the way for the international sales of Hollywood products through various strategies, including direct trade negotiations with foreign governments, antipiracy campaigns, and so on. (Wasko 2005: 14)

This approach along with some other factors have yielded a dominant position for Hollywood globally. “Although every region of the world produces and distributes film and television programming, the United States has long been the dominant exporter, with a net trade balance for these products of at least \$4 billion a year. (Vogel 2011:94) The English language as an important cultural factor is especially vital in explaining this dominance,

The base language is English, the second most used after Mandarin Chinese, with the majority of its speakers residing in the wealthiest countries. This means that the ‘cultural discount’ – the diminished value of an imported film or program due to differences of style, cultural references and preferences, and relevance... is relatively small. (94)

⁵ A common way to refer to the US film industry

Figure 1.3 – Domestic and International Box-Office, and DVD Sales Revenue



(Source: Walls 2010)

What all these facts amount to is the complexity of the theatrical window which makes analysis within it not as clear cut as the analysis in the home entertainment markets. Also, the importance of the overall fraction of revenues the domestic box office generates for a film has been waning. In 1999, the total – foreign and domestic –box office revenue was only 22% of the total revenues generated that year. Home entertainment generated 55% of the revenue with the remaining 23% coming from licensing agreements with cable, broadcast channels and pay-per-view (Brewer et al. 2008:2). Focusing more narrowly on just revenues from the foreign and domestic box office, as well as home video sales and rentals for 2007, the domestic box office percentage was 19% compared to the international box office's portion coming in at 34% and home video rentals and sales taking up the last 47% (Walls 2010:263). Figure

1.3 tracks the change of importance of these three revenue sources from the year 2004 to 2007. It clearly demonstrates the trend for the domestic box office to be diminishing in significance as a source of a film's overall revenue.

1.2.3 Industry Competitive Structure and Practices

The following quote sums up the competitive structure of the industry.

From the theatrical box office, to [home entertainment] sales, to the sale of films to television and cable outlets, the Hollywood majors rule the film business as a reigning oligopoly. Although there may be some competition (for instance, between major releases), the studios also cooperate in typical oligopolistic fashion to determine industry policies and to protect and promote the industry.” (Wasko 2005:16)

The Hollywood ‘*majors*’ are six largest studios in the industry. Each is a subsidiary of large multinational firms invested in several industries. The majors are Sony Pictures (Sony), owned by the Sony Corporation, Warner Brothers (Warner), owned by the Time Warner Corporation, The Walt Disney Studios (Disney), owned by The Walt Disney Company, NBCUniversal (Universal), owned by Comcast, Paramount Motion Pictures Group (Paramount), owned by the Viacom Corporation and Fox Entertainment Group (Fox), owned by Newscorp. With the majors controlling nearly eighty percent of the industry, the remaining twenty percent is left to several small firms labeled the ‘*minors*’. Due to the complexity of the supply chain, with its various windows of distribution, the majors and minors are also dependent on several small service and production firms (Vogel 2011:78). This includes exhibition outlets like film exhibition theaters and subscription-video-on-demand (SVOD) services, like Netflix.

The complex competitive structure of the industry amplified its susceptibility to the digital revolution. It is convergence that has caused a shift in the power dynamics from producers to consumers in these markets. With more standardized methods of viewing content the user has become more autonomous and in control of what she consumes. Media economist Alan Albarran discusses how this has affected the industry, “This seminal change has disrupted traditional business models...traditional media have had to evolve and respond so as not to be totally left out of the picture.”(Albarran: 4-5). The exhibitionist-to-audience ratio is one important model disrupted, changing from a one-to-many to a one-to-one dynamic (Doyle :77).

The dramatic effect of convergence notwithstanding, the film industry is used to change and understands that they must embrace it. Fred Bucher, group VP of marketing for Warner recently said,

When you're faced with disruption, you have to adopt it because it's not going away...The motion picture industry has often been criticized for [lagging], but if you look at what's going on in the industry, the moment we saw pay-TV and subscription services start to launch, even the launch of TV itself, the movie industry first fights, and then ultimately finds a way to monetize it. (Tribbey 2014d)

Although the industry has embraced the recent changes and are attempting to monetize them, whether or not their efforts will lead to increased profitability is questionable as industry economist Harold Vogel points out, “...weak cost constraints, fragmentation of markets and audiences, and increased competition for talent resources have capped profit margins, incremental new-media revenue contributions notwithstanding.” (2011: 97-98). Since the profitability of adaptation is not yet secure, any changes the industry implements must be carefully monitored so as to avoid damaging existing profitability.

1.2.4 Home Entertainment Markets

The sell-through and rental home entertainment markets being the focus of this paper deserve special attention. First I briefly describe their overall importance and performance over the data time span in this paper which starts in late 2012 and ends in early 2014. I then provide some relevant information about the purchase and rental markets individually.

Home entertainment markets that have traditionally been a dominant and steady source of revenue for the film industry have been in a state of flux due to the digital revolution. Following their inception in the late 1970's these markets grew to be an important source of revenue for the industry with their current earnings encompassing at least two-thirds of the industry's overall revenue (Chiou 2008). This large chunk has mainly been declining over the last ten years from a peak amount of \$22 billion in 2004 (Tribbey 2012) to a recent trough of \$18 billion in 2012 (Gruenwedel 2013a). 2013 showed a small amount of growth with total revenues from these markets increasing to \$18.2 billion (Arnold 2014a).

This small increase was not due to rental markets. Rental markets experienced a drop in revenue during the period in question. The revenue channels in this market are brick-and-mortar stores, SVOD services, and kiosk rental services⁶, mainly from

⁶ Kiosk rental involves transactions between consumers and interactive computerized kiosks. These transactions include selecting and renting a disc for a price of \$1.20 a day, and the returning of discs. Redbox currently operates kiosks at 39,500 locations nationwide (source: <http://www.redbox.com/facts>).

Redbox. Rentals from these three sources accounted for sixty two percent of the rental revenue in 2012 with the remaining thirty eight percent coming from digital rentals (Gruenwedel 2013a). Redbox ended 2012 with a forty five percent share of the physical disc rental market, with smaller box office titles bringing in higher revenues. Throughout 2013 kiosk activity was stable but brick-and-mortar revenues fell fourteen percent and SVOD fell nineteen percent (Gruenwedel 2013b). These drops in revenue are consistent with my findings and likely reflect the effect that UltraViolet has had on these markets.

Purchase markets bring in more revenue per transaction than rental markets making profit maximization in purchase markets of paramount importance to the industry (Gruenwedel 2013a). Consequently, swaying consumers' consumption behavior to buy instead of rent is of special interest to the industry. David Bishop, president of home entertainment for Sony recently said, “Now the focus has to be on the value of ownership going forward. What we're trying to do is get the transaction mix back to 2006 levels.’ In 2006 the share of home entertainment was split 70% rental, 30% sell-through. Today that's roughly 80% and 20%...”.(Tribbey 2014a)

1.2.5 Disc and Digital

In this section I provide relevant information about the distribution formats looked at in this paper. First there is a brief discussion of the blu-ray disc format. I then turn the spotlight to digital distribution. Finally I touch upon the industry's recent realization that the two formats can coexist.

Blu-ray discs were first introduced in 2006. The reason for their innovation was rooted in a need for higher definition media files to be stored and watched on high definition screens, which had become the standard for home exhibition. The file size limitation to DVDs made them less than optimal for the new exhibition technology thus consumers had been turning away from them over the last few years. This was the cause of net declines in packaged media revenue mentioned above. This decline has been offset somewhat by the rise of the Blu-ray format evidenced by the fact that packaged media revenues went down eight percent in 2013 yet Blu-ray disc sales finished 2013 five percent ahead of 2012. The increasing household penetration of digital exhibition technology in the US is partly responsible for the Blu-ray format's success. As of January 2014, Blu-ray player penetration was at seventy-two million homes and HDTV penetration was at ninety-six million homes (Arnold 2014a).

Digital distribution through sales and rental channels has been penetrating the hearts and minds of consumers as well over the last few years. At the beginning of 2014 that there were as many as thirty-eight million people inclined to buy digital (Tribbey 2014a). Throughout 2013, total consumer spending on digital content was up nearly twenty-four percent from the prior year to \$6.46 billion. The video-on-demand (VOD)⁷ and SVOD revenues from digital distribution both increased over the prior year with five and thirty two percent increases respectively. Most relevant and impressive is the increase in digital sales alone which was up forty-seven percent over

⁷ Video on demand is essentially the renting of a digital file.

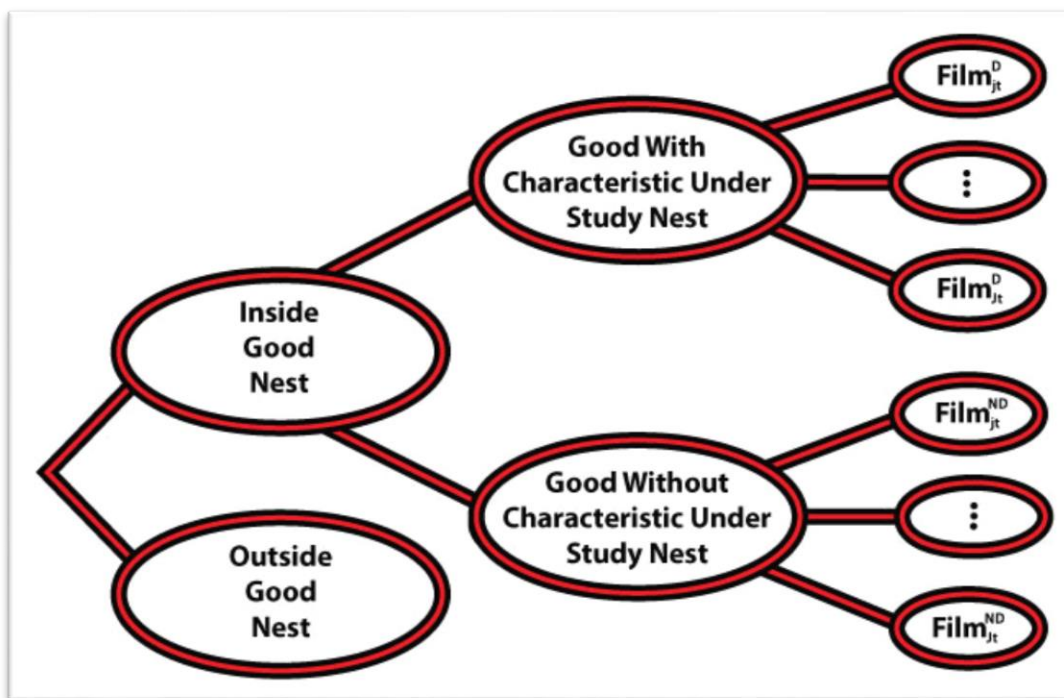
2012. A pressing question on the industry's mind is whether or not revenues from digital distribution, will permanently offset the decline in revenue from packaged media sales which as of 2012 encompassed seventy-three percent of all home entertainment spending (Gruenwedel 2013a).

Perhaps the answer to this question is at hand given that the home entertainment industry has come to understand that digital and discs can together provide more value to consumers than apart. Combo-packs released by the involved majors, include Blu-rays, DVDs, and a digital file access. Man Jit Singh, president of Sony Pictures Home Entertainment recently commented on the importance of this inclusion, "This strategy has helped drive digital ownership, served as an ideal gateway to digital and has added value to the physical product." (Prange 2014b). An analyst for the NPD group recently contended that the industry should direct consumers, "...toward physical/digital ecosystem rather than inundating the market with myriad digital-only platforms and deluding consumer response." (Gruenwedel 2014b).

1.3 Model

The workhorse model for the three works is a nested logit model. The model has proven flexible in studying consumption behavior in film markets. Although there are subtle differences in how it is employed throughout the three analytical approaches, the basic model is the same and thus detailed here. Section 1.3.1 describes the nested logit model. Section 1.3.2 goes into detail about the components of the model that are instrumented and the nature of the instrumental variables. The final section 1.3.3

Figure 1.4 – General Two Level Nested Logit Model Schematic Diagram



Note: The superscript D denotes the inclusion of the characteristic under study in a film. The superscript ND denotes films that do not include this characteristic.

describes the observable components of utility, which include film characteristics and seasonal/competition components.

1.3.1 Nested Logit Model⁸

The model is a two level nested logit model as figure 1.4 depicts. Each film is indexed by j where $j \in J$ and each time period is denoted by t . The first nesting level, also known as the ‘*upper model*’, is the ‘*type-of-good*’ nesting level. The type of goods in binary opposition are the inside good and the outside good. The empirical analysis is performed on the rental and sales markets independently throughout the three works, so in any instance, choosing to rent or purchase a film is tantamount to choosing the

⁸ The discussion of the model is based in part on Chiou (2008) and Train (2007). Train’s Chapters 3 and 4 are an excellent resource for gaining an in-depth understanding of logit and nested logit models.

inside good. The outside good represents all other possible choices for leisure activity. The second nesting level, or ‘*middle model*’, is comprised of a nest for films that contain the characteristic under study throughout the empirical works (Good With Characteristic Under Study Nest) and a nest for films that do not (Good Without Characteristic Under Study Nest). The ‘*lower model*’ is the choice of a film.

The utility from consuming film i is modeled as

$$U_{it} = \beta X_i - \rho(t - r_i) + \alpha_i + \gamma_t + \varepsilon_{it}, \quad (1)$$

having four observable components and an error term capturing idiosyncratic behavior. The first component, βX_i is part of the lower model, representing the utility one gets from the individual characteristics of a film⁹. The second component, $-\rho(t - r_i)$, also part of the lower model, represents the decay of utility over time where r_i denotes the date a film is released in home entertainment markets and ρ represents the decay rate. Following Chiou (2008) and Einav (2007), my model assumes that the decay effect is independent of the video release date and the individual film characteristics. The third component α_i , the middle model, represents the utility from the inclusion of the characteristic under study. The third component, γ_t , is a vector of shift parameters common to all inside goods capturing seasonal market effects, and, thus constituting the upper model. Lastly, the unobserved component of utility is denoted ε_{it} .

⁹ These are discussed in detail in section 1.3.3

The choice probabilities of the nested logit model¹⁰ can be expressed in terms of the log-sum coefficients λ_k and λ_m on the inclusive values¹¹ for each nest. These λ values provide a measure of the correlation of the error term within nests. The higher the λ value, the less substitutable are the options within the respective nesting level. The parameter λ_k represents the degree of substitutability within the characteristic under study nests B_k while λ_m represents the degree of substitutability of the type-of-good nesting level D_m . If the nests all have zero substitutability, with the λ values equaling 1, the model collapses down to a standard logit model. Also, as long as the λ values stay between 0 and 1 the entire ranges of the explanatory variables will be consistent with random utility maximization. If this is not the case and λ is greater than one the model is consistent with utility-maximizing behavior for some range of the explanatory variables (Train: 85).

The nested logit model with λ values between 0 and 1 also exhibit independence of irrelevant alternatives (IIA) within nests. IIA means that proportional substitution occurs between options within a nest but not across nests. For example, suppose a film with chapter 3's digital distribution window falls out of the market. If the middle model has a λ value between 0 and 1, then consumers are more likely to choose another film

¹⁰ Logit choice probabilities are derived by assuming the unobserved portion of utility to be distributed extreme value. Doing so allows for a closed form solution to the probability integral over all possible error values.

¹¹ An inclusive value combined with its respective log-sum coefficient represents the expected utility from a lower nest (Train 2007:87). See Appendix A for more information.

with the digital distribution window instead of one without. A standard logit model has this property across all options¹².

I invert the market share formula¹³ and simplify to obtain a relationship between film i 's market share (relative to the outside good) and mean utility

$$\begin{aligned} \ln s_{it} - \ln s_{ot} = & \beta X_i - \rho(t - r_i) + \alpha_i + \gamma_t + (1 - \lambda_k \lambda_m) \ln s_{i|B_k,t} \\ & + (1 - \lambda_m) \ln s_{B_k|D_m,t} + \varepsilon_{it} \end{aligned} \quad (2)$$

where $\ln s_{i|B_k,t}$ is the log of film i 's within group share of group k (good with/without characteristic of study nest) and $\ln s_{B_k|D_m,t}$ is the log of group k 's within group share of group m (type-of-good nest). Generally, $\ln s_{j|B_k,t}$ is the amount of times a film is chosen, denoted by n , in a given time period t , as a fraction of all the films chosen the same time period in the same characteristic of study nest,

$$\ln s_{j|B_k,t} = \ln \frac{n_{jt}}{N_{kt}}. \quad (3)$$

where

$$\sum_{j \in B_k} n_{jt} = N_{kt}. \quad (4)$$

Similarly,

¹² This is considered to be one of its main limitations.

¹³ See Appendix A for derivation.

$$\ln s_{B_k|D_m,t} = \ln \frac{N_{kt}}{\sum_{B_k \in D_m} N_{kt}} \quad (5)$$

is the number of times the films in a characteristic of study nest are chosen in a time period as a fraction of the total inside goods chosen, D_m .

The dependent variable is the log of film i 's market share, s_{it} , relative to the outside good's market share, s_{Ot} , where the O subscript denotes the outside good. The film's market share is defined mathematically as

$$s_{it} = \frac{n_{it}}{p_t}$$

where p_t is the United States population at time t . It follows from this construct that the outside good's market share is

$$s_{Ot} = \frac{p_t - n_{it}}{p_t}$$

which in practice is very close to one, making its log very close to zero. Thus the dependent variable is a close approximation to the log of a film's market share.

1.3.2 Two Stage Least Squares Estimation

The market shares for film i , $\ln s_{i|B_k,t}$ and $\ln s_{B_k|D_m,t}$, cannot be estimated directly due to their endogeneity. As such two stage least squares is needed in order to instrument for them. Following Chiou (2008) I use the characteristics of competing

films as instruments. The first characteristic I use is the total box office of the within group competitors in a given time period. For $\ln s_{i|B_k,t}$ I use

$$I_{BO,it}^k = \sum_{j \in B_k} \ln bo_j, \quad \text{where } i \neq j \text{ and } i \in B_k$$

the sum of the log of box office of all its group k competitors at time t. Similarly for $\ln s_{B_k|D_m,t}$ I use

$$I_{BO,it}^m = \sum_j \ln bo_j - \sum_{j \in B_k} \ln bo_j, \quad \text{where } i \in B_k$$

which is the total box office of the opposing group k in a particular week. The idea is that at in every time period there is a high degree of correlation between a film's likelihood of being chosen and the variation in quality of its competitors. The correlation is negative given that the higher the competitors' quality, the lower the likelihood of a film being chosen.

The second instrument works the same way. It is the total decay of the competing nest. The decay, denoted δ_{it} , is defined as the number of weeks a film has been available in home entertainment markets

$$\delta_{it} = t - r_i$$

The logic of the decay specification is that the longer a film is available in a market, the less likely consumers are to choose it¹⁴. The second instrument for $\ln s_{i|B_k,t}$ is

$$I_{Decay,it}^k = \sum_{j \in B_k} \delta_{jt}, \quad \text{where } i \neq j \text{ and } i \in B_k$$

representing the total decay of all of film i 's competing films within group k . For group k 's share of the inside group, m , the expression is

$$I_{Decay,it}^m = \sum_j \delta_{jt} - \sum_{j \in B_k} \delta_{jt} \quad \text{where } i \in j$$

, which again, is the total decay of the films in the opposing durability nest of film i .

The three works utilize the first two instruments, with the third work utilizing a third instrument. The third and final instrument works the same way. It is the total critic ratings of the competing nest. The third instrument for $\ln s_{i|B_k,t}$ is

$$I_{critic,it}^k = \sum_{j \in B_k} \text{critic rating}_{jt}, \quad \text{where } i \neq j \text{ and } i \in B_k$$

representing the total ratings of film i 's competing films within group k . For group k 's share of the inside group, m , the expression is

¹⁴ This conception of decay captures the idea that consumers are assumed to only consume a film once. It's a fact that, "...the first three weeks of a video's release generates approximately 50% of total rental revenues over a five month period." (Chiou 2008) Thus it's assumed that the majority of consumers make their choices early relative to the time of a film's release to consume.

$$I_{critic,it}^m = \sum_j critic\ rating_{jt} - \sum_{j \in B_k} critic\ rating_{jt} \quad \text{where } i \in j$$

, which again, is the total critic ratings of the films in the opposing superstar/niche nest of film i .

1.3.3 Observables

I go into detail here on the observable components of utility in two categories: film characteristics and seasonal/ competition/economic conditions components.

Film Characteristics¹⁵

Equation 6,

$$\begin{aligned} \beta X_i = & \beta_1[\log(box\ office)]_i + \beta_2(genre\ dummy)_i + \beta_3(MPAA\ dummy)_i \\ & + \beta_4[\log(user\ reviews)]_i + \beta_5[\log(critic\ reviews)]_i \\ & + \beta_6(sequel\ dummy)_i + \beta_7[\log(source\ dummy)]^{16}_i, \end{aligned} \quad (6)$$

shows the components of βX_i to be (in the same order as above) the log of film i 's theatrical box office, a series of genre dummies, a series of MPAA¹⁷ ratings dummies, the log of a measure of user satisfaction, the log of a measure of professional critics'

¹⁵ Decay is omitted. See above for discussion of this variable.

¹⁶ Only included in third work

¹⁷ The Motion Picture Association of America is a consortium of the major players in the industry who work together to support and protect the industry. Included in their responsibilities is the rating of film content intended to send signals to parents about what may or may not be appropriate for their children's eyes.

assessment of a film, a dummy for the sequel status of a film, and a series of dummies for the creative source of a film¹⁸.

The theatrical box office variable is included to capture the quality of a film relative to its competitors. Following Chiou (2008), instead of estimating a film's fixed effects I use the theatrical box office revenues as a measure of quality. The heterogeneity amongst films is observed by proxy in this case. Given that a film will generally compete with a similar pool of new releases in downstream distribution windows as it does in the theatrical window, its theatrical box office revenue is a good proxy for its quality relative to its competitors. The value used is the total domestic box office earned in dollars.

The genre dummies control for variation in consumption behavior with regard to genre characteristics¹⁹. For the first two works in chapters two and three, the included genres are Comedy, Romantic Comedy, Drama, Action, Horror, Suspense and Family with the omitted genre being Family. In the third work in chapter four, the included genres are Comedy, Documentary, Romantic Comedy, Drama, Action, Horror, and Family with its omitted genre being Action.

The MPAA dummies control for variation in a film's utility resulting from its rating. In chapters two and three, the three ratings categories included are PG, PG-13, and R with PG being omitted. PG stands for '*parental guidance*'. The G²⁰ rating,

¹⁸ The source dummy only shows up in the first work (chapter 2)

¹⁹ This includes iconography and paradigmatic story elements

²⁰ There are no films in my sample with a G rating.

which stands for '*general audiences*', is used when the content of a film is deemed acceptable for all viewers. So PG has some content, relative to a G film, that parents may want to review before deciding to give their children permission to view. PG-13 is explained with the same principle, but the MPAA suggests to parents that the content may not be appropriate for children under the age of 13. The R rating restricts viewership to any individual under the age of 17 that is not accompanied by an adult. The ratings included in chapter four are G, PG, PG-13, R, NC-17 and NR with G being omitted. The additional rating NC-17 goes a step further than the R rating, barring any person under the age of 17 from watching a film regardless of any circumstance. Finally NR stands for '*not rated*' and signifies films that were not rated by the MPAA.

I also include two measures of word of mouth satisfaction. One is the log of the average review score from a typical film consumer. The other is the log of the average professional critic's review score.

Finally, I include dummies representing more in-depth qualities of the film content. The first is a dummy for the sequel status of a film capturing the familiarity of a film's content to a viewer. The second is a set of dummies which control for the nature of a film's source material and is only included in chapter two. These include '*Based on Non-fictional Events*', '*Original Screenplay*', '*Based on Pre-Existing Fictional Work*' and '*Remake*'. The omitted category is Based on Non-fictional Events. As far as I know the testing of the source dummies is novel to this paper.

Seasonality/Competition/Economic Conditions Characteristics

Equation 7

$$\begin{aligned}\gamma_t = & \gamma_1(\text{time trend})_t + \gamma_2(\text{season dummy})_t \\ & + \gamma_3[\log(\text{theatrical competition})]_t + \gamma_4(\text{gdp growth rate})_t \quad (7) \\ & + \gamma_5[\log(\text{unemployment rate})]_t,\end{aligned}$$

shows the components of γ to be (in the same order as above) a time trend variable, a series of dummies for the calendar seasons, the log of a measure of the competitiveness of the theatrical market, the gross domestic product growth rate at time t and the log of the unemployment rate.

The seasonality dummies capture the effect calendar seasons have on demand in the home entertainment disc rental market. The time trend variable, included only in chapter four's model, is included to have the analysis be more in line with related literature. The second is a simple set of dummies to control for the calendar seasons' effects on demand. Included are Spring, Summer, Fall and Winter with Spring being the omitted category. The third γ component captures the degree of competition the theatrical market has relative to the home entertainment market. It is the log of the aggregate total box office revenues of the top twenty earning films in the theatrical market at time t . The last two components are again exclusive to chapter for and are meant to capture the turbulent economic fluctuations that occurred as a result of the great recession, which occurred during the sample period. Included is the gdp growth rate with the second being the log of the unemployment rate.

1.4 Data

The data set used throughout this paper was constructed from two main data sources. One is Nash Information Services, used in the first and second works, and the other is the Rentrak Corporation, which provided data used in all three of the work. Using a permutation of these sources and doing a bit of web-scraping yielded the complete data sets used throughout this paper. Section 1.4.1 discusses the particulars of the Nash data set and Section 1.4.2 discusses the Rentrak data set.

1.4.1 Nash

Nash Information Services collects data on various film industry markets and provides them to the public and the industry. The data they offer is for the theatrical window as well as the home entertainment markets for renting and buying of discs. Beyond these numbers Nash also offers descriptive data on films such as genre and date of release.

The majority of the data I used from Nash is descriptive. The only numerical data is the total box office revenue earned in the domestic theatrical window. The rest of the data is mainly used to construct dummies for genre, sequel status, and source. I also utilized their data on home entertainment market release date for each film used to construct the decay variable.

1.4.2 Rentrak

The foundational portion of the data set came from Rentrak. Rentrak collects data about the performance of all domestic film markets as well as some foreign markets. The film industry is dependent on these figures. They work with the industry to generate figures, some of which come from direct industry sources while others are estimates generated by Rentrak themselves. Rentrak was kind enough to provide me with data on weekly units sold and rented, for all films²¹ released from 1980 onwards that made at least one million dollars in the domestic box office. They also provided the name of each film's distributor and the rating information.

The packaged media sales numbers Rentrak provided me are estimates based on data from brick-and-mortar stores nationwide. They do not include numbers from online retailers such as Amazon.com. The rental figures are estimates based on numbers from the three channels mentioned above, SVOD, rental kiosks, and the nearly extinct brick-and-mortar stores. There was variation in data availability of the three sources over the time frame of the three works in this paper providing for limitations and opportunities²².

²¹ I excluded non-fiction films as well as foreign films from the analysis for chapters 2 and 3.

²² More on this in each respective chapter's 'Data - Time Frame' section.

2 The Introduction of Infinite Durability to an Information Good and the Decision to Buy or Rent: Evidence from the Film Industry

2.1 Introduction

Change is fuel for observation based research. The home entertainment distribution rung in the industrial ladder of the film industry has been undergoing major change throughout the recent transition into the digital age. With oligopolistic markets and a heavy dependence on ever-changing technologies, the industry is rife with potential for natural experiments. This chapter focuses on one realization of that potential; the introduction of infinite durability to an information good and the imperfectly competitive market place that is attempting to implement it. The result, in practice, has been that one of the six major film studios, which collectively control approximately 80% of the marketplace (Albarran 2010 : 3-4), chose to approach the situation differently than the other five. Specifically, five of the six major studios have decided to work together to standardize the ecosystem whereby consumers engage firms in market transactions, manage their information good purchases, and access their content, while the sixth studio chose to abstain. With the implementation of this ecosystem occurring over the last few years, patterns of consumption of home media have revealed preferences on the part of consumers, vis-à-vis the durability of an information good and how this affects their willingness to buy versus rent the good. The main revelation is that under certain conditions, indefinitely extending an

information good's durability creates enough utility to warrant a shift in consumption behavior away from renting toward buying it.

The five major studios that embarked on the challenge of standardizing their product ecosystem are Paramount, Warner Brothers, Sony, Fox, and Universal. Collectively, this group has standardized the market for digital versions of their films in a cloud²³ based ecosystem which they have termed '*UltraViolet*'. At its core, UltraViolet is a shared digital space in which the film companies provide access to managing and viewing content via streaming. Users have a '*digital locker*' in the digital space composed of a set of licenses to view their purchased content. The content has been given an industry wide formal moniker, '*Digital HD*', to help brand this method of purchasing a film²⁴. Characterized as the buy-once-play-anywhere product by the industry, UltraViolet's main selling point is the permanence of the purchase of Digital HD. Permanence connotes not just permanent ownership, but permanent access as well, as one can permanently depend on being able to view a purchase from all possible devices, *ad infinitum*.

²³ The '*cloud*' refers to computing via the web. Instead of housing all files in one's computing device, a user keeps some files on servers located in a different geographic location which can permanently be accessed via any modern web enabled device.

²⁴ The ecosystem also houses television shows. I have kept the scope of this paper to films to be consistent with related academic literature.

The aspect of UltraViolet that is central to this paper is the inclusion of UltraViolet access in packaged media²⁵ purchases (DVDs²⁶ and Blu-rays²⁷). After the implementation of the UltraViolet digital infrastructure, which was initiated in the fall of 2011, the five aforementioned studios along with some smaller studios, progressively began including UltraViolet access in packaged media purchases. This access took the form of a paper slip²⁸ with an access code. A consumer simply had to log on to an UltraViolet portal, enter the code, and add the content to her digital locker. Although there were some problems initially in the agreement amongst the five companies on what the access portals would be as well as other logistics of the system, eventually improvements in the system made it more cohesive and user friendly.

Starting in 2008, prior to the UltraViolet era, distributors began including digital copies of films on a separate disc with the purchase of packaged media (Musgrove 2008). This was more of a buy-once-play-some-places product which allowed for a digital version of content to be stored in a consumer's home computing system, but with limited access across device platforms. The problem with these files was two-fold. One, the files can be misplaced or deleted easily, and two, as already mentioned, the files cannot be played on all devices, and certainly are not accessible regardless of the geographic location of a user. These limitations are what motivated

²⁵ Packaged media refers to disc based distribution methods

²⁶ DVD stands for '*digital versatile disc*' and is a type of physical media that stores digital files. Films on DVDs can be played in any device that plays these type of discs including DVD players and various computing devices with DVD disc drive.

²⁷ A Blu-ray is a similar type of media to a DVD, differing only in its capacity to store much large files.

²⁸ A sample slip is included in Appendix B as Figure B1

the five studios to bring forth the UltraViolet ecosystem. These limitations remained with Disney's products, albeit with minor improvements, until they introduced their own buy-once-play-anywhere platform²⁹, '*Disney Movies Anywhere*' in February of 2014. Thus, the time period from fall of 2011 to February of 2014 provided the perfect conditions for a natural experiment in which one could analyze exactly how infinite durability affects a buyer's consumption behavior for information goods, using films as a proxy, by comparing the consumption patterns of films from all studios within the packaged media rental and sell through markets.

I perform my analysis using a discrete choice model on a unique data set of weekly rental and sales units. The decision to buy versus rent was modeled using a nested logit model. The analysis looks at sales and rental units of packaged media, aggregated across formats, as well as in subsets of DVDs and Blu-rays. The unbalanced³⁰ panel data set is comprised of 286 unique films, over the course of seventy-three weeks.

Varying results were found in each subset of the rental and sales markets. The starkest result is that consumers of the most sophisticated packaged media format, Blu-ray discs, were most sensitive to the introduction of infinite durability. Although the purchase of all packaged media exhibited a significant positive differential in buying behavior due to the introduction of infinite durability, it is only in the Blu-ray subset

²⁹ Although the system offers infinite durability, it does is not connected to the UltraViolet network.

³⁰ Not all films were released at the start of the time frame and thus there is a variable amount of weekly data points for each film.

that a significant effect was measured across sell-through and rental markets. Specifically, films without UltraViolet access were found to have a lower likelihood of being purchased and a higher likelihood of being rented due to the proliferation of the system. Also, in purchase markets, a relatively high amount of substitutability is found to exist within the nests of infinitely durable goods and non-infinitely durable goods, implying that the inclusion of infinite durability to a film creates enough value for consumers to make goods without this characteristic less appealing by comparison.

The following is a description of the paper structure. The paper begins by placing this work within the context of related works conducted by the industry. It then goes on to detail relevant aspects of the film industry. The empirical model is presented in the subsequent section, followed by a section describing the data. To close out the chapter, there is a section detailing the empirical results succeeded by closing remarks.

2.2 Related Work

Outside of academia, the film industry is engaged in its own research, conducted either by the firms themselves or industry consultancy groups. Several studies have been conducted on home video market trends and the nature of the proliferation of UltraViolet, detailed below. Their data and results are proprietary and thus not transparent to academia.

2.2.1 Industry Conducted Research

Over the last year, the NPD group, an industry consultancy firm, reported on the characteristics of UltraViolet users, providing results that are consistent with the findings in this chapter's empirical work. Their results are based on consumer survey data collected internally rather than transactional data.

In December of 2013 the NPD group reported that twenty nine percent of physical disc users are buying more discs after being introduced to UltraViolet (Tribbey 2013). This is consistent with the increased likelihood to buy in sell-through markets I observe in this paper. Six months later, in May of 2014, NPD reported that UltraViolet users are four times more likely to own a connected Blu-ray player or some other streaming media device. Also, UltraViolet users spend three times as much as other consumers on home entertainment (Tribbey 2014b). This reveals them to be high value film consumers. In the rental markets they are high low-value consumers of films. Meaning, that they value the film they consume in rental markets enough that the increased utility from the introduction of infinite durability would be enough to sway them to buy instead of rent. These second report's findings support my own findings which were most pronounced in the blu-ray data.

2.3 Industry

Here I discuss important details about the UltraViolet ecosystem. I then close out this section with facts relating to Disney's role.

2.3.1 UltraViolet³¹

The UltraViolet ecosystem is what embodies the central concept in this chapter, infinite durability, warranting a telling of its story. I present in this section all the relevant facts about the system. First I mention some of the motivations for its existence. Next, I define exactly what UltraViolet is. I then discuss the inter-industry consortium created to support the system. Finally I provide a snapshot of the growth of the ecosystem over the course of the analytical time frame in this paper.

UltraViolet is a digital rights authentication and cloud-based licensing system that lets consumers stream and download purchased content to multiple platforms and devices. Its launch in the fall of 2011 was characterized as a “transformational moment” in the history of home entertainment. As mentioned, the majors were looking for a way to bridge physical to digital sell-through and to revive waning home video sales. For consumers it is a simple way to enjoy entertainment anywhere there is web access, without the confusion of too many distribution formats and platforms. It also eliminated the problematic digital file format that could easily be misplaced, erased, or not viewed on all possible devices. Once a disc with UltraViolet is purchased, a consumer uses her access code to engage her digital right to access the content in perpetuity via her digital locker. On a variety of gateway sites such as Flixster.com and

³¹ Unless otherwise stated, the information in this section mainly comes from the Home Media Magazine Staff Report (2012)

Figure 2.1 – UltraViolet Timeline of Significant Events and Growth of User Base



(Source: Home Media Magazine)

Vudu.com, one can purchase Digital HD, manage one's collection, and stream it. The file can be viewed over the web, smart televisions, computers, tablets and phones.

UltraViolet is backed by more than seventy members of the Digital Entertainment Content Ecosystem (DECE) consortium. This consortium is made up mostly of the majors, key retailers, and consumer-electronics producers. The majors, minus Disney, produce and distribute the content. Key retailers, like Walmart and

Target sell the product, either as packaged media or via the web through an online store. Consumer electronics producers create technology that is compatible with UltraViolet. The ancillary members of the consortium are a variety of servicers such as internet service providers and other internet systems and security vendors that help to maintain the structural logistics of the system.

UltraViolet hit a couple of bumps as it attempted to hit the ground running, but has been sprinting ever since. As figure 2.1 shows that at the start of 2012 there were already 750,000 active accounts. At first, several of the players wanted to have proprietary gateway platforms that made ownership confusing. Consumers often did not know which company's website to go to in order to access their content. By September of 2014, the system was streamlined enough that worldwide total accounts had surpassed 19 million.

Beyond standardizing the accessibility, over the course of its first two and a half years in existence the ecosystem kept improving in other ways which increased the network externalities. For example in April 2012, Walmart introduced a disc-to-digital service for 4000 films that allowed consumers to convert their older media into the infinitely durable format for a small fee. Another example is the expansion of gateway digital locker platforms like Flixster.com to video game consoles like Xbox, smart TVs³² and Blu-ray players.

³² Televisions that have an operating system which provides minimal functionality over exhibited content.

2.3.2 Disney

Disney's reluctance to take part in the system despite these expansions and user base growth deserves special attention. First I briefly discuss an early effort to keep up with the other studios, and, ponder the question of whether or not Disney made a mistake in not taking part in UltraViolet. I then provide a thumbnail sketch of their independent digital rights authentication cloud-based licensing system introduced in February of 2014, Disney Movies Anywhere. I close out this section as well as the overall industry section with a brief discussion of the potential implication for profitability of the coexistence of the two systems.

During the over two year period that Disney was competing in packaged media markets without offering infinite durability there were subtle signs it was affecting their performance. In 2013, as UltraViolet was blossoming as a system and consumers were discovering the value of infinite durability, Disney was in the process of developing its own system. In June of that year Disney introduced a means for their customers to download a digital copy of the films purchased (Arnold 2013). This was intended to cut out the extra disc with a digital copy included previously in their packaged media combo packs. Given that they were developing Disney Movies Anywhere and thus did not need to make this temporary adjustment is a sign that their revenues were suffering, as my analysis shows.

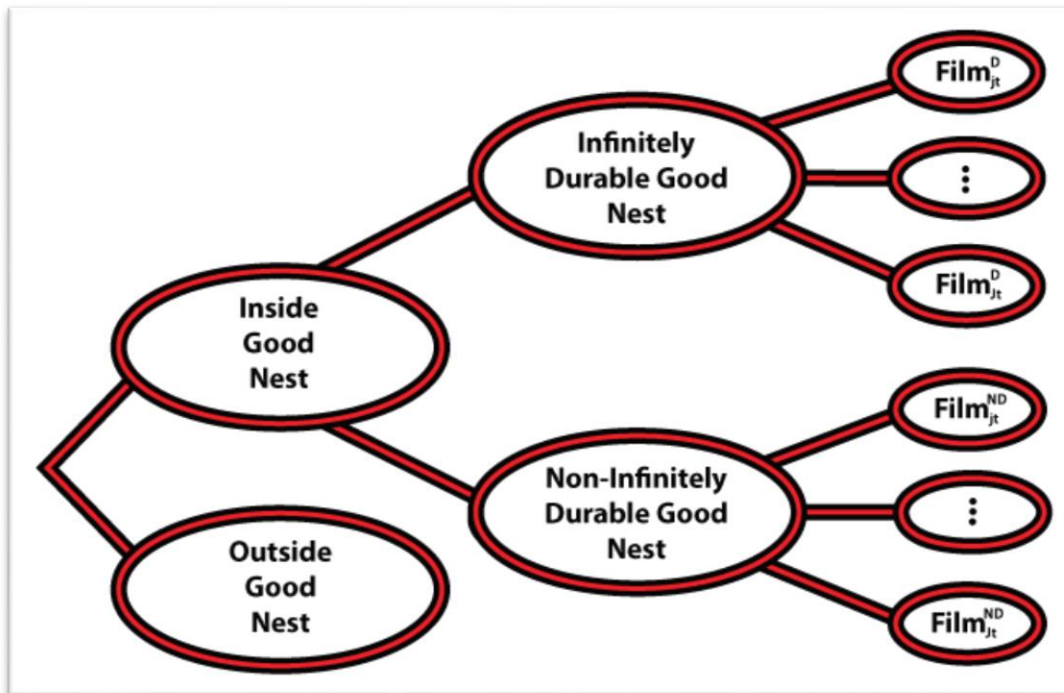
More evidence of this suffering came in early 2014, immediately preceding the launch of Disney Movies Anywhere, when Disney CEO Bob Iger commented

pessimistically on the small increase in revenues the home entertainment industry had seen over the course of the prior year. He was not as enthusiastic as the other studio representatives had been who had attributed the growth in revenues to UltraViolet (Prange 2014a). Downplaying the significance of UltraViolet's effect may have been a subtle way to downplay the hit their revenues took over the time period in question.

In February of 2014 Disney finally launched Disney Movies Anywhere. The service is much less interconnected throughout the web and retailers than UltraViolet. Consumers can only buy content through one vendor, iTunes. As of April of 2013, iTunes accounted for two-thirds of digital film sales, so this isolation should not hinder the platform's potential for success. The service is accessible through an app exclusively on Apple products which makes it even more exclusionary (Arnold 2014b). These seeming shortcomings notwithstanding the app has been download 4.5 million times as of September of 2014, a sign it is succeeding (Gruenwedel 2014c).

The coexistence of the two systems is certainly a new interesting market phenomenon that is worthy of closer attention. So far there are mixed feeling about it in the industry. "A Wedbush Securities analyst Michael Pachter said Disney's refusal to join UltraViolet undermines the platform and the industry's attempt at conformity — the latter key to wider consumer adoption of cloud-based storage of entertainment." Another view is more inclusive. "Russ Crupnick, senior media analyst with The NPD Group, said Disney's digital service could help both electronic sell-through and UltraViolet as consumers accept digital purchases and storage" (Gruenwedel 2014a).

Figure 2.2 – UltraViolet Two-Level Nested Logit Model Schematic Diagram



Note: The superscript D denotes the inclusion of infinite durability in a film. The superscript ND denotes films that do not include infinite durability.

Regardless of how it plays out, one fact is certain, for over two and a half years one major behaved differently than the other five. This allowed for a direct window into examining how the introduction of infinite durability has affected the consumption behavior of consumers of buying versus renting an information good, which this work examines in detail.

2.4 Model

I employ the nested logit model to study the extent to which the inclusion of infinite durability has increased the utility of an information good enough to sway a consumer's behavior away from renting it to buying it. Figure 2.2 shows the schematic for this chapter's version of the nested logit model. This section describes measures

used to study the effects of UltraViolet and presents the final derived model used for the empirical work in this chapter.

2.4.1 UltraViolet Observables

Equation 8,

$$\begin{aligned} \alpha_i = & \alpha_1(Disney\ Dummy)_t + \alpha_2(UltraViolet\ Dummy)_t \\ & + \alpha_3(UltraViolet\ Penetration\ Effect\ on\ Disney)_t \end{aligned} \quad (8)$$

shows the components of α to be (in the same order as above) a dummy indicating if a film is distributed by Disney, a dummy signifying if a film has UltraViolet access, and a dummy interacting Disney with a measure of UltraViolet penetration.

The measure of penetration denoted as

$$\theta_t = \frac{users_t}{users_0}, \quad (9)$$

is simply the number of users that have created accounts in the UltraViolet ecosystem indexed to the amount of accounts in the first week of observations. The measure of how the growth of the UltraViolet user base has affected the differential in Disney's market share is thus the product of θ_t and the Disney dummy, D_t

$$UltraViolet\ Penetration\ Effect\ on\ Disney = \theta_t \cdot D_t \quad .$$

Adding these variables to the others representing the other components of utility in from chapter one yield the inverted market share formula estimated here

$$\begin{aligned}
\ln s_{it} - \ln s_{ot} = & \beta_1[\log(\text{box office})]_i + \beta_2(\text{genre dummy})_i \\
& + \beta_3(\text{MPAA dummy})_i + \beta_4[\log(\text{user reviews})]_i \\
& + \beta_5[\log(\text{critic reviews})]_i + \beta_6(\text{sequel dummy})_i \\
& + \beta_7[\log(\text{source dummy})]_i - \rho(\delta_{it}) \\
& + \alpha_1(\text{Disney Dummy})_t + \alpha_2(\text{UltraViolet Dummy})_t \\
& + \alpha_3(\text{UltraViolet Penetration Effect on Disney})_t \\
& + \gamma_1(\text{season dummy})_t + \gamma_2(\text{holiday dummy})_t \\
& + \gamma_3(\text{holiday shopping dummy})_t \\
& + \gamma_4[\log(\text{theatrical competition})]_t + (1 - \lambda_k \lambda_m) \ln s_{i|B_k,t} \\
& + (1 - \lambda_m) \ln s_{B_k|D_m,t} + \varepsilon_{it}
\end{aligned} \tag{10}$$

2.5 Data

Section 2.5.1 has information on the time frame chosen for the analysis. The section subsection 2.5.2 provides information on data sources for all other measures used (sourced outside of the two main sources).

2.5.1 Time Frame

The analytical time frame begins the week of October 1, 2012 and ends the week of February 17, 2014. There are seventy-three weekly time periods in the data. The date range was initially set by limitations of the data but ultimately became a reasonable time frame for what I was looking to accomplish. The limitation comes from the fact that the rental data set includes numbers from the kiosk channel starting only in October 2012. Also, the SVOD data has a gap of availability from April 2010

to October 2012. Thus the time period in which UltraViolet has existed, which starts in the fall of 2011, has two different types of data in the rental market. There would be rental numbers from only brick-and-mortar stores from the fall of 2011 to October of 2012, with numbers from brick-and-mortar, SVOD and kiosk channels from October 2012 onward. To avoid complicating the analysis, and maintain consistency across the rental and sales markets I chose to start the analysis in October of 2012.

This turned out to be an appropriate time to start the analysis for a variety of reasons. Figure 1, the timeline of significant UltraViolet dates, includes the dates the various firms involved began offering UltraViolet access. The dates are scattered throughout the first few months of the UltraViolet's existence. Also, as mentioned earlier, there were initially problems with the standardization of the gateways to the system that caused confusion for consumers interested in using the system. Essentially there were growing pains, which eventually settled. October of 2012 is a good month to assume that the growing pains had subsided.

The growth of the UltraViolet user base during the data time frame further provides support for its appropriateness. The number of users increased greatly from October of 2012 onward. I estimate there to be 5.5 million users on October 1st, 2012. By February of 2014 there were 17 million users. This means that over the period considered in this paper, UltraViolet has not only taken root, it has sprouted huge network effects, which is a different market environment than the initial introductory period for the system.

2.5.2 Ancillary Data Sources

This section details the ancillary data sources used. Namely, the UltraViolet index of market penetration, the market share, the degree of theatrical market competition, the user and critic reviews and UltraViolet inclusion all requires extra data sources outside of the Nash and Rentrak data sets.

The UltraViolet index, θ_t , uses a weekly number of active UltraViolet accounts. The data for this measure came from a linear interpolation from four data points gleaned from cited articles in Home Media Magazine over the time frame considered in this paper. The U.S. population weekly numbers³³ used for the market share were generated using the same method. A linear relationship was assumed between three annual population numbers.

The theatrical market competition measure data comes from BoxOfficeMojo.com. The site provides data on a variety of aspects of the theatrical market including historical data for the weekly total box office revenue from the top twenty grossing films. The log of this number was used in my analysis.

The user and critic review measures were taken from RottenTomatoes.com. The user review is the percentage of users that have given a film a rating of 3.5 or higher on a scale of 1 to 5. It compiles reviews from upwards of 45,000 individual users. The critic measure is the percentage of approved professional critics who have

³³ This data was sourced from the US census bureau

given the film a positive review. The measure generally aggregates reviews from around 150-250 critics.

Lastly, and most importantly, the coding of which films included UltraViolet access was compiled from two sources. One is Blu-ray.com which is a home entertainment database and forum compiled from information coming from both private and public sources. They provided historical data for all film's released with UltraViolet access. To verify the information gleaned from this site I looked up each film on Amazon.com. The data is comprised of 283 films with 211 of these films having UltraViolet access, 13 having been released by Disney, leaving 62 films that are neither Disney films, nor include UltraViolet.

2.6 Results

The results of the two stage least squares (2SLS) analysis are presented in tables 2.1-2.3. The first important result is that the inclusion of UltraViolet generated a positive and significant effect on a film's market share³⁴ in the sales markets. The second significant result is that although Disney films have a positive differential relative to non-Disney films in market share throughout the sales markets, the growth of UltraViolet's market penetration has been having a significant negative effect on it. This means that over the course of the analytical time period consumers in this market were less likely to purchase a Disney film, regardless of format, due to the proliferation of UltraViolet's user base. An extension to this result is that in the Blu-ray rental

³⁴ Throughout this section, when I refer to the dependent variable as a film's market share, I am referring to the log of a film's market share relative to the outside good

Table 2.1: Empirical Results for Total Units Sold and Rented

	Total Sales Market				Total Rental Market			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	2SLS	OLS	1 st . Stage: $\ln s_{ilB_k}$	1 st . Stage: $\ln s_{B_k D_m}$	2SLS	OLS	1 st . Stage: $\ln s_{ilB_k}$	1 st . Stage: $\ln s_{B_k D_m}$
UltraViolet	.3744** (.1503)	.0309* (.0165)	-.7160*** (.1308)	1.2942*** (.0361)	.0798 (.0798)	.0991*** (.0239)	-.6589*** (.0556)	.9225*** (.0128)
Disney	.8864*** (.2903)	.3492*** (.0949)	1.3609*** (.3160)	.0553 (.1448)	.0410 (.1719)	.0012 (.0795)	.0069 (.1551)	.0405 (.0599)
UltraViolet Penetration Effect on Disney	-.3634*** (.1503)	-.1614*** (.0369)	-.4769*** (.1308)	-.0243 (.0586)	.0191 (.0725)	.0071 (.0308)	.1993*** (.0653)	-.0233 (.0257)
$\ln s_{ilB_k}$	.5700*** (.0478)	.9429*** (.0026)			.8083*** (.0664)	.9827*** (.0015)		
$\ln s_{B_k D_m}$	.4119*** (.0989)	.9106*** (.0079)			.7930*** (.0729)	.9368*** (.0123)		
Decay	-.0298*** (.0033)	-.0055*** (.0002)	-.0625*** (.0009)	-.0001 (.0002)	-.0128*** (.0047)	-.0009*** (.0001)	-.0653*** (.0007)	-.0003*** (.0003)
$\ln$ Box Office	.3595*** (.0412)	.0517*** (.0039)	.8032*** (.0131)	.0024 (.0045)	.0901*** (.0324)	.0063*** (.0016)	.4646*** (.0071)	.0018 (.0017)
Comedy	.0335 (.0540)	.0110 (.0155)	.0364 (.0568)	-.0024 (.0165)	.0251 (.0357)	-.0002 (.0066)	.1198*** (.0350)	.0011 (.0066)
Drama	-.1968*** (.0604)	-.0287* (.0157)	-.4148*** (.0584)	-.0118 (.0182)	-.0356 (.0372)	-.0016 (.0063)	-.1820*** (.0341)	-.0053 (.0072)
Action	.0341 (.0493)	.0125 (.0152)	.0672 (.0522)	-.0113 (.0161)	-.0083 (.0329)	-.0026 (.0065)	-.0371 (.0332)	-.0073 (.0064)
Horror	-.2248 (.0777)	-.0172 (.0184)	-.5534*** (.0760)	-.0084 (.0182)	-.1141* (.0609)	-.0118 (.0077)	-.5998*** (.0573)	-.0053 (.0072)
Romantic Comedy	-.3087*** (.0747)	-.0271 (.0193)	-.7448*** (.0699)	-.0067 (.0228)	-.0330 (.0418)	-.0073 (.0086)	-.1712*** (.0408)	-.0035 (.0089)
Suspense	.1139* (.0603)	.0223 (.0171)	.2650*** (.0627)	-.0117 (.0182)	.0413 (.0390)	.0037 (.0072)	.2125 (.0370)	-.0068 (.0072)
$\ln$ User Reviews	.2155*** (.0598)	.0325** (.0325)	.5200*** (.0578)	.0065 (.0199)	-.0748* (.0407)	-.0023 (.0056)	-.4008*** (.0354)	.0018 (.0080)
$\ln$ Critic Reviews	-.0019 (.0139)	.0022 (.0039)	-.0200*** (.0160)	.0012 (.0065)	-.0051 (.0125)	-.0007 (.0015)	.0251** (.0124)	.0018 (.0026)
PG-13	.0663 (.0428)	-.0017 (.0125)	.1689*** (.0445)	.0027 (.0148)	.0378 (.0320)	.0027 (.0052)	.2052*** (.0288)	.0020 (.0060)
R	-.0036 (.0438)	-.0169 (.0129)	.0405 (.0461)	-.0011 (.0144)	.0625* (.0360)	.0065 (.0055)	.3371*** (.0292)	.0004 (.0059)
Sequel	-.0204 (.0380)	-.0038 (.0110)	-.0348 (.0390)	.0092 (.0103)	-.0398 (.0312)	.0004 (.0042)	-.2234*** (.0257)	.0047 (.0040)
Pre-Existing Fiction	-.0024 (.0563)	.0147 (.0155)	-.0033 (.0607)	-.0133 (.0211)	-.0041 (.0342)	.0013 (.0071)	-.0324 (.0343)	-.0079 (.0083)
Original Screenplay	-.0632 (.0577)	.0085 (.0152)	-.1587*** (.0610)	-.0077 (.0206)	-.0200 (.0358)	.0011 (.0069)	-.1399*** (.0351)	-.0068 (.0081)
Remake	-.0553 (.0801)	.0182 (.0232)	-.2056** (.0866)	.0072 (.0312)	-.0200 (.0545)	-.0054 (.0112)	-.1229** (.1229)	.0027 (.0124)
Holiday	.0132 (.0267)	-.0078 (.0063)	.0142 (.0279)	-.0105 (.0072)	.0222 (.0173)	.0271*** (.0021)	-.0305* (.0176)	.0180*** (.0034)
Holiday Shopping	.8003*** (.0471)	.8804*** (.0100)	-.2747*** (.0474)	.0144 (.0123)	.0198 (.0260)	.0277*** (.0055)	-.0157 (.0263)	-.0246*** (.0043)
Summer	-.1629*** (.0382)	-.2930*** (.0113)	.2943*** (.0378)	.0297** (.0122)	.0201 (.0245)	.0330*** (.0029)	-.0921*** (.0251)	.1006*** (.0055)
Autumn	.1950*** (.0397)	.2969*** (.0121)	-.7505*** (.0525)	.0790*** (.0205)	-.0853*** (.0257)	-.1007*** (.0063)	.0141 (.0325)	.1087*** (.0070)
Winter	.0864** (.0390)	.0081 (.0141)	-.0774 (.0496)	-.0473** (.0202)	.0497* (.0282)	.0825*** (.0034)	-.1247*** (.0326)	-.0044 (.0071)
Log Theatrical Competition	.0700* (.0420)	-.0003 (.0089)	.0135 (.0388)	.2030*** (.0129)	.0755*** (.0237)	.0807*** (.0032)	.0247 (.0239)	-.0522*** (.0045)
<i>To instrument</i> $\ln s_{ilB_k}$			-.0019*** (.0004)	.0001* (.0000)			-.0007*** (.0001)	.0003*** (.0000)
Total Box Office			.0004*** (.0000)	.0000* (.0000)			.0001*** (.0000)	-.0001*** (.0000)
Total Decay								
<i>To instrument</i> $\ln s_{B_k D_m}$			-.0016*** (.0001)	-.0003*** (.0001)			.0001 (.0000)	-.0005*** (.0000)
Total Box Office			.0007*** (.0001)	.0000* (.0000)			.0000 (.0000)	.0001*** (.0004)
Total Decay								
Constant	-14.7769*** (1.1154)	-.62957*** (.0895)	-17.6039*** (.3226)	-.1647*** (.1059)	-5.3200*** (.7711)	-3.4016*** (.0414)	-9.2894*** (.1978)	-1.2518*** (.0397)
Observations	11948	11948	11948	11948	12241	12241	12241	12241
F-Statistic			645.33	1280.5			1281.97	6677.41
R-Squared	.6975	.9776	.6355	.8035	.8007	.9935	.7686	.9605

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is Family. The omitted rating is PG. The omitted source is Based on Non-Fictional Events. Also, film j belongs to durability nest g.

Table 2.2: Empirical Results for Blu-ray Units Sold and Rented

	Blu-ray Sales Market				Blu-ray Rental Market			
	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln S_{ijk}$	(4) 1 st . Stage: $\ln S_{ijk D_m}$	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln S_{ijk}$	(4) 1 st . Stage: $\ln S_{ijk D_m}$
UltraViolet	.5549*** (.1882)	.1444*** (.0214)	-.5613*** (.1126)	1.3054*** (.0426)	.0514 (.0148)	.1752*** (.0253)	-.7007*** (.0631)	.8990*** (.0155)
Disney	.8717*** (.3140)	.3800*** (.1059)	.9596*** (.3557)	.0307 (.1700)	-.1328 (.1773)	-.1372** (.0709)	-.4598*** (.1771)	.0273 (.0668)
UltraViolet Penetration Effect on Disney	-.3780*** (.1359)	-.1716*** (.0419)	-.3644** (.1525)	-.0123 (.0687)	.1587** (.0761)	.0806*** (.0276)	.4488*** (.0739)	-.0150 (.0280)
$\ln S_{ijk}$	.6215*** (.0717)	.9242*** (.0030)			.5919*** (.0599)	.9768*** (.0013)		
$\ln S_{ijk D_m}$	.3696*** (.1229)	.8439*** (.0092)			.6552*** (.0681)	.9087*** (.0133)		
Decay	-.0306*** (.0056)	-.0068*** (.0003)	-.0752*** (.0010)	-.0001 (.0003)	-.0247*** (.0040)	-.0001 (.0001)	-.0600*** (.0007)	-.0002*** (.0001)
$\ln$ Box Office	.2988*** (.0590)	.0580*** (.0050)	.7732*** (.0160)	.0025 (.0054)	.2581*** (.0397)	.0081*** (.0071)	.6289 (.0098)	.0017 (.0018)
Comedy	-.2031*** (.0786)	-.0384** (.0193)	-.5817*** (.0704)	-.0049 (.0202)	.0370 (.0388)	-.0086 (.0070)	.0859** (.0390)	.0008 (.0069)
Drama	-.2899*** (.0872)	-.0580*** (.0199)	-.6889*** (.0717)	-.0152 (.0221)	-.0969** (.0426)	.0009 (.0068)	-.2357*** (.0397)	-.0055 (.0076)
Action	.0614 (.0608)	.0159 (.0186)	.1703*** (.0641)	-.0129 (.0197)	.0802** (.0375)	-.0013 (.0069)	.2003*** (.0357)	-.0061 (.0067)
Horror	-.2984*** (.1010)	-.0562*** (.0229)	-.7794*** (.0844)	-.0097 (.0225)	-.2560*** (.0656)	-.0212*** (.0083)	-.6298*** (.0638)	-.0046 (.0074)
Romantic Comedy	-.4122*** (.1127)	-.0739*** (.0254)	-.10937*** (.0886)	-.0085 (.0278)	-.1146** (.0511)	-.0185** (.0091)	-.2788*** (.0495)	-.0040 (.0095)
Suspense	-.1772** (.0801)	-.0326 (.0214)	-.4365*** (.0765)	-.0133 (.0223)	.1907*** (.0492)	.0075 (.0078)	.4676*** (.0413)	-.0065 (.0075)
$\ln$ User Reviews	.2073*** (.0682)	.0424** (.0173)	.5364*** (.0657)	.0069 (.0244)	-.2500*** (.0584)	-.0046 (.0061)	-.6195*** (.0476)	.0023 (.0084)
$\ln$ Critic Reviews	.0212 (.0197)	.0067 (.0062)	.0433** (.0224)	.0014 (.0079)	.0188 (.0145)	-.0025 (.0016)	.0462*** (.0142)	.0009 (.0028)
PG-13	.0164 (.0526)	-.0039 (.0162)	.0234 (.0563)	.0048 (.0179)	.1159*** (.0373)	.0080 (.0056)	.2872*** (.0332)	.0025 (.0064)
R	.0433 (.0539)	-.0026 (.0164)	.0234 (.0563)	-.0004 (.0175)	.1970*** (.0442)	.0183*** (.0058)	.4873*** (.0336)	.0008 (.0063)
Sequel	-.0479 (.0481)	-.0031 (.0136)	-.1314*** (.0490)	.0108 (.0127)	-.1123*** (.0343)	.0034 (.0690)	-.2864*** (.0279)	.0044 (.0040)
Pre-Existing Fiction	.0097 (.0655)	.0182 (.0205)	.0408 (.0710)	-.0129 (.0257)	-.0906** (.0440)	-.0053 (.0075)	-.2275*** (.0428)	-.0064 (.0089)
Original Screenplay	-.0821 (.0677)	.0005 (.0204)	-.2212*** (.0706)	-.0066 (.0251)	-.1498*** (.0472)	-.0078 (.0072)	-.3781*** (.0437)	-.0049 (.0088)
Remake	-.1468 (.0968)	-.0010 (.0305)	-.4755 (.1030)	.0104 (.0381)	-.1607*** (.0673)	-.0229 (.0118)	-.4023*** (.0649)	.0031 (.0133)
Holiday	.0452 (.0318)	.0493*** (.0081)	-.0584* (.0335)	-.0235*** (.0089)	.0222 (.0218)	.0492*** (.0024)	-.0570*** (.0218)	.0053 (.0036)
Holiday Shopping	.9084*** (.0606)	.9634 (.0132)	-.3320*** (.0572)	-.0180 (.0149)	-.0018 (.0038)	.0445*** (.0057)	-.0884*** (.0337)	-.0268*** (.0052)
Summer	-.2104*** (.0420)	-.3075*** (.0147)	.3405*** (.0419)	-.0593*** (.0146)	.0014 (.0281)	.0058* (.0033)	.0223 (.0292)	.0818*** (.0060)
Autumn	.1306** (.0537)	.3222*** (.0154)	-.8081*** (.0614)	.0961*** (.0242)	-.0646** (.0299)	-.0933*** (.0065)	.0623* (.0379)	.0965*** (.0080)
Winter	.0676 (.0441)	.0025 (.0171)	.0701 (.0551)	-.0537** (.0241)	.0135 (.0315)	.0722*** (.0037)	-.0447 (.0380)	-.0021 (.0078)
Log Theatrical Competition	-.0447 (.0602)	-.1149*** (.0125)	.1078** (.0453)	.3126*** (.0165)	.0703*** (.0279)	.0752*** (.0038)	.0154 (.0285)	-.0201*** (.0049)
<i>To instrument</i> $\ln S_{ijk}$								
Total Box Office			-.0017*** (.0001)	.0001*** (.0001)			-.0006*** (.0001)	.0004*** (.0000)
Total Decay			.0004*** (.0001)	.0000 (.0000)			.0001*** (.0000)	-.0001*** (.0000)
<i>To instrument</i> $\ln S_{ijk D_m}$								
Total Box Office			-.0006*** (.0002)	-.0004*** (.0001)			.0001 (.0001)	-.0006*** (.0000)
Total Decay			.0002*** (.0001)	.0000 (.0000)			-.0000 (.0000)	.0001*** (.0000)
Constant	-14.5044*** (1.5854)	-7.5942*** (.0305)	-18.0380*** (.3695)	-1.7057*** (.1291)	-10.2720	-5.2817*** (.0454)	-11.4374*** (.2346)	-1.1933*** (.0442)
Observations	10316	10316	10316	10316	12216	12216	12216	12216
F-Statistic			555.73	941.79			914.07	5379.43
R-Squared	.6736	.9699	.6433	.7613	.7472	.9935	.7030	.9543

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is Family. The omitted rating is PG. The omitted source is Based on Non-Fictional Events. Also, film j belongs to durability nest g.

Table 2.3: Empirical Results for DVD Units Sold and Rented

	DVD Sales Market				DVD Rental Market			
	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln S_{ij B_k}$	(4) 1 st . Stage: $\ln S_{B_k D_m}$	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln S_{ij B_k}$	(4) 1 st . Stage: $\ln S_{B_k D_m}$
UltraViolet	.4071*** (.1561)	-.0070 (.0070)	-.7632*** (.0968)	1.2778*** (.0336)	.0618 (.0817)	.0816*** (.0232)	-.6336*** (.1577)	.9279*** (.0124)
Disney	.9010*** (.2951)	.3601*** (.0928)	1.3518*** (.3128)	.0664 (.1337)	.0439 (.1783)	.0271 (.0817)	.0830 (.1577)	.0432 (.0588)
UltraViolet Penetration Effect on Disney	-.3684*** (.1238)	-.1700*** (.0358)	-.4623*** (.1292)	-.0296 (.0540)	.0038 (.0750)	-.0069 (.0316)	.1650*** (.0669)	-.0250 (.0253)
$\ln S_{ij B_k}$	.5764*** (.0474)	.9554*** (.0023)			.8795*** (.0707)	.9854*** (.0015)		
$\ln S_{B_k D_m}$	.3794*** (.1065)	.9348*** (.0083)			.8622*** (.0804)	.9451*** (.0118)		
Decay	-.0288*** (.0031)	-.0049*** (.0002)	-.0604*** (.0009)	-.0001 (.0002)	-.0084* (.0051)	-.0010*** (.0001)	-.0673*** (.0007)	-.0003*** (.0001)
$\ln$ Box Office	.3452*** (.0400)	.0422*** (.0036)	.7779*** (.0132)	.0023 (.0041)	.0545* (.0332)	.0057*** (.0016)	.4459*** (.0073)	.0018 (.0018)
Comedy	.0819 (.0566)	.0182 (.0144)	.1451*** (.0581)	-.0011 (.0148)	.0199 (.0379)	.0016 (.0067)	.1497*** (.0364)	.0012 (.0066)
Drama	-.1466** (.0601)	-.0181 (.0146)	-.3046*** (.0593)	-.0098 (.0164)	-.0208 (.0383)	-.0018 (.0064)	-.1688*** (.0352)	-.0052 (.0072)
Action	-.0005 (.0519)	.0090 (.0170)	-.0173 (.0537)	-.0101 (.0145)	-.0118 (.0347)	-.0025 (.0066)	-.0892*** (.0344)	-.0076 (.0064)
Horror	-.1783** (.0767)	-.0024 (.0171)	-.4603*** (.0753)	-.0073 (.0163)	-.0698 (.0627)	-.0089 (.0077)	-.5878*** (.0584)	-.0055 (.0072)
Romantic Comedy	-.2412*** (.0734)	-.0085 (.0180)	-.6190*** (.0706)	-.0057 (.0206)	-.0151 (.0423)	-.0045 (.0087)	-.1236*** (.0420)	-.0034 (.0090)
Suspense	.1492 (.0634)	.0251 (.0159)	.3449*** (.0638)	-.0106 (.0163)	.0225 (.0400)	.0033 (.0073)	.1791*** (.0384)	-.0068 (.0072)
$\ln$ User Reviews	.2002*** (.0614)	.0264** (.0122)	.4873*** (.0588)	.0066 (.0179)	-.0436 (.0407)	-.0019 (.0057)	-.3794*** (.0356)	.0017 (.0081)
$\ln$ Critic Reviews	-.0122 (.0147)	.0011 (.0036)	-.0456*** (.0163)	.0011 (.0060)	.0026 (.0130)	-.0004 (.0015)	.0201 (.0131)	.0012 (.0026)
PG-13	.0703 (.0450)	-.0051 (.0117)	.1869*** (.0456)	.0015 (.0134)	.0195 (.0325)	.0013 (.0053)	.1744*** (.0299)	.0019 (.0060)
R	.0048 (.0458)	-.0182 (.0120)	.0666 (.0470)	-.0015 (.0130)	.0346 (.0360)	.0039 (.0055)	.3029*** (.0303)	.0003 (.0060)
Sequel	-.0337 (.0392)	-.0063 (.0102)	-.0640* (.0394)	.0082 (.0091)	-.0237 (.0322)	.0000 (.0042)	-.2182*** (.0264)	.0047 (.0040)
Pre-Existing Fiction	.0118 (.0573)	.0160 (.0144)	.0333 (.0606)	-.0133 (.0191)	.0010 (.0350)	.0021 (.0072)	-.0121*** (.0358)	-.0082 (.0084)
Original Screenplay	-.0294 (.0580)	.0154 (.0141)	-.0839 (.0607)	-.0081 (.0187)	-.0102 (.0365)	.0023 (.0069)	-.1212*** (.0358)	-.0073 (.0082)
Remake	-.0125 (.0842)	.0243 (.0217)	-.1033 (.0890)	.0052 (.0283)	-.0058 (.0549)	-.0022 (.0113)	-.0747 (.0548)	.0027 (.0124)
Holiday	-.0140 (.0276)	-.0487*** (.0060)	.0393 (.0283)	-.0051 (.0064)	.0197 (.0178)	.0221*** (.0021)	-.0275 (.0181)	.0206*** (.0034)
Holiday Shopping	.7545*** (.0476)	.8223*** (.0088)	-.2592*** (.0475)	.0289*** (.0108)	.0210 (.0266)	.0242*** (.0056)	-.0033 (.0269)	-.0233*** (.0041)
Summer	-.1680*** (.0403)	-.3085*** (.0101)	.2633*** (.0389)	.0642*** (.0115)	.0290 (.0294)	.0388*** (.0030)	-.1133*** (.0257)	.1037*** (.0055)
Autumn	.1903*** (.0399)	.2599*** (.0111)	-.6895*** (.0529)	.0723*** (.0185)	-.0951*** (.0265)	-.1036*** (.0030)	.0121 (.0333)	.1108*** (.0067)
Winter	.0866*** (.0399)	.0211 (.0132)	-.1393*** (.0502)	-.0453*** (.0185)	.0621** (.0299)	.0842*** (.0035)	-.1433*** (.0332)	-.0052 (.0071)
Log Theatrical Competition	.1261*** (.0407)	.0827*** (.0078)	-.0129 (.0391)	.1493*** (.0114)	.0789*** (.0246)	.0821*** (.0032)	.0273 (.0246)	-.0587*** (.0046)
<i>To instrument</i> $\ln S_{ij B_k}$								
Total Box Office			-.0019*** (.0001)	.0001* (.0000)			-.0007*** (.0001)	-.0004*** (.0000)
Total Decay			.0003*** (.0000)	.0001*** (.0000)			.0001*** (.0000)	.0000*** (.0000)
<i>To instrument</i> $\ln S_{B_k D_m}$								
Total Box Office			-.0018*** (.0001)	-.00023*** (.0001)			.0001 (.0000)	-.0005*** (.0000)
Total Decay			.0008*** (.0001)	.0000*** (.0000)			.0000 (.0000)	.0000*** (.0000)
Constant	-14.9641*** (1.0923)	-6.5149*** (.0811)	-16.8501*** (.3247)	-1.6147*** (.0954)	-4.6776*** (.8078)	-3.5546*** (.0405)	-9.0554*** (.2051)	-1.2644*** (.0395)
Observations	11868	11868	11868	11868	12241	12241	12241	12241
F-Statistic			586.04	1551.34			1245.62	6851.13
R-Squared	.6648	.9797	.6078	.8229	.7972	.9936	.7659	.9605

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is Family. The omitted rating is PG. The omitted source is Based on Non-Fictional Events. Also, film j belongs to durability nest g.

market, the increase in UltraViolet penetration has been having a significant positive effect on Disney titles. Again, this means that consumers of this content were increasingly more likely to rent Disney titles throughout the period considered with respect to the growth of UltraViolet's user base. What can be extrapolated from these facts is that the lack of inclusion of infinite durability in this particular market for films caused a shift in behavior of consumers away from buying to renting. Supporting these finding is the final set of important results which are the measures of substitutability within the durability nests of each data set. A significant amount of substitutability was found in the sales market for the durability nesting level. This signifies that consumers were more likely to substitute between Ultraviolet titles versus non-UltraViolet titles over the course of the time period in question. Essentially, increasing the durability of an information good increases the substitutability of it amongst other goods of the same durability.

This final section covers the results in the following manner. Section 6.1 discusses general results from the model. Section 6.2 then provides more details on the two central results of the paper.

2.6.1 General Results

Before covering the central results in more detail, I provide some observations about the overall performance of the model I used. The 2SLS process went well and deserves some mention. The film characteristics that captured between variations have

a few interesting results worth mentioning as well. Lastly there are some interesting behaviors of the seasonal variables that are also thrown in for good measure.

2SLS

The 2SLS results are consistent with Chiou (2008). All instruments were significant and in the right direction. Meaning the first instrument, total box office of competitors in a nest, has a negative relationship with a film's market share, as expected. Also, the second instrument, the total decay of a film's competitors in a nest, has a positive relationship with competitors in a nest. Thus, the older the competitors of a film are, the more likely that film is to be chosen. All the instrumented market shares in the 2SLS estimates were significant and in the expected direction as well.

The overall variation captured by the model is partly consistent with Chiou (2008). The sales market results in both our papers have nearly identical R^2 results, explaining upwards of 65% of the variation in demand. The rental markets results are less in line with her model explaining 93% variation and my model explaining upwards of 75%. I attribute this difference to the difference in our data sets. My data set includes data from the declining brick-and-mortar channel, which made up the totality of her data set, but also includes SVOD and kiosk figures. Also, her data set covers a period from 2000 to 2003 in which the proliferation of entertainment substitutes, specifically social media, have likely muddied the demand waters for low-value consumers, given that social media are more likely to be substitutes to a rented film than to a purchased one. Also, the digital rental option has proliferated as well. Thus

including data on changing patterns of substitutes to home video markets would have likely increased the explained variation. Unfortunately this is data I did not have access to.

Between Variation

Again, the variables in common with Chiou (2008) had consistent results. The proxy for unobserved quality, the log of a film's theatrical box office, proved to be positive and very significant in every market, as was expected. The decay variable fared well too, having the same consistency in significance, and in the expected negative direction. The genre and ratings variables overall, behaved as expected.

The source variables turned out to have significance only in the Blu-ray rental market. This might reflect a quality in high low-value consumers to be more selective about what they choose than the lowest value consumers, DVD renters. Evidently the Blu-ray renters are even more selective than the highest value consumers, Blu-ray buyers, since this same significance is not found in the sales markets.

Sequel status films had the interesting result of being negative across the board, but significant only in the Blu-ray rental market. What the negative sign could signify is that '*franchise fatigue*', where consumers experience diminishing returns on an ongoing storyline, is indeed present in some film markets. Again, this may reflect the degree of selectiveness of this group and thus their sensitivity to franchise fatigue.

The final film characteristics worth commenting on are the word of mouth measures. Professional critics' reviews seem to have no significance in any market

while user reviews are significant across the board. It is clear that positive word of mouth causes consumers to rent less and buy more. This relationship is significant in the total sell-through markets (Blu-rays + DVDs), loses some significance in the DVD market, and gains it in the Blu-ray market. This implies that higher value consumers are more likely to buy versus rent given positive word of mouth.

Within Variation

As far as the seasonality and competition variables go, the results are mainly not surprising. National holidays seem to have no effect on these markets, while the holiday shopping period is extremely significant in all the purchase markets. The calendar seasons seem to be more important in the purchase markets than in the rental markets. Again, it goes back to high value versus low value consumers. High value consumers are likely to have more high value substitutes throughout the seasons.

As far as the effects of theatrical competition go, the results show that the theatrical market and the home entertainment markets are mainly complements. The higher the quality of films in a theater, as measured by the aggregate box office of the top 20 earners, the more likely consumers are to rent and buy more films. The Blu-ray purchase market is the only one that did not have significance in this result, with a negative sign. This implies that the highest value consumers are not affected by this phenomenon.

2.6.2 Infinite Durability

As mentioned, the two big results regarding the introduction of infinite durability are that it has mainly affected the sell-through markets and that Blu-ray customers are less likely to buy and more likely to rent if it is not included. This last result could naturally lead to the corollary that infinite durability spurs buyers to buy instead rent, but given all the results, this assertion is weakly supported.

Across the board, the UltraViolet dummy was positive and significant in the sales markets. This means that infinite durability has created enough utility for consumers in this market to warrant an increased market share for products that have it. This is consistent with the evidence on these type of high value consumers which, as mentioned above, demonstrated their willingness to buy more discs after being introduced to UltraViolet. There were no significant negative differentials in the rental data for the UltraViolet dummy to justify the conclusion that infinite durability has shifted behavior away from renting to buying simply based on this measure alone. In fact, although having no significance and of small magnitude, the values were positive for this dummy in the rental market.

The second result does support the idea that UltraViolet has shifted renting and buying behavior concurrently. Although Disney films have a higher market share than non-Disney films in the sell-through markets, the negative and significant value of the UltraViolet penetration measure demonstrates that they have been losing market share due to the introduction of infinite durability by competitors. In the rental markets,

Table 2.4 - Log-Sum Coefficient Results

	λ_k	λ_{IN}
Total Sales	0.7312	0.5881
Blu-ray Sales	0.6004	0.6304
DVD Sales	0.6826	0.6206
Total Rentals	0.9261	0.207
Blu-ray Rentals	1.1847	0.3448
DVD Rentals	0.8738	0.1379

The other set of results supporting the increased likelihood to buy due to UltraViolet's penetration has caused Disney films to have a higher likelihood of being rented as the positive and significant value for the penetration measure demonstrates. This result is only statistically significant in the Blu-ray rental market which is consistent with the facts stated above about the relationship between UltraViolet and Blu-ray users. Specifically, that UltraViolet users are four times more likely to own a Blu-ray player. Thus, it makes sense that it would be these users that would be affected enough to change their buying to renting behavior (and possibly, vice versa).

The other set of results supporting the increased likelihood to buy due to UltraViolet's introduction comes from the nested logit model's coefficients of the log sum which measures substitutability within nests. As table 2.4 shows, the inside good is highly substitutable relative to the outside good, which is consistent with Chiou (2008) and Einav (2007). Interestingly, the rental markets are much more correlated across the inside good than the purchase markets which might reflect a tighter budget constraint for these low value consumers, and thus less alternatives in the outside good.

Most important though is the substitutability within the durability nests. In the purchase markets the degree of substitutability in the durability nests was relatively large. This is consistent with the positive and significant differential for UltraViolet

products. Consumers value infinite durability enough to consider films with this quality closer substitutes than those without. The combined effect of the evidence is that infinite durability clearly does cause consumers to buy more, regardless of what their renting behavior might be.

As far as the rental markets go, it's evident that the inclusion of UltraViolet has not affected the substitutability of the durability nest the same way as in the sell-through markets. The λ_k value in the Blu-ray rental market is of slight interest though. Since the value is greater than one, as mentioned above, this value is only consistent with random utility maximization within a limited range. Since the value is close to one, this is not a big concern.

2.7 Conclusion

The film industry will continue to be in a state of flux as long as technologies used to experience their goods continues to evolve. Thus it is of the utmost importance that any attempts to adapt to change be closely tracked in order to maintain the highest level of profitability. Sales of films generate higher revenues than rentals so it is in the firms' best interest to promote technologies that will spur consumers to buy rather than rent.

What this work has demonstrated is that the inclusion of infinite durability in an information good creates enough extra value to cause consumers to buy more films. It has also demonstrated that not including infinite durability in a marketplace where it exists will cause consumers to shift their behavior away from buying to renting. Thus

infinite durability increases profits via increased buying, and hurts profits from high value customers if it is not included, by lowering revenues due to increased renting behavior. Again, the corollary that infinite durability creates enough value to shift a consumer's consumption behavior away from renting to buying an information good is weakly supported, but supported nonetheless.

The model used to generate this result can be used in a variety of industries that deal with information goods, such as the music industry and the publishing industry to further investigate this phenomenon. If the value to a consumer of an information good lies not just in the content, but in the durability of that content, firms should strive to make these products as infinitely accessible as possible in order to maximize revenues.

Looking within the film industry, and specifically the introduction of Disney Movies Anywhere, it would be of interest to perform a similar analysis in a few years to see if the inclusion of infinite durability in their products has been enough to offset the negative effects observed here. The more interesting question to pursue would be whether or not the fact that they have chosen to not be a part of the UltraViolet network will hurt their revenues, or have no effect.

3 Early to Sell, Do Revenues Rise? The Effect of the Digital Sell-Through Window on Home Entertainment Markets

3.1 Introduction

The film industry is rife with change due to the digital revolution. Home entertainment markets in particular have been struggling to figure out the adaptation puzzle presented to them with the introduction of new technologies. In 2012, the major film studios began experimenting with a distribution window in which digital versions of films were released for sale 1-4 weeks before other formats, such as physical disc media in rental and sales markets. This paper examines the effects this windowing experiment has had on physical media rental and sales markets. The main finding is that the strategy has been successful in increasing firm revenues.

Since 2004, home entertainment revenues have been steadily decreasing, a trend that was seemingly reversed in 2013. This has been attributed to the increased revenues from digital distribution. Since 2011 the industry has been attempting to monetize on this new format's potential mainly via two strategies. One is the introduction of UltraViolet³⁵, an ecosystem in which digital files are sold, housed, and viewed in a shared digital space provided by most of the major firms in the industry. chapter 2 demonstrated that the introduction of UltraViolet and the inclusion of digital files with packaged media has managed to shift consumption behavior away from

³⁵ See Axarlian (2014) for details

renting to buying for some consumers, increasing revenues. The second big strategy is the one discussed in this chapter. This chapter demonstrates that similar results were indeed garnered from this strategy, with the conversion of renters to buyers also increasing revenues. Thus, these strategies have proven to be a successful approach to adaptation to the new market conditions.

I performed my analysis using a discrete choice model on a unique data set of home video weekly rental and sales units. The decision to buy versus rent was modeled using a nested logit model. The analysis looks at sales and rental units of physical media, aggregated, as well as in subsets of the dvd and blu-ray formats. The unbalanced³⁶ panel data set is comprised of 278 unique films, over the course of 73 weeks.

My results show that the effect of the new digital distribution window was most pronounced for disc renters. A decrease in the likelihood of consumption was found for renters of both dvd and blu-ray discs that were offered earlier via the distribution window. The blu-ray format was less sensitive to the effects of the new strategy showing a similar but less pronounced effect to the one observed for dvds. Another significant finding is that the effect of the window on consumption behavior is inversely related to the length of the window. Specifically, the longer the window, the less effect it has on consumption behavior for other options. This result was found across formats and markets, with blu-ray renters being the sole subset where this result was not

³⁶ Not all films were released at the start of the time frame and thus there is a variable amount of weekly data points for each film.

significant. Finally, my findings also suggest and that the strategy is not creating consumers that are loyal to this new method of consumption. Meaning, consumers who intertemporally substituted away from prior consumption options, are not loyal to the new digital purchase option.

The chapter is structured as follows. Section 3.2 begins by placing this work within the context of related industry conducted research. Section 3.3 then goes on to detail the nature of the marketplace for film content. The fourth section describes the nuances of the discrete choice model used, followed by a fifth section describing the data and variables used. The results of the analysis are then presented in detail in section six. Lastly, I make some concluding remarks in the final section.

3.2 Related Work

Several studies have been conducted by the film industry on home video market trends and the nature of the distribution window, which are not transparent to parties outside of the industry and are detailed below.

3.2.1 Industry Conducted Research

In 2013, the DEG, Digital Entertainment Group, an industry consortium tasked to spearhead the industry transition into the digital distribution era reported that consumers spent 47% more in 2013 than in 2012 on home entertainment products. They attributed the main driver to be the digital window (Arnold 2014b).

This are consistent with my own findings. Given my results demonstrating the decrease in likelihood to rent in both blu-ray and dvd formats for films that were given

the digital window, it makes sense that these consumers are intertemporally substituting away from one form of consumption to another. Buying digital, which has low marginal costs of production, generate more profits for these firms.

The next section provides more insight into the industry, providing more context for my results, and well as their likely connection to the DEG's finding.

3.3 Industry

This section provides relevant information on the film industry and the digital distribution window.

3.3.1 Digital Distribution Window

The digital distribution window which is the central focus of this paper deserves a detailed discussion. First I mention some features of the window followed by a discussion of the history of the window with respect to the majors. I then turn to the industry reported effects of the window on home entertainment markets. Finally I briefly discuss the window's relationship to UltraViolet.

As mentioned the window is usually 1-4 weeks in length and can include some bonus features. According to Steve Beeks, co-chief operating officer of Lionsgate, a minor firm, the length of the window is determined using an algorithm. Mr. Beeks has said, "I think the only standard is that there is not a standard" (Ault). To boost the success of the window, given the experimental nature of the window duration, is the inclusion of bonus features with a purchase that are exclusive to this method of consumption, including behind the scenes material for the films.

In 2011, Fox was the first to take the experimental plunge, releasing a documentary via the digital window on iTunes and then becoming the first studio to have a digital window for a major release Bad Teacher (Ault 2013). Four of the other majors, Paramount, Warner, Sony and Universal followed suit in this windowing experiment (Gruenwedel 2013c). A major catalyst for this risky behavior was the pattern across these companies of merging their digital and disc divisions that had previously been separate and working somewhat competitively within each firm (Fritz). By merging departments they were able to coordinate strategies, as well as end the competition for development, marketing and distribution resources. Disney is the only major to not have done this, and thus was the last major to incorporate the distribution window into their home entertainment release strategy (Ault). Several minors have since incorporated the strategy as well. The window was mainly intended to change the behavior of dvd sell-through customers, "...the window is seen as a way to train the subset of the audience who are dvd collectors to make the jump to digital ownership by getting movies earlier than they would on disc." (Ault).

According to all industry reports, the results have been very positive. Ron Sanders, Warner's home entertainment president stated that they have, "...seen a fundamental shift in consumer behavior based on that early digital availability." (Fritz) Universal's home entertainment president Craig Kornblau was quoted as saying that sales on their top selling online title of 2013, which had the window, was double that of their 2012 top selling online title. Paramount's Paranormal Activity 4, which also had the digital window in January of 2013 sold 12 times the digital units than

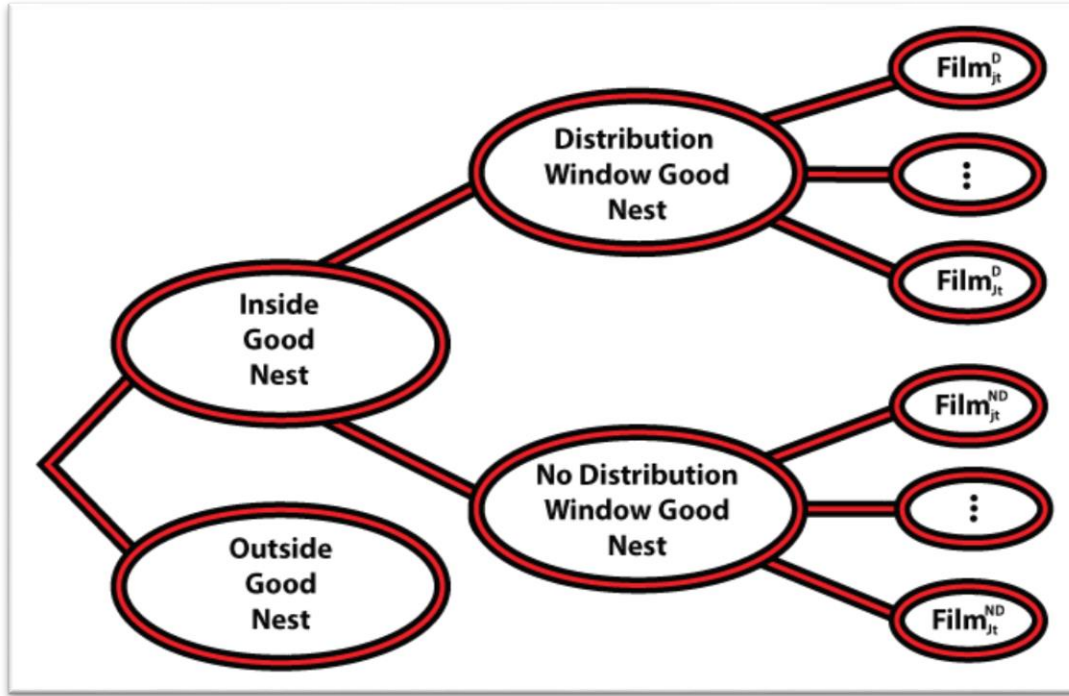
Paranormal Activity 3 the prior year. “‘For those who want the film first, they’ll come out and purchase it,’ said Dennis Maguire, president of worldwide home media distribution at Paramount.” Also, Mike Dunn, Fox’s president of home entertainment has touted the distribution window’s positive effects on impulse buying due to the ease of purchasing with consumers having their payment information loaded in their preferred online storefronts (Ault).

Despite the evidence to demonstrate the positive effect this windowing experiment has had on the relevant markets, the introduction of UltraViolet occurred at the same time which obfuscates the causality. Chapter 2 demonstrates that its introduction, as well as the merging of digital with disc, has led to increased profits as well. Thus the industry has been interested the question of which was more responsible for the increased revenues in home entertainment revenues. The answer seems to be that both UltraViolet and the window have buttressed each other, and thus collectively generated the positive gains. UltraViolet made buying digital more user friendly, and the window made it more appealing. My results support this idea, showing that the effectiveness of the window was improved by the proliferation of UltraViolet.

3.4 Model

I employ the nested logit model to study the extent to which the inclusion of distribution window has affected consumption behavior. Figure 3.1 shows the schematic for this chapter’s version of the nested logit model. This section describes measures used to study the effects of distribution window and presents the final derived model used for the empirical work in this chapter.

Figure 3.1 – Distribution Window Two Level Nested Logit Model Schematic Diagram



Note: The superscript D denotes the inclusion of the digital distribution window for a film. The superscript ND denotes films that do not include the digital distribution window.

3.4.1 Distribution Window Observables

Equation 11,

$$\alpha_i = \alpha_1(\text{Window Dummy})_t + \alpha_2(\text{Length of Window In Weeks})_t + \alpha_3(\text{UltraViolet Penetration Effect on Window})_t \quad (11)$$

shows the components of α to be (in the same order as above) a dummy indicating if a film includes a digital distribution window, the window length measured in weeks, and a dummy interacting the window dummy with a measure of UltraViolet penetration.

The measure of penetration denoted as

$$\theta_t = \frac{users_t}{users_0}, \quad (12)$$

is simply the number of users that have created accounts in the UltraViolet ecosystem indexed to the amount of accounts in the first week of observations. The measure of how the growth of the UltraViolet user base has affected the differential in film with a distribution's market share is thus the product of θ_t and the Disney dummy, W_t

$$\text{UltraViolet Penetration Effect on Window} = \theta_t \cdot W_t \quad .$$

Adding these variables to the others representing the other components of utility in from chapter one yield the inverted market share formula estimated here

$$\begin{aligned} \ln s_{it} - \ln s_{0t} = & \beta_1[\log(\text{box office})]_i + \beta_2(\text{genre dummy})_i \\ & + \beta_3(\text{MPAA dummy})_i + \beta_4[\log(\text{user reviews})]_i \\ & + \beta_5[\log(\text{critic reviews})]_i + \beta_6(\text{sequel dummy})_i - \rho(\delta_{it}) \\ & + \gamma_1(\text{season dummy})_t + \gamma_2(\text{holiday dummy})_t \\ & + \gamma_3(\text{holiday shopping dummy})_t \\ & + \gamma_4[\log(\text{theatrical competition})]_t \\ & + \alpha_1(\text{Window Dummy})_t \\ & + \alpha_2(\text{Length of Window In Weeks})_t \\ & + \alpha_3(\text{UltraViolet Penetration Effect on Window})_t \\ & + (1 - \lambda_k \lambda_m) \ln s_{i|B_k,t} + (1 - \lambda_m) \ln s_{B_k|D_m,t} + \varepsilon_{it} \end{aligned} \quad (13)$$

3.5 Data

Section 3.5.1 has information on the time frame chosen for the analysis. Then section 3.5.2 provides information on data sources for all other measures used (sourced outside of the two main sources mentioned in chapter 1).

3.5.1 Time Frame

The analytical time frame begins the week of October 1, 2012 and ends the week of February 17, 2014. There are seventy-three weekly time periods in the data. The date range was initially set by limitations of the data but ultimately became a reasonable time frame for what I was looking to accomplish. The limitation comes from the fact that the rental data set includes numbers from the kiosk channel starting only in October 2012. Also, the SVOD data has a gap of availability from April 2010 to October 2012. Thus the time period in which the digital distribution window has existed, which starts in the fall of 2011, has two different types of data in the rental market. There would be rental numbers from only brick-and-mortar stores from the fall of 2011 to October of 2012, with numbers from brick-and-mortar, SVOD and kiosk channels from October 2012 onward. To avoid complicating the analysis, and maintain consistency across the rental and sales markets I chose to start the analysis in October of 2012.

3.5.2 Ancillary Data Sources

This section details the ancillary data sources used. Namely, the distribution window designation, the length of the window, the UltraViolet index of market

penetration, the UltraViolet inclusion, the market share, the degree of theatrical market competition, the user and critic reviews all required extra data sources outside of the Nash and Rentrak data sets.

The films that included the digital distribution window, as well as the length of each film's window, were determined by webscraping from four different sites. The first is the website of Home Entertainment Magazine³⁷. The second is from the Fox Home Entertainment YouTube channel³⁸. The third is HDroom³⁹ which is another industry magazine. The final source is the website New DVD Release Dates⁴⁰, which compiles information about home video releases.

The UltraViolet index, θ_t , uses a weekly number of active UltraViolet accounts. The data for this measure came from a linear interpolation from four data points gleaned from cited articles in Home Media Magazine over the time frame considered in this paper. The U.S. population weekly numbers⁴¹ used for the market share were generated using the same method. A linear relationship was assumed between three annual population numbers.

The theatrical market competition measure data comes from BoxOfficeMojo.com. The site provides data on a variety of aspects of the theatrical

³⁷ <http://homemediamagazine.com/>

³⁸ <https://www.youtube.com/user/tcfoxconnect>

³⁹ <http://www.thehdroom.com/>

⁴⁰ <http://www.newdvdreleasedates.com/>

⁴¹ This data was sourced from the US census bureau

market including historical data for the weekly total box office revenue from the top twenty grossing films. The log of this number was used in my analysis.

The user and critic review measures were taken from RottenTomatoes.com. The user review is the percentage of users that have given a film a rating of 3.5 or higher on a scale of 1 to 5. It compiles reviews from upwards of 45,000 individual users. The critic measure is the percentage of approved professional critics who have given the film a positive review. The measure generally aggregates reviews from around 150-250 critics.

The data is comprised of 286 films. 93 films have an early release window. Five have a window of 4 weeks. 13 have a window length of 3 weeks. 63 have a window length of 2 weeks, and 12 have a window length of 1 week.

3.6 Results

The results of the two stage least squares (2SLS) analysis are presented in tables 3.1-3.3. The first significant finding is that the window is swaying low value consumers' behavior away from renting discs to buying digital. There was no significant effect found in the sales markets. Thus the window is effective in swaying behavior of low value consumers to purchase, consequently increasing firm revenues. This result is further supported by the fact that it is more pronounced in the market for dvd rentals than blu-ray rentals; the lowest of low value consumers of film, dvd renters, are most swayed by the distribution window. The second notable result is that the length of the distribution window is inversely related to its effect on the preference to

Table 3.1: Empirical Results for Total Units Sold and Rented

	Total Sales Market				Total Rental Market			
	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln S_{ilB_k}$	(4) 1 st . Stage: $\ln S_{B_k D_m}$	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln S_{ilB_k}$	(4) 1 st . Stage: $\ln S_{B_k D_m}$
Window	-.1173 (.0748)	-.0490*** (.0197)	-.0630*** (.0009)	1.3148*** (.1799)	-.3237*** (.0754)	-.0004 (.0067)	-.6974* (.3760)	1.2647*** (.1599)
Window Length	1.2037*** (.1666)	.3044*** (.0335)	1.0301*** (.2703)	-.8087*** (.1229)	.5461*** (.1674)	-.0129 (.0095)	.3506* (.2016)	-.6352*** (.0971)
UltraViolet Penetration Effect on Window	-.4525*** (.0626)	-.1204*** (.0122)	-.3984*** (.1048)	.3127*** (.0452)	-.1581*** (.0608)	.0061* (.0034)	.3506* (.0774)	.2471*** (.0364)
$\ln S_{ilB_k}$	.3663*** (.0495)	.9395*** (.0027)			.2170* (.1357)	.9826*** (.0016)		
$\ln S_{B_k D_m}$	.6673*** (.0759)	.9624*** (.0071)			.4243*** (.0926)	.9583*** (.0052)		
Decay	-.0411*** (.0033)	-.0057*** (.0002)	-.0630*** (.0009)	-.0000 (.0002)	-.0529*** (.0092)	-.0008*** (.0001)	-.0665*** (.0006)	-.0001 (.0001)
$\ln$ Box Office	.5205*** (.0427)	.0525*** (.0038)	.8090*** (.0124)	.0016 (.0033)	.3833*** (.0664)	.0066*** (.0016)	.4788*** (.0069)	.0000 (.0013)
Comedy	.0029 (.0520)	.0097 (.0150)	-.0231 (.0536)	.0059 (.0157)	.0584* (.0354)	-.0045 (.0066)	.0404 (.0344)	.0029 (.0064)
Drama	-.2984*** (.0588)	-.0248 (.0155)	-.4776*** (.0550)	.0046 (.0164)	-.1909*** (.0489)	-.0059 (.0064)	-.2536*** (.0340)	.0057 (.0067)
Action	.0216 (.0483)	.0161 (.0149)	-.0019 (.0503)	-.0093 (.0162)	-.0474 (.0349)	.0088 (.0066)	-.0914*** (.0339)	-.0112 (.0068)
Horror	-.3707*** (.0782)	-.0219 (.0181)	-.6032*** (.0737)	-.0066 (.0200)	-.4880*** (.0977)	-.0156** (.0078)	-.6530*** (.0560)	-.0002 (.0085)
Romantic Comedy	-.4870*** (.0747)	-.0279 (.0664)	-.8011*** (.0664)	-.0010 (.0191)	-.1899*** (.0519)	-.0110 (.0086)	-.2691*** (.0396)	.0023 (.0073)
Suspense	.1199** (.0586)	.0229 (.0167)	.1812*** (.0603)	.0147 (.0180)	.0934** (.0400)	-.0008 (.0073)	.1079*** (.0364)	.0125* (.0074)
$\ln$ User Reviews	.3233*** (.0587)	.0398 (.0132)	.5340*** (.0548)	.0022 (.0146)	-.3230*** (.0631)	-.0023 (.0057)	-.3837*** (.0354)	.0015 (.0058)
$\ln$ Critic Reviews	-.0054 (.0138)	.0015 (.0038)	-.0146 (.0144)	.0006 (.0038)	.0280** (.0132)	-.0004 (.0015)	.0336*** (.0125)	.0003 (.0014)
PG-13	.1092*** (.0426)	.0033 (.0124)	.1840*** (.0429)	-.0074 (.0124)	.1352*** (.0382)	.0024 (.0053)	.1990*** (.0278)	-.0062 (.0052)
R	.0209 (.0432)	-.0087 (.0127)	.0364 (.0445)	-.0146 (.0131)	.2429*** (.0500)	.0046 (.0054)	.3062*** (.0282)	-.0097* (.0055)
Sequel	-.0198 (.0371)	.0032 (.0108)	-.0476 (.0385)	.0142 (.0126)	-.1855*** (.0433)	-.0006 (.0042)	-.2592*** (.0250)	.0120** (.0056)
Pre-Existing Fiction	-.0084 (.0549)	.0089 (.0154)	.0021 (.0574)	-.0070 (.0174)	-.0063 (.0337)	.0033 (.0073)	.0042 (.0337)	-.0130* (.0076)
Original Screenplay	-.1086 (.0564)	.0002 (.0151)	-.1373** (.0577)	-.0100 (.0170)	-.0917*** (.0368)	.0034 (.0070)	-.0766** (.0339)	-.0156** (.0073)
Remake	-.1091 (.0789)	.0095 (.0231)	-.1578** (.0818)	-.0075 (.0242)	.0999* (.0551)	-.0022 (.0113)	-.0803 (.0531)	-.0122 (.0090)
Holiday	.0365 (.0252)	-.0092 (.0059)	.0007 (.0254)	.0561*** (.0055)	.0350** (.0161)	.0490*** (.0018)	-.0053 (.0161)	-.0125*** (.0032)
Holiday Shopping	.8314*** (.0481)	.8879** (.0099)	-.0624 (.0467)	-.1427*** (.0134)	.0285 (.0263)	.0414*** (.0050)	.0148 (.0262)	-.0609*** (.0051)
Summer	-.1481*** (.0395)	-.2886*** (.0112)	.0394 (.0372)	.2572*** (.0125)	-.0357 (.0253)	.0212*** (.0033)	-.1766*** (.0241)	.2054*** (.0058)
Autumn	.1272*** (.0379)	.3104*** (.0115)	-.8481*** (.0529)	.0870*** (.0181)	-.0543** (.0281)	-.1284*** (.0060)	-.0712** (.0353)	.1914*** (.0112)
Winter	.2021*** (.0394)	.0426*** (.0136)	-.1795*** (.0479)	.0080 (.0157)	-.0371 (.0285)	.0524*** (.0033)	-.1589*** (.0331)	.0298*** (.0101)
<i>To instrument</i> $\ln S_{ilB_k}$								
Total Box Office			-.0020*** (.0001)	.0000 (.0000)			-.0665*** (.0001)	-.0003*** (.0001)
Total Decay			.0005*** (.0000)	.0001*** (.0000)			.0001*** (.0000)	.0000 (.0000)
<i>To instrument</i> $\ln S_{B_k D_m}$								
Total Box Office			-.0005* (.0003)	-.0014*** (.0001)			-.0002*** (.0000)	-.0013*** (.0001)
Total Decay			.0002*** (.0001)	.0002*** (.0000)			.0007*** (.0002)	.0003*** (.0000)
Constant	-18.6613*** (1.1135)	-6.2937*** (.0887)	-18.6694*** (.3026)	-.3049*** (.0869)	-11.940*** (1.5498)	-3.2653*** (.0336)	-10.2494*** (.1886)	-.5309*** (.0394)
Observations	11948	11929	11929	12391	12241	12211	12211	12211
F-Statistic			735.39	304.89				
R-Squared	.6996	.9779	.6776	.3775	.7994	.9933	.7984	.7888

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is Family. The omitted rating is PG. The omitted source is Based on Non-Fictional Events. Also, film j belongs to distribution window nest g.

Table 3.2: Empirical Results for Blu-ray Units Sold and Rented

	Blu-ray Sales Market				Blu-ray Rental Market			
	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln s_{ijk}$	(4) 1 st . Stage: $\ln s_{ijk D_m}$	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln s_{ijk}$	(4) 1 st . Stage: $\ln s_{ijk D_m}$
Window	.0479 (.0807)	-.3052 (.0244)	-2.4145*** (.5509)	2.0756*** (.1969)	-.1857*** (.0715)	.0013 (.0079)	-1.5915*** (.4192)	1.3535*** (.1565)
Window Length	1.4564*** (.1896)	.2368*** (.0401)	2.3717*** (.2915)	-.8966*** (.1330)	.0223 (.1876)	-.2031*** (.0114)	.4206* (.2266)	-.6466*** (.0952)
UltraViolet Penetration Effect on Window	-.5722*** (.0724)	-.0956*** (.0146)	-.9366*** (.1147)	.3468*** (.0487)	.0209 (.1876)	.0799*** (.0041)	-.1567*** (.0875)	.2510*** (.0356)
$\ln s_{ijk}$	.2189*** (.0714)	.9203 (.0032)			.6118*** (.1119)	.9809*** (.0013)		
$\ln s_{ijk D_m}$	.5711*** (.0853)	.8714*** (.0083)			.6039*** (.0582)	.8629*** (.0055)		
Decay	-.0595*** (.0055)	-.0074*** (.0003)	-.0751*** (.0010)	.0000 (.0002)	-.0237*** (.0071)	-.0001 (.0001)	-.0610*** (.0007)	-.0001 (.0001)
$\ln$ Box Office	.6071*** (.0579)	.0603*** (.0050)	.7701*** (.0153)	.0018 (.0040)	.2555*** (.0735)	.0081*** (.0017)	.6496*** (.0096)	.0002 (.0014)
Comedy	-.4782*** (.0761)	-.0407** (.0189)	-.6187*** (.0665)	.0071 (.0190)	.0077 (.0381)	-.0138** (.0069)	-.0096 (.0386)	.0038 (.0070)
Drama	-.5898*** (.0855)	-.0573*** (.0198)	-.7654*** (.0672)	.0038 (.0199)	-.1235** (.0557)	-.0087 (.0067)	-.3282*** (.0397)	.0058 (.0074)
Action	.0862 (.0587)	.0199 (.0184)	.0997* (.0611)	-.0106 (.0194)	.0600 (.0390)	-.0135** (.0069)	.1333*** (.0366)	-.0099 (.0074)
Horror	-.6484*** (.1000)	-.0592*** (.0228)	-.8289*** (.0817)	-.0086 (.0241)	-.2604*** (.0915)	-.0239*** (.0081)	-.6992*** (.0625)	-.0004 (.0092)
Romantic Comedy	-.8644*** (.1115)	-.0689*** (.0252)	-.11217*** (.0844)	-.0020 (.0234)	-.1451** (.0648)	-.0214** (.0089)	-.3957*** (.0484)	.0022 (.0081)
Suspense	-.3938*** (.0778)	-.0314 (.0252)	-.5260*** (.0732)	.0166 (.0218)	.1404** (.0569)	.0001 (.0077)	.3528*** (.0410)	.0132* (.0080)
$\ln$ User Reviews	.4199*** (.0683)	.0493*** (.0177)	.5395*** (.0606)	.0018 (.0176)	-.2498*** (.0824)	-.0048 (.0061)	-.6148*** (.0481)	.0015 (.0063)
$\ln$ Critic Reviews	.0413** (.0198)	.0077 (.0062)	.0583*** (.0211)	.0008 (.0047)	.0266 (.0157)	-.0015 (.0016)	.0553*** (.0141)	.0003 (.0016)
PG-13	.0451 (.0534)	-.0015 (.0161)	.0647 (.0557)	-.0085 (.0150)	.0844** (.0446)	.0026 (.0055)	.2609*** (.0327)	-.0062 (.0057)
R	.1093** (.0543)	-.0007 (.0164)	.1552*** (.0560)	-.0163 (.0158)	.1706*** (.0590)	.0075 (.0057)	.4357*** (.0328)	-.0098 (.0061)
Sequel	-.0978** (.0471)	.0025 (.0136)	-.1380*** (.0482)	.0185 (.0150)	-.1167** (.0491)	.0002 (.0046)	-.3390*** (.0275)	.0117** (.0060)
Pre-Existing Fiction	.0259 (.0644)	.0160 (.0205)	.0365 (.0699)	-.0086 (.0210)	-.0755 (.0468)	.0006 (.0075)	-.1877*** (.0418)	-.01275 (.0082)
Original Screenplay	-.1745*** (.0675)	-.0030 (.0203)	-.2166*** (.0692)	-.0122 (.0204)	-.1369** (.0545)	.0000 (.0116)	-.3079*** (.0424)	-.0157** (.0078)
Remake	-.2999 (.0954)	.0023 (.0303)	-.4065*** (.0975)	-.0101 (.0296)	-.1694*** (.0754)	-.0108 (.0116)	-.3744*** (.0628)	-.01261 (.0101)
Holiday	.0176 (.0293)	.0160** (.0075)	-.0683** (.0302)	.0904*** (.0062)	.0439** (.0204)	.0635*** (.0021)	-.0301 (.0203)	-.0245*** (.0033)
Holiday Shopping	.8663*** (.0592)	.9315*** (.9315)	-.0746 (.0568)	-.1630*** (.0151)	.0121 (.0333)	.0467*** (.0049)	-.0552 (.0337)	-.0642*** (.0057)
Summer	-.1708*** (.0426)	-.2705*** (.0151)	-.0327 (.0416)	.3065*** (.0156)	-.0067 (.0283)	.0034 (.0036)	-.1105*** (.0286)	.2247*** (.0062)
Autumn	-.0624 (.0587)	.3841*** (.0148)	-.10603*** (.0605)	.1048*** (.0207)	-.0850*** (.0292)	-.1122*** (.0059)	-.0350 (.0409)	.2093*** (.0115)
Winter	.2494*** (.0421)	.0801*** (.0163)	-.1043** (.0516)	.0039 (.0191)	-.0089 (.0304)	.0306*** (.0034)	-.0930** (.0383)	.0481*** (.0100)
<i>To instrument</i> $\ln s_{ijk}$								
Total Box Office			-.0014*** (.0001)	-.0001** (.0000)			-.0002*** (.0003)	.0002*** (.0000)
Total Decay			.0003*** (.0001)	.0001*** (.0000)			.0000* (.0000)	.0000 (.0000)
<i>To instrument</i> $\ln s_{ijk D_m}$								
Total Box Office			.0002 (.0003)	-.0017*** (.0001)			.0011*** (.0003)	-.0013*** (.0001)
Total Decay			.0002*** (.0001)	.0003*** (.0000)			-.0002*** (.0001)	.0002*** (.0000)
Constant	-22.2851*** (1.5292)	-7.65*** (.1093)	-18.514*** (.3474)	-.3221*** (.1057)	-10.1321*** (1.5158)	-5.1072*** (.0358)	-12.4704*** (.2272)	-.5244*** (.0451)
Observations	10316	10306	10306	12391	12216	12186	12186	12211
F-Statistic			529.39	243.94			849.02	1551.44
R-Squared	.6778	.9698	.6512	.2851	.7450	.9936	.7439	.7482

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is Family. The omitted rating is PG. The omitted source is Based on Non-Fictional Events. Also, film j belongs to distribution window nest g.

Table 3.3: Empirical Results for DVD Units Sold and Rented

	DVD Sales Market				DVD Rental Market			
	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln s_{ij B_k}$	(4) 1 st . Stage: $\ln s_{B_k D_m}$	(1) 2SLS	(2) OLS	(3) 1 st . Stage: $\ln s_{ij B_k}$	(4) 1 st . Stage: $\ln s_{B_k D_m}$
Window	-.1242 (.0778)	-.0405** (.0183)	.4660 (.4670)	.8373*** (.1722)	-.3665*** (.0806)	.0006 (.0068)	-.5237 (.3813)	1.2484*** (.1608)
Window Length	1.1999*** (.1616)	.3835*** (.0316)	.5902** (.2616)	-.7627*** (.1174)	.7189*** (.1775)	.0287*** (.0096)	.3715 (.2023)	-.6320*** (.0977)
UltraViolet Penetration Effect on Window	-.4505*** (.0604)	-.1511*** (.0115)	-.2267** (.1015)	.2950*** (.0434)	-.2171*** (.0628)	-.0101*** (.068)	-.0981 (.0776)	.2459*** (.0367)
$\ln s_{ij B_k}$	.3885*** (.0491)	.9518*** (.0024)			.0152* (.0017)	.9800*** (.0015)		
$\ln s_{B_k D_m}$	.6928*** (.0787)	1.0272*** (.0072)			.3003*** (.1210)	.9844*** (.0052)		
Decay	-.0386*** (.0032)	-.0048*** (.0002)	-.0612*** (.0009)	.0000 (.0002)	-.0686*** (.0120)	-.0009*** (.0001)	-.0687*** (.0006)	-.0001 (.0001)
$\ln$ Box Office	.4893*** (.0416)	.0419*** (.0035)	.7852*** (.0126)	.0013 (.0029)	.4624*** (.0801)	.0060*** (.0016)	.4599*** (.0071)	-.0001 (.0013)
Comedy	.0705 (.0547)	.0163 (.0139)	.0813 (.0554)	.0050 (.0138)	.1008*** (.0396)	-.0024 (.0067)	.0711** (.0358)	.0027 (.0063)
Drama	-.2173*** (.0583)	-.0121 (.0143)	-.3644*** (.0563)	.0051 (.0146)	-.2246*** (.0537)	-.0051 (.0065)	-.2380*** (.0352)	.0057 (.0067)
Action	-.0276 (.0508)	.0131 (.0138)	-.0813 (.0554)	-.0088 (.0143)	-.1123*** (.0407)	-.0077 (.0067)	-.1419*** (.0352)	-.0114* (.0068)
Horror	-.2986*** (.0770)	-.0076 (.0167)	-.5106*** (.0733)	-.0055 (.0178)	-.6027*** (.1164)	-.0130* (.0079)	-.6388 (.0571)	-.0001 (.0084)
Romantic Comedy	-.3868 (.0728)	-.0113 (.0175)	-.6686*** (.0674)	-.0004 (.0168)	-.1933*** (.0529)	-.0082 (.0087)	-.2207*** (.0408)	.0023 (.0072)
Suspense	.1651*** (.0619)	.0253* (.0155)	.2620*** (.0619)	.0136 (.0159)	.0844*** (.0408)	-.0008 (.0074)	.0740** (.0378)	.0123* (.0073)
$\ln$ User Reviews	.2914*** (.0596)	.0345*** (.0120)	.5046*** (.0565)	.0023 (.0129)	-.3793*** (.0725)	-.0017 (.0058)	-.3605*** (.0355)	.0015 (.0057)
$\ln$ Critic Reviews	-.0203 (.0146)	-.0004 (.0035)	-.0387*** (.0151)	.0005 (.0034)	.0307** (.0139)	-.0003 (.0015)	.0288** (.0131)	.0003 (.0014)
PG-13	.1106*** (.0448)	.0005 (.0115)	.1941*** (.0445)	-.0069 (.0110)	.1459*** (.0399)	.0019 (.0054)	.1701*** (.0290)	-.0032 (.0051)
R	.0354 (.0451)	-.0072 (.0118)	.0590 (.0458)	-.0137 (.0116)	.2720*** (.0550)	.0037 (.0054)	.2742*** (.02943)	-.0097 (.0055)
Sequel	-.0355 (.0381)	.0013 (.0100)	-.0731* (.0389)	.0114 (.0113)	-.2292*** (.0506)	-.0006 (.0042)	-.2521*** (.0256)	.0120** (.0055)
Pre-Existing Fiction	.0131 (.0564)	.0105 (.0140)	.0432 (.0580)	-.0064 (.0155)	.0127 (.0347)	.0034 (.0073)	.0248 (.0345)	-.0131* (.0072)
Original Screenplay	-.0596 (.0570)	.0066 (.0140)	-.0569 (.0582)	-.0092 (.0151)	-.0922** (.0380)	.0036 (.0071)	-.0578* (.0347)	-.0156** (.0072)
Remake	-.0498 (.0831)	.0122 (.0215)	-.0526 (.0853)	-.0064 (.0212)	-.0694 (.0548)	-.0007 (.0115)	-.0298 (.0538)	-.0121 (.0089)
Holiday	.0335 (.0267)	-.0256*** (.0055)	.0273 (.0259)	.0352*** (.0053)	.0325** (.0164)	.0454*** (.0018)	-.0024 (.0164)	-.0099*** (.0032)
Holiday Shopping	.7923*** (.0486)	.8538*** (.0090)	-.0668 (.0471)	-.1200*** (.0122)	.0350 (.0270)	.0404*** (.0051)	.0269 (.0267)	-.0598*** (.0050)
Summer	-.1574*** (.0412)	-.3225*** (.0099)	.0747** (.0380)	.2319*** (.0109)	-.0538** (.0276)	.0255*** (.0033)	-.1879*** (.0247)	.2013*** (.0057)
Autumn	.1340*** (.0377)	.2455*** (.0106)	-.7793*** (.0537)	.0851*** (.0168)	-.0376 (.0308)	-.1325 (.0061)	-.0702** (.0360)	.1873*** (.0112)
Winter	.1813*** (.0401)	.0300** (.0129)	-.2233*** (.0488)	.0171 (.0140)	-.0745 (.0335)	.0571*** (.0034)	-.1754*** (.0337)	.0252*** (.0102)
<i>To instrument $\ln s_{ij B_k}$</i>								
Total Box Office			-.0021*** (.0001)	.0000 (.0002)			-.0006*** (.0001)	.0003*** (.0000)
Total Decay			.0006*** (.0000)	.0000 (.0000)			.0001*** (.0000)	-.0000 (.0000)
<i>To instrument $\ln s_{B_k D_m}$</i>								
Total Box Office			-.0010*** (.0003)	-.0011*** (.0001)			.0007*** (.0002)	-.0013*** (.0001)
Total Decay			.0002 (.0001)	.0002*** (.0000)			-.0002*** (.0000)	.0003*** (.0001)
Constant	-18.2885*** (1.0827)	-6.4406*** (.0793)	-17.9847*** (.3087)	-.2954*** (.0762)	-14.1126*** (1.9047)	-3.4270*** (.0334)	-10.0183*** (.1949)	-.5325*** (.0391)
Observations	11868	11849	11849	12391	12241	12211	12211	12211
F-Statistic			671.87	380.50			1391.95	2050.44
R-Squared	.6666	.9801	.6493	.4468	.7962	.9934	.7952	.7949

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is Family. The omitted rating is PG. The omitted source is Based on Non-Fictional Events. Also, film j belongs to distribution window nest g.

buy or rent discs. My findings show that, aside from the blu-ray rental market, there is a significant positive rent or buy disc as the length of the window increases. So if a digital version of a film is released a month rather than a week before the release of the film on disc, it will be less likely to affect the preference to buy or rent discs. The final significant result found is in the measures of substitutability within the distribution window nests of each data set that suggest that in no market are consumers getting converted to digital buyers by the digital window. Although consumption behavior is being swayed, they are not being permanently altered⁴².

This final section covers the results in the following manner. Section 6.1 discusses general results from the model. Section 6.2 then provides more details on the central results of the paper.

3.6.1 General Results

Before covering the central results in more detail, I provide some observations about the overall performance of the model I used. The 2SLS process went well and deserves some mention. The film characteristics that captured between variations have a few interesting results worth mentioning as well. Lastly there are some interesting behaviors of the seasonal variables that are also thrown in for good measure.

⁴² More on this idea in section 3.6.2

2SLS

The 2SLS results are consistent with Chiou (2008) and Axarlian (2014). All instruments were significant and in the right direction. Meaning the first instrument, total box office of competitors in a nest, has a negative relationship with a film's market share, as expected. Also, the second instrument, the total decay of a film's competitors in a nest, has a positive relationship with competitors in a nest. Thus, the older the competitors of a film are, the more likely that film is to be chosen. All the instrumented market shares in the 2SLS estimates were significant and in the expected direction as well.

The overall variation captured by the model is partly consistent with Chiou (2008) and completely consistent with Axarlian (2014). The sales market results in both Chiou (2008) and my papers have nearly identical R^2 results, explaining upwards of 65% of the variation in demand. The rental markets results are less in line with her model explaining 93% variation and my model explaining upwards of 75%. I attribute this difference to the difference in our data sets. My data set includes data from the declining brick-and-mortar channel, which made up the totality of her data set, but also includes SVOD and kiosk figures. Also, her data set covers a period from 2000 to 2003 in which the proliferation of entertainment substitutes, specifically social media, have likely muddied the demand waters for low-value consumers, given that social media are more likely to be substitutes to a rented film than to a purchased one. Also, the digital rental option has proliferated as well. Thus including data on changing patterns

of substitutes to home video markets would have likely increased the explained variation. Unfortunately this is data I did not have access to.

Between Variation

Again, the variables in common with Chiou (2008) and Axarlian (2014) had consistent results. The proxy for unobserved quality, the log of a film's theatrical box office, proved to be positive and very significant in every market, as was expected. The decay variable fared well too, having the same consistency in significance, and in the expected negative direction. The genre and ratings variables overall, behaved as expected. The source variables, first tested in chapter 2 turned out to have consistent results.

The sequel status of films had the interesting result of being negative across the board, with no significance in the DVD market. What the negative sign could signify is that '*franchise fatigue*', where consumers experience diminishing returns on an ongoing storyline, is indeed present in some film markets.

The final film characteristics worth commenting on are the word of mouth measures. Professional critics' reviews seem to only have significance with the lowest and the highest value consumers. It makes sense that the highest value consumers, blu-ray purchasers, would seek the aid of professional word of mouth information in order to select which films to consume. This same logic applies to the lowest value consumers, dvd renters. The opportunity cost of watching films is likely high for these consumers so they want to be as selective as possible when making film consumption

choices⁴³. On the other hand, the middle-of-road consumers, blu-ray renters and dvd purchasers, value watching films, but not too much and not too little. Blu-ray renters value film's enough to keep up with the exhibition technology, and thus are open to consuming films regularly. As a renter, the commitment is less expensive than a purchase and thus being less selective would make sense. Purchasers of dvds on the other hand, value films more than dvd renters, but not enough to invest in the newest exhibition technology. This implies that they would be less selective in their purchases than renters are in their choices. As far as word-of-mouth from the average consumer goes, it is clear that positive word of mouth causes consumers to rent less and buy more, which is consistent with the results from chapter 2. This relationship is highly significant across all formats, which is more telling than the prior chapter, demonstrating the clear importance of this pattern amongst consumers in this market.

Within Variation

As far as the seasonality and competition variables go, the results are mainly not surprising. Contrary to chapter 2 national holidays are significant in rental markets. Consistent chapter 2, the holiday shopping period is extremely significant in all the purchase markets. The calendar seasons seem to be more important in the purchase markets than in the rental markets. Again, it goes back to high value versus low value

⁴³ As DVD renters, they value leisure time spent watching films the lowest for all film consumers. This implies that they value other leisure activities or work activities much higher and thus the value of their foregone opportunities are relatively higher than all other consumers in this market.

consumers. High value consumers are likely to have more high value substitutes throughout the seasons.

3.6.2 Distribution Window⁴⁴

As mentioned, there are three results central to the defining theme of this paper worthy of discussion. There is also a fourth result related to UltraViolet worth mentioning.

The effectiveness of the digital distribution window, captured by a dummy variable for films that have this window, is negative and significant only in the rental markets. As mentioned in the Industry section, the target for the strategy was to convert dvd collectors (buyers) so the result was not necessarily what the industry intended, but beneficial nonetheless. DVD buyers were found to have a negative effect from the window but the result is not statistically significant. The relevance of the negative and significant results across both of the disc rental markets implies that the digital window strategy is effective in increasing revenues. By converting low value consumers into purchasers, firms are extracting consumer surplus from low value consumers that are willing to pay more to consume a film, but do not value the goods enough to purchase them from existing purchase options. Both the reduced price of the digital option as well as the extra benefit from consuming the film earlier creates enough value for these

⁴⁴ The results in this chapter do not affect the results from chapter 2. The variables from that section were included here but ultimately left out to maintain the focus of the work.

consumers to temporarily alter their behavior. This resulted in increased revenues for the firms since the digital option has a very low marginal cost.

The window length metric which measures the increased likelihood of choosing a film with respect to a one week increase in the digital distribution window yielded an interesting result. First of all a positive and significant result was found for both sales markets. Without significance for the distribution window dummy in the sales market, the relevance of this significance on sales market is of a murky character so I will avoid commenting on it. The rental market for DVDs was found to be positive and significant as well. It implies that the longer the window is, the less likely it will affect the preference to rent the DVD option. This same result was not found in the blu-ray rental market. One possible explanation for the rental market finding might lie in the degree of awareness that consumers have about the release of these films on digital. It is likely that the studios are spending their home entertainment distribution advertising budgets on traditional format releases like disk and very little on the early digital window. Thus the closer the digital distribution is to the physical media release, the more ubiquitous are the ads making the digital distribution a viable alternative option for film consumption. The lack of significance in the blu-ray rental market can be attributed to the fact that blu-ray renters are higher value consumers of film than dvd consumers. DVD consumers value films least in these markets, making their interest in gathering information about the more sophisticated distribution options of the lowest priority making them more susceptible to advertising. They do not search for information and thus they only have information from the advertising they see. Given that they invest

Table 3.4 – Log Sum Coefficients

	λ_k	λ_{IN}
Total Sales	1.110012194	0.629003
Blu-ray Sales	1.061963419	0.8037
DVD Sales	1.072898665	0.6365
Total Rentals	1.109975062	0.802
Blu-ray Rentals	1.200910796	0.7466
DVD Rentals	1.097546161	0.8232

in the latest exhibition technology makes them more likely to be aware of the digital distribution window, regardless of its length.

Unfortunately for these firms, this strategy does not appear to be creating consumers loyal⁴⁵ to this new method of consumption which is implied by the nested logit model's coefficients of the log sum which measures substitutability within nests.

Table 3.4 provides the results for the log-sum coefficients.

The first result from this method of analysis worth mentioning is in regard to the substitutability of the inside good. Meaning how much correlation is there in the behavior of consumers of home entertainment products, versus all other leisure options. As table 4 shows, the inside good is high substitutable relative to the outside good, which is consistent with Chiou (2008) ,Einav (2007) and chapter 2.

More importantly, with regard to the substitutability of the good in the digital window nests, the λ_k values are all very close to one which means there is no degree

⁴⁵ Since the lambda values are close to one, then, as stated, the inclusion of the window is not revealing any sort of correlation for the behavior of these consumers with respect to this choice. So although the inclusion of a window may prompt a disc renter to buy digitally at any given time, it does not imply that the choice of another film with this feature will lead to the same result. Thus I used the term 'loyal' to embody this idea.

of substitutability within the nest of films that have the digital distribution window nor in the nest of films that did not have this option. If any of the λ_k values were between 0 and 1, the closer the value to 0, the more substitutable these options would be. High substitutability implies that if a film without this window became unavailable, a consumer would be more likely to choose a film without the window than one with the window. This implies that options with a window are not considered as much, and thus due to the likelihood they are being consumed in the new alternative manner. Essentially in this illustrative example, consumers have become loyal to the new digital consumption option; their behavior has been permanently altered with respect to their engagement in these markets. Again, since none of these values are between zero and one in results presented in table 3.4, one can assert with confidence that consumers are not becoming loyal to the new method of consumption given the introduction of the digital distribution window.

Finally, one more ancillary result worth mentioning is with regard to the effect that the proliferation of the UltraViolet ecosystem on the digital distribution window. The penetration of the system seems to have increased the effectiveness of the digital distribution window's effect in these markets. So the more user the UltraViolet system had, the large the effect of disc renters to shift their consumption behavior away from renting to buying discs. These results establish the fact that the increase in revenues can be attributed to both of these adaptation strategies working in tandem.

3.7 Conclusion

As most industries have been attempting to adapt to and monetize on the digital revolution, the film industry has proven to be successful in its risky adaptation strategies. As both chapter 1 and this chapter's works demonstrate, the attempts to buoy the home entertainment revenues that have been in a downward trajectory have been successful.

The results garnered from the analysis in this chapter are consistent with the claims the industry has made about the effectiveness of their digital distribution window experiment. By affecting the consumption behavior of disc renters primarily they have successfully captured the consumer surplus from this population. Their next step is to streamline the length of the window so as to make the strategy as effective as possible. As my analysis has demonstrated, standardizing the length of the window to 1-2 weeks makes the digital purchase option more of a viable alternative to disc renting. This would help to increase revenues even more.

The chapter also serves to provide more evidence that the nested logit model has robust applications in these product markets. With the application to the introduction of UltraViolet, and the effectiveness of the distribution window, the model has proved to provide valuable insights into changes in consumption behavior with respect to changes in distribution strategies.

Although this chapter focuses specifically on the home entertainment markets, the analysis can be extended to other mediums, such as digital distribution of music

and books. Similar analysis might prove helpful to develop digital distribution window strategies in these media markets as well.

4 The Long Tail Effect in Home Entertainment Rental Markets

4.1 Introduction

The film industry is just one of several industries that have been affected by the ‘*long tail*’ provided by the introduction of infinite inventory retailers. These are generally online retailers that offer a variety of products which have infinite shelf life, severely changing the nature of consumption in these markets. What these changes ultimately look like is a subject of interest in both the academic literature and industry discussion. One question of concern is whether or not the long tail leads to niche products gaining prominence in market share, or if superstars simply become even bigger superstars, leaving niche products relatively insignificant in importance. This chapter examines this phenomenon in the home entertainment market for disc film rentals in the hopes of providing more insight into this puzzle. It also examines the relationship between the long tail effect and substitutability of niche and superstar products. My findings show that superstar products gain market share with long tail availability in these markets. Also, the relationship between long tail availability and substitutability is revealed to be complex, due to its dependence on how the consumer values the overall product type. The relationship changes with regard to whether a consumer is a high value or low value consumer.

The long tail is a term coined by Chris Anderson, a former editor of Wired magazine, and a former US business editor at The Economist. If one were to imagine

the product variety in a market in descending order from biggest to the smallest quantity sold on the X axis in the Cartesian plane, then the tail refers to the group of products furthest away from the origin. In the brick-and-mortar retail world, physical shelf space is limited, thus niche products do not get a chance to sell at all, with the ones that do, selling small quantities. Infinite inventory retailers like Amazon and Netflix do not have to contend with physical constraints on shelf space, and thus they are able to offer a larger variety of products for an infinite amount of time (theoretically). With their recommender systems, consumers have their tastes instantaneously matched to products. These matches are to both the bestselling superstars, as well as the niche products that would otherwise not be considered, and in many cases, be unavailable. Thus these niche products create a longer and thicker tail, with many more niche available and selling in larger volume. Anderson asserts that tail availability will lead to niche products eventually making up a larger portion of overall revenues, eclipsing the dominant market share of superstars.

I used data from home video market rentals to examine the nature of this phenomenon further. The Rentrak Corporation, an industry analyst, provided me a data set which had varying data sources over an extended period of time. From May of 2010 to October of 2012 the data for film rentals is sourced from only brick-and-mortar transactions. The data immediately preceding it, ending in April of 2010 was sourced from both brick-and-mortar transactions and infinite inventory retailers. This variation in data availability provided the conditions which allowed me to study the nature of

long tail availability in these markets vis-à-vis niche and superstar products⁴⁶. The data is broken down into subsets of dvd and blu-ray transactions which served as proxies for low value and high value film consumers respectively.

I performed my analysis using both OLS analysis and a 2SLS estimation of a discrete choice model on a unique data set of home video weekly rental units. The analysis looks at rental units of physical media, aggregated, as well as in subsets of dvd and blu-ray video formats. The unbalanced⁴⁷ panel data set is comprised of 1060 unique films, over the course of 239 weekly time periods.

The results revealed insights into the relationship between long tail availability, substitutability of films, product type, and the degree to which a consumer values the general filmic product. Low value consumers and high value consumers viewed the degree of substitutability differently both in a long tail market setting, as well as one without. Low value consumers considered both superstars and niche products as extremely substitutable in a non-long tail setting. In a long tail context, both product types lose their substitutability. At the same time, there was an increased likelihood of choosing both superstars and niche products for these consumers in a long tail setting. These results imply an inverse relationship between substitutability and the effect of

⁴⁶ Essentially I have a data set that is solely from brick-and-mortar stores and one that is from both brick-and-mortar stores and an infinite inventory retailer. Although infinite inventory retailers are available in the world in the first data set, I am working under the assumption that given that infinite inventory retailers are subscription services, then the two methods of consumption are mutually exclusive. So if a consumer consumes in a brick-and-mortar store then she is not also consuming from the infinite inventory retailer. Thus the analysis in the first data set reveals preferences with respect to consuming niche and superstars products that is fundamentally different from the second data set.

⁴⁷ Not all films were released at the start of the time frame and thus there is a variable amount of weekly data points for each film.

long tail availability on market share for low value consumers. Examining the behavior of high value consumers revealed this relationship to not be uniform for different consumer types. In a non-long tail setting high value consumers do not view niche nor superstar products as substitutes whereas in a long tail context they view superstars as substitutes, with niche products remaining without substitutability. At the same time, in a long tail setting, niche products were less likely to be chosen than in a non-long tail setting, and superstars become more likely to be chosen. Although there is no observable pattern between substitutability and the long tail effect on niche and superstars, the behavior of consumers in these markets can be explained. The logic and implications of these results are expounded upon in the results section.

This chapter is structured as follows. Section 4.2 places this paper within the context of related literature. Section 4.3 discusses relevant aspects of the industry as well as the long tail phenomenon. Section 4.4 details the model used to analyze the data. Section 4.5 discusses the nature of the data used. Finally, section 4.6 provides the results followed by a brief section with some closing remarks.

4.2 Related Work

This section places this chapter's empirical work within the context of the academic literature focused on the long tail.

4.2.1 The Long Tail

These four papers study the nature of the long tail effect with respect to consumer welfare, niche/superstar products and price. The first paper by Brynjolfsson

et al. (2003) establishes that consumer welfare gains from infinite inventory retailers are larger than expected with increased product variety playing a huge role. Elberse et al. (2007) investigates the long tail effect on superstar and niche products in the home entertainment sales market and finds that both superstars and niche products increase market share. She finds that superstars had a negative second order trend which leads her to assert that superstar products need to be improved in order to remain competitive against a growing selection. Broder (2010) conducts a similar analysis in the market for mainly films and music with his finding demonstrating that niche products gain market share and superstars do as well as a result of the niche increase. Meaning that customers searching for niche products also buy the superstars they prefer, due to the “one-stop-shopping” nature of infinite inventory retailers. Lastly, Ellison, et al (2014) studied the effects of the long tail in the market for used books finding that the long tail leads to higher prices for niche products leading to both increased seller profits and consumer surplus.

4.3 Industry

The long tail is an integral player in the story of the film industry’s adaptation to the digital era. Home entertainment markets in particular have had a turbulent transition into this new technological era making understanding the long tail effects of paramount importance to optimal adaptation. In section 4.3.1 I discuss the emergence and nature of the long tail theory. Section 4.3.2 discusses opposition to the long tail paradigm as well as evidence from media markets that provide insight into the

complexity of it. Finally, section 4.3.3 focuses specifically on the long tail and its relationship to home entertainment markets, with a special focus on Netflix.

4.3.1 The Long Tail

As previously mentioned, Chris Anderson coined the term and introduced the concept of the long tail in a Wired magazine article in 2004, which was followed up by a book of the same title in 2006. According to his treatise, “Many of our assumptions about popular taste are actually artifacts of poor supply-and-demand matching – a market response to inefficient distribution.” He attributes these conditions to two defining restraints. One is that niche content producers were restrained in their ability to find the right audience. The second restraint was physical, due to limited shelf space in brick-and-mortar stores. The result of these conditions was a world where the Pareto principle, also known as the 80-20 rule, defines the market outcomes. “Hit-driven economics is a creation of an age without enough room to carry everything for everybody”, Anderson states, referring to the fact that only 20% of most media content will be hits, leaving only 80% to be misses. The music industry has a worse distribution, with only 10% being hits and 90% being misses.

The introduction of infinite inventory retailers such as Amazon and Netflix, changed these markets dramatically. Anderson describes the benefits of long tail availability as follows, “A hit and a miss are on equal economic footing, both just entries in a database called up on demand, both equally worthy of being carried...Suddenly popularity no longer has a monopoly on profitability.” Anderson’s big prediction for this new market characteristic is that niche products will garner a

larger market share, “Combine enough non-hits on the long tail and you’ve got a market bigger than the hits.” In order for this effect to occur, he did acknowledge that niche products need to coexist with superstars in order to get customers in the digital front door. Customers then are guided to niche content that they will likely enjoy, and in the process made to feel more like individuals. This prediction has been questioned on philosophical grounds as well as in practice.

4.3.2 Superstar Effect vs. The Long Tail in Practice

Contrary to Anderson’s predictions, over the last decade there is evidence that the relative importance of superstars has shifted in varying degrees in different media markets, with a consistent trend of positive growth in market share across them. This evidence supports the dominant counter prediction about the long tail effect, spearheaded by Anita Elberse of Harvard Business School, that superstars become even bigger in the digital retail market space. Elberse published the book, Blockbusters: Hit-making, Risk-taking, and the Big Business of Entertainment in 2013, which was partly intended as a response to Anderson’s Long Tail argument. Using case studies she, “...demonstrates[s] that popular culture remains big business, and that, in an increasingly complicated and unpredictable cultural marketplace, hits are more dominant than ever.” Elberse asserts that these results have revealed the tendency of consumers to follow the herd, stating, “...we would rather lump than split.” In part she attributes this trend toward bigger superstars to firm policy that reacted to the expansion of consumer choice. More choices pressured the, “...big media companies to create grand spectacles that bring us together.” She asserts that if firms did not follow this

policy, they would witness their market share diminish. So superstars have inherently been changed as a result of living in a long tail world.

Data from the market for books supports Elberse's assertions. Marcello Vena, a media industry analyst, although acknowledging that Anderson's concept of the long tail assertion is valid, argues that in the book market, supply will eventually outweigh demand. In his view demand in this market is partly determined by the high opportunity costs of reading a book. Although more niche products are available with infinite inventory retailers, the amount of time consumers are willing to give up to read books is not increasing. He asserts that expanding the selection was bound to lead to an oversupply problem. Vena's data demonstrated that the tail is getting less relevant as the digital market grows. Although both superstars and niche products are increasing in sales, head sales (superstars) are growing more. Another interesting market characteristic he observed is an inverse correlation between competition in ebook retailers and the Long Tail effect, where decreasing competition lead to growth in long tail revenues (2015).

A recent music industry consultancy report titled The Death of the Long Tail summarized empirical evidence with the main finding being that superstar products' collective market share has increased. "The top 1% account for 75% of CD revenues but 79% of subscription revenue. This is attributed to two factors. One is the diminished front end display, especially on mobile devices, and the other is the "tyranny of choice", the idea that excessive choice actually hinders discovery.

(Mulligan 2015) Thus in this case it's the opportunity cost of searching that hinders the market from having the Anderson long tail effect.

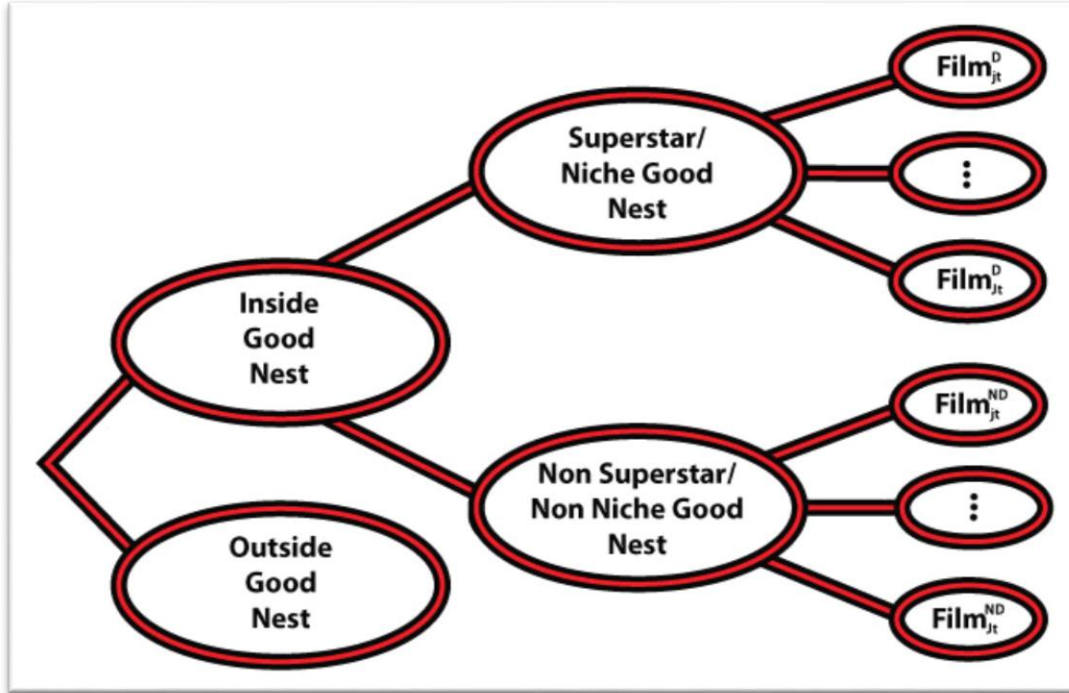
4.3.3 Home Entertainment Rental Market's Long Tail

The home entertainment market for film rentals where the long tail effect is clearly present has been exhibiting different behavior than the book and music markets. Netflix, the infinite inventory retailer with the largest market share for disc rentals, is an example of this. Although the home entertainment market is declining due to the continuing transition from disc to digital, Netflix's long tail selection places it in a less vulnerable position than content exhibitors that stick to offering mostly hits.

Netflix generated \$89 million in the fourth quarter of 2014 in profit from disc rentals, more than 50% of the company's operating income (Gruenwedel 2015). The CFO was quoted as saying, "I continue to believe that the DVD business is going to have a long tail." He attributes this in part to the subscribers in rural areas as well as cinephiles. Although he acknowledged there has been an overall year-over-year attrition rate for physical discs, it's currently holding steady (Sanneh 2013).

The consistency of Netflix's success may be attributed to the nature of the content, as well as the efficiency of their recommender systems. The opportunity cost of viewing a film is severely less than that of a book. Plus the duration and complexity of a film give the content more of a unique fingerprint making recommender systems able to connect tastes to content more efficiently than in the market for music.

Figure 4.1 – Long Tail Two Level Nested Logit Model Schematic Diagram



Note: The superscript *D* denotes the either a superstar or niche film (depending on the analytical iteration). The superscript *ND* denotes films that are not superstars or niche films.

4.4 Model

I again employ the nested logit model to study the nature of the long tail in home entertainment markets. Figure 4.1 shows the schematic for this chapter's version of the nested logit model. This section describes measures used to study the long tail and presents the final derived model used for the empirical work in this chapter.

4.4.1 Superstar/ Niche Observables

Equation 14,

$$\alpha_i = \alpha_1(\text{Superstar Dummy})_t + \alpha_2(\text{Niche Dummy})_t \quad (14)$$

shows the components of α to be (in the same order as above) a dummy indicating if a film is a superstar and a dummy signifying if a film falls into the niche category.

That covers all the individual utility components of the workhorse-model for the empirical work. Putting all of them together in equation form in the inverted market share formula yields the model that was estimated

$$\begin{aligned}
\ln s_{it} - \ln s_{0t} = & \beta_1[\log(\text{box office})]_i + \beta_2(\text{genre dummy})_i \\
& + \beta_3(\text{MPAA dummy})_i + \beta_4[\log(\text{user reviews})]_i \\
& + \beta_5[\log(\text{critic reviews})]_i + \beta_6(\text{sequel dummy})_i + \rho(\delta_{it}) \\
& + \alpha_1(\text{Superstar Dummy})_t + \alpha_2(\text{Niche Dummy})_t \\
& + \gamma_1(\text{time trend})_t + \gamma_2(\text{season dummy})_t \\
& + \gamma_3[\log(\text{theatrical competition})]_t \\
& + \gamma_4(\text{gdp growth rate})_t + \gamma_5[\log(\text{unemployment rate})]_t \\
& + (1 - \lambda_k \lambda_m) \ln s_{i|B_k,t} + (1 - \lambda_m) \ln s_{B_k|D_m,t} + \varepsilon_{it}
\end{aligned} \tag{15}$$

The OLS model used for the first part of the analysis is a variation on this model with the dependent variable being the log of units rented, and without the market share covariates.

4.5 Data

Section 4.5.1 has information on the time frame chosen for the analysis. Then section 4.5.2 provides information on data sources for all other measures used (sourced outside of the two main sources mentioned in chapter 1).

4.5.1 Time Frame

The analytical time frame begins the week of March 3rd, 2008 and ends the week of September 24, 2012. There are 239 weekly time periods in the data. The time frame, which was mainly dictated by the variation of data source availability faced by Rentrak, is central to establishing the conditions for the natural experiment analyzed in this paper. Specifically, from May of 2010 to October of 2012 Rentrak only has data from brick-and-mortar stores. Prior to this time period, from 2005 – April of 2010 their data is sourced from both brick-and-mortar stores and SVOD (ie Netflix). For the sake of symmetry I chose to include roughly the same amount of time periods prior to May of 2010, choosing the week of March 3rd, 2008 as the starting week to analyze the long tail effect on the market.

4.5.2 Ancillary Data Sources

This section details the ancillary data sources used. Namely the designation of a niche film or superstar film, the gdp growth rate and the unemployment rate, the market share, the degree of theatrical market competition, the user and critic reviews, the video release date and genre all required extra data sources outside of the Rentrak data set. Rotten Tomatoes⁴⁸ and Box Office Mojo⁴⁹ served as the main source of these ancillary numbers.

Films were coded as niche if a film had received a theatrical release in 1500 theaters or less. Films were given the superstar designation if they earned 100 million

⁴⁸ <http://www.rottentomatoes.com/>

⁴⁹ <http://boxofficemojo.com/>

or more in their domestic theatrical run. Box Office Mojo was the source for this information. The economic indicator variables, the gdp growth rate and the unemployment rate were both sourced from the bureau of economic analysis. The U.S. population weekly numbers⁵⁰ used for the market share were generated from a linear interpolation from annual points. A linear relationship was assumed between three annual population numbers.

The theatrical market competition data comes from BoxOfficeMojo.com. The site provides data on a variety of aspects of the theatrical market including historical data for the weekly total box office revenue from the top twelve grossing films. The log of this number was used in my analysis.

The user and critic review measures were taken from RottenTomatoes.com. The user review is the percentage of users that have given a film a rating of 3.5 or higher on a scale of 1 to 5. It compiles reviews from upwards of 45,000 individual users. The critic measure is the percentage of approved professional critics who have given the film a positive review. The measure generally aggregates reviews from around 150-250 critics.

Genre was coded from both Box Office Mojo and Rotten Tomatoes

4.6 Results

The results of the ordinary least squares (OLS) analysis and the two stage least squares (2SLS) analysis are presented in tables 4.1 and 4.2 respectively. The OLS

⁵⁰ This data was sourced from the US census bureau

Table 4.1: Ordinary Least Squares Results

	Blu-ray	DVD
Dependent Variable	(1)	(2)
	Log Blu-ray Rental Units	Log DVD Rental Units
Niche	1.3146*** (.0601)	-.4321*** (.0537)
Long Tail Effect on Niche	-.3405*** (.0284)	.0291 (.0247)
Superstar	-1.1680*** (.0614)	-.3851*** (.0606)
Long Tail Effect on Superstar	.4920*** (.0297)	.0922*** (.0285)
Long Tail	.3934 (.0146)	.6246*** (.0140)
Decay	-.0154*** (.0001)	-.0167*** (.0001)
ln Box Office	.3124*** (.0040)	.4513*** (.0032)
Comedy	-.3934*** (.0085)	-.0814*** (.0086)
Documentary	-.8311*** (.0253)	-.6935*** (.0120)
Drama	-.2424*** (.0086)	-.0532*** (.0087)
Family	-.2398*** (.0140)	.1861*** (.0129)
Horror	-.3960*** (.0120)	-.1132*** (.0118)
Romantic Comedy	-.3949*** (.0134)	-.1022*** (.0136)
ln User Reviews	-.0251** (.0109)	.1394*** (.0101)
ln Critic Reviews	.0204*** (.0049)	-.0735*** (.0043)
PG	.0256 (.0163)	.0305*** (.0165)
PG-13	.2486*** (.0181)	.3342*** (.0183)
R	.3894*** (.0185)	.5091*** (.0186)
NC-17	1.3607*** (.1409)	1.0352*** (.1323)
Not Rated	.2625*** (.0231)	-.3274*** (.0260)
Sequel	-.1103*** (.0098)	-.0800*** (.0093)
Time Trend	-.0049*** (.0001)	-.0050*** (.0001)
GDP Growth Rate	.0054*** (.0014)	-.0038*** (.0014)
Log Unemployment Rate	.0905*** (.0269)	-.4224*** (.0272)
Summer	-.0584*** (.0075)	-.0711*** (.0071)
Autumn	.0387*** (.0080)	-.0722*** (.0080)
Winter	.0274*** (.0086)	-.0080 (.0078)
Log Theatrical Competition	.0110 (.0084)	-.0589*** (.0080)
Constant	7.0440*** (.1708)	9.9751*** (.1638)
Observations	115394	148204
R-Squared	.6830	.7321

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%; *significant at 10%. The omitted genre is action. The omitted rating is G.

Table 4.2: Two Stage Least Squares Results

	Blu-Ray				DVD			
	Superstar		Niche		Superstar		Niche	
	(1) No Long Tail	(2) Long Tail	(3) No Long Tail	(4) Long Tail	(1) No Long Tail	(2) Long Tail	(3) No Long Tail	(4) Long Tail
Niche			1.4008*** (.1867)	.2885 (.3326)			-.2448** (.1254)	-.2514* (.1458)
Superstar	.0444** (.0214)	-.0086 (.0507)			-.3183*** (.0202)	-.0905** (.0377)		
$\ln S_{il\beta_k}$	.1008*** (.0234)	.8238*** (.0446)	.1242*** (.0257)	.7673*** (.0493)	.9435*** (.0352)	.4870*** (.0604)	.9573*** (.0330)	.5055*** (.0876)
$\ln S_{BklDm}$	.1538*** (.0134)	.7704*** (.0391)	.1957* (.1072)	.9247*** (.1864)	.6575*** (.0239)	.5676*** (.0649)	.8298*** (.0330)	.6210*** (.0876)
Decay	-.0133*** (.0004)	-.0039*** (.0011)	-.0130*** (.0004)	-.0051*** (.0157)	-.0009 (.0147)	-.0122*** (.0021)	-.0007 (.0005)	-.0118*** (.0021)
$\ln$ Box Office	.2889*** (.0087)	.0511*** (.0148)	.2731*** (.0093)	.0670*** (.0157)	.0236 (.0147)	.2727*** (.0464)	.0172 (.0140)	.2632*** (.0470)
Comedy	-.3948*** (.0140)	-.0453** (.0202)	-.3815*** (.0148)	-.0893*** (.0204)	-.0088 (.0104)	.0288 (.0192)	-.0061 (.0102)	.0285 (.0191)
Documentary	-.7902*** (.0342)	-.1438** (.0716)	-.7559*** (.0351)	-.2047*** (.0729)	-.0519 (.0372)	-.1143*** (.0413)	-.0387 (.0357)	-.1095*** (.0413)
Drama	-.2729*** (.0119)	-.01560 (.0171)	-.2583*** (.0123)	-.0216 (.0170)	-.0082 (.0130)	.0462** (.0202)	-.0054 (.0102)	.0459** (.0202)
Family	-.2221*** (.0169)	-.0205 (.0268)	-.2159*** (.0171)	-.0253 (.0269)	.0146 (.0166)	.0207 (.0266)	-.0120 (.0164)	.0188 (.0266)
Horror	-.3113*** (.0154)	-.0964*** (.0364)	-.2952*** (.0158)	-.1283*** (.0380)	-.0074 (.0126)	-.1151*** (.0334)	-.0035 (.0127)	-.1098** (.0335)
Romantic Comedy	-.4434*** (.0189)	-.0018 (.0233)	-.4267 (.0197)	-.0076 (.0233)	-.0117 (.0156)	.0348 (.0291)	-.0076 (.0155)	.0335 (.0290)
$\ln$ User Reviews	.0747*** (.0126)	-.0519** (.0249)	.0775*** (.0126)	-.0741*** (.0260)	.0176 (.0143)	-.0059 (.0215)	.0132 (.0140)	-.0086 (.0215)
$\ln$ Critic Reviews	-.0313*** (.0058)	.0217** (.0103)	-.0314*** (.0058)	.0319*** (.0108)	-.0097 (.0071)	.0271*** (.0093)	-.0075 (.0069)	.0086 (.0215)
PG	-.01102 (.0197)	.0245 (.0267)	-.0062 (.0194)	.0220 (.0268)	.0123 (.0212)	.2423*** (.0467)	.0086 (.0211)	.2340*** (.0506)
PG-13	.1751*** (.0222)	.0843** (.0367)	.1763*** (.0218)	.0984*** (.0375)	.0142 (.0235)	.3005*** (.0598)	.0106 (.0234)	.2897*** (.0607)
R	.2901*** (.0234)	.1320** (.0446)	.2872*** (.0233)	.1548*** (.0462)	.0232 (.0267)	.4100*** (.0758)	.0176 (.0265)	.3944*** (.0770)
NC-17	1.0760*** (.1418)		1.2278*** (.1405)		.1357 (.1388)		.1213 (.1370)	
Not Rated	.1285*** (.0000)	.1315*** (.0528)	.1298*** (.0271)	.1660*** (.0545)	-.0144 (.0309)	-.2434*** (.0644)	-.0116 (.0308)	-.2307*** (.0637)
Sequel	-.0870** (.0116)	-.0276 (.0184)	-.0856*** (.0116)	-.0297 (.0184)	-.0021 (.0102)	-.1041*** (.0258)	.0000 (.0102)	-.0996*** (.0263)
Time Trend	-.0071*** (.0003)	.0059*** (.0012)	-.0067*** (.0004)	.0058*** (.0014)	-.0125*** (.0004)	-.0014* (.0008)	-.0124*** (.0004)	-.0024*** (.0008)
GDP Growth Rate	-.0114*** (.0027)	-.0222*** (.0035)	-.0088*** (.0030)	-.0211*** (.0037)	.0225*** (.0029)	-.0057** (.0024)	.0262*** (.0029)	-.0054*** (.0025)
Log Unemployment	-.9612*** (.2255)	.5477*** (.0979)	-1.2093*** (.2205)	.3680*** (.1071)	-2.6813*** (.2015)	-.3706*** (.0834)	-2.5137*** (.1961)	-.3757*** (.0860)
Rate								
Summer	-.1216*** (.0085)	-.0388** (.0197)	-.1195*** (.0084)	-.0192 (.0213)	-.1006*** (.0077)	-.0858*** (.0203)	-.1070*** (.0079)	-.0801*** (.0221)
Autumn	.0416*** (.0101)	-.0143 (.0230)	.0397*** (.0116)	.0275 (.0295)	-.0772*** (.0102)	-.1286*** (.0178)	-.0751*** (.0109)	-.1214*** (.0220)
Winter	.0495*** (.0173)	.0515** (.0515)	.0502*** (.0109)	.0646*** (.0231)	.0731*** (.0103)	-.0098 (.0200)	.0763*** (.0103)	-.0043 (.0202)
Log Theatrical	.0070 (.0099)	.1703*** (.0166)	.0139 (.0104)	.1971*** (.0197)	.0277*** (.0097)	.0884*** (.0193)	.0149 (.0098)	.0887*** (.0208)
Competition								
Constant	-9.1702*** (.6223)	-11.1124*** (.4255)	-8.675*** (.6274)	-11.5167*** (.4576)	2.7875*** (.6236)	-7.9151*** (.6134)	2.8143*** (.6035)	-7.6984*** (.5856)
Observations	89010	26384	89010	26384	106925	41279	106925	41279
R-Squared	.6080	.5673	.6132	.5689	.6772	.6117	.6773	.6121

Note: Robust standard errors in parentheses. *** significant at 1%; **significant at 5%;*significant at 10%. The omitted genre is action. The omitted rating is G.

model was used to understand the effect that long tail availability has had on the market performance of niche and superstar films. The 2SLS nested logit model was used to

identify the substitutability of niche and superstar products in both the market with and without long tail availability. The most significant result is that superstars are becoming bigger due to the long tail in these markets.

This final section covers the results in the following manner. Section 6.1 discusses general results from the models. Section 6.2 then provides detailed insight into the long tail specific results.

4.6.1 General Results

Before covering the central results in more detail, I provide some observations about the overall performance of the models used. Both the OLS and the 2SLS models performed well and deserve some mention. The film characteristics that captured between variation have a few interesting results worth commenting on as well. Lastly there are some notable behaviors of the seasonal variables that are also thrown in for good measure.

OLS and 2SLS

The OLS results are consistent with Ferri (2013) that employed a similar empirical approach. The overall variation explained by the model are upwards of 68% which is in line with Ferri's models for rental units. The overall variation captured by the 2SLS model is also consistent with Chiou (2008) for the most part. The results are less in line with her model explaining 93% variation and my model explaining upwards of 56%. I attribute this difference to the difference in our data sets.

Between Variation

The proxy for unobserved quality, the log of a film's theatrical box office, proved to be positive and very significant in every market, in both models, except in the 2SLS dvd no long tail subset. This could be attributed to the fact that these are the lowest value consumers of film, that likely do not keep up with theatrical releases, and thus would be unaffected by the success of a film in the theatrical box office. This is in contrast to the same consumers in the long tail setting, where the selection is much bigger, giving them more incentive to either make more informed searches, or to be more informed about the big theatrical releases due to automated word of mouth recommender systems' algorithms. The same logic can be applied to the decay variable, which had the same consistent significance but in the negative direction, in all models and data sets except for the dvd no long tail set. These same consumers, in brick-and-mortar rental markets are less likely to be sensitive to the newness of a film. In a long tail setting, recommender systems likely prioritize newer releases making the decay in utility of an older release a significant explanatory variable for this market.

The genre and rating variables overall, behaved as expected.

Sequel status was found to be negative and significant in both dvd and blu-ray markets in the OLS analysis, but only negative and significant in the blu-ray data set in the 2SLS analysis. Consistent with Axarlian (2014), the negative sign could signify is that '*franchise fatigue*', where consumers experience diminishing returns on an ongoing storyline, is present in rental film markets.

The final film characteristics worth commenting on are the word of mouth measures. Both seem to have varying results across the models and data subsets. For high value consumers, critic reviews had a positive significance in the OLS analysis. This implies that high value consumers tend to be more informed about professional opinion with respect to the choices they make. Looking closer at the data set via the 2SLS analysis reveals this same direction of significance only in the long tail setting. In the non-long tail market for blu-ray rentals the critic reviews have a negative impact. This result could reflect that fact that in a non-long tail setting, the selection is limited and there are no recommender systems which may cause the relative value of a film to be greater than for one in the long tail setting. Thus, if a film is valued highly by professional critics, this may prompt individuals to purchase films rather than rent them. Given these are high-value consumers (blu-ray renters), a marginal increase in utility could conceivably change one's behavior to buy versus rent. If this is true, then it implies that a long tail setting, with respect to critic reviews, lowers firm revenues by prompting these consumers to rent. More work on the effect of the long tail on the decision to rent versus buy would be interesting to pursue. With respect to low value consumers, the results are less clear. In the OLS analysis, this covariate proved to be negative and significant. This result is not consistent with the results of the 2SLS analysis, making any inference inconclusive. The user reviews had opposing signs in the OLS analysis to the critic reviews, with a similar pattern of consistency in the 2SLS analysis.

Within Variation

Within variation is measured in seasonality, competition and economic conditions. The results of each set of variables across the analysis are detailed below.

The calendar seasons mostly demonstrate significance in this market. The OLS results are mainly consistent with the 2SLS results across formats as well as with no significance found in the low value market in OLS, and again in the long tail DVD 2SLS analysis. Although there is some variation in the results, it's not enough to make any significant inference about with regard to the long tail.

As far as the theatrical competition variable goes, the results are inconclusive.

The time trend is negative and significant across all data sets making it the most consistent result in this set of variables. It clearly demonstrates the trend discussed in the industry section, in which overall revenues from rental markets have been declining over the course of the time period of interest. It is also consistent with Elberse (2007) result for her time trend.

Finally, the economic variables capturing the changes in the overall economy, included to reflect the turbulent nature of the business cycle over the time period of interest, are all significant. Although there is no pattern that would suggest some characteristic of the long tails effect on these markets with respect to the bigger economy, their inclusion makes the model more robust in explanatory power.

4.6.2 Long Tail Effects on Niche and Superstar Films

Starting with high value consumers' niche consumption behavior, the OLS analysis suggests that these consumers tend to decrease their niche consumption in a long tail setting. This result is supported by the 2SLS analysis which demonstrates that there is a drop in niche consumption across marginal effects from the non-long tail to the long tail data sets. The long tail result though is not statistically significant making the result not completely robust. Regardless, the analysis does suggest that high value consumers decrease their consumption of niche products in a long tail setting.

The behavior of these consumers with respect to superstar consumption is also not robust across models, but does again suggest a pattern of behavior. The OLS results show a significant and positive effect on superstar consumption for high value consumers in a long tail setting. The 2SLS results are inconclusive. Again, one can infer from the analysis that these consumers increase their consumption of superstars in a long tail setting.

The results for low value consumers are also somewhat muddy across models, but do suggest a more consistent pattern of behavior than for high value consumers. With respect to niche products, across both models there does not appear to be any change in the consumption of these films when introducing long tail availability. The strongest result across both consumer types and models is with respect to the consumption pattern of low value consumers of superstar films in a long tail setting.

Table 4.3 - Log-Sum Coefficient Results

Blu-ray/ High Value Consumers				
	No Long Tail λ_k	Long Tail λ_k	No Long Tail λ_{IN}	Long Tail λ_{IN}
Niche	1.0889	3.0881	.0753	.8043
Superstar	1.0626	.7677	.8462	.2296
DVD/ Low Value Consumers				
	No Long Tail λ_k	Long Tail λ_k	No Long Tail λ_{IN}	Long Tail λ_{IN}
Niche	.2509	1.3046	.1702	.3760
Superstar	.1649	1.1862	.3425	.4324

Specifically, across both the OLS and 2SLS models, the consumption of superstars had a significant increase in a long tail setting.

In summary, it appears that in these markets the long tail has led to increased consumption of superstar products. Although it cannot be confidently stated that niche products had a drop in consumption in a long tail setting, it is clear from the results that there was no observable increase in the consumption of niche products. This result is consistent with the Elberse assertion as well as the trends found in online book and music markets.

More insight into these relationships is revealed by the measures of substitutability provided by the nested logit model. Most importantly is the fact that there is no observable relationship between substitutability of a product type and a change in long tail availability.

First of all, as table 4.3 shows, the inside good is highly substitutable relative to the outside good, which is consistent with Chiou (2008) and Einav (2007). Of higher relevance is the degree of substitutability within the superstar and niche nests. For high value consumers, niche products had no change in substitutability in a long tail setting.

Table 4.4 – Results Summary

	Blu-ray / High Value Consumers			DVD / Low Value Consumers		
	Non-Long Tail Market	Long Tail Market	Long Tail Effect	Non-Long Tail Market	Long Tail Market	Long Tail Effect
Niche Films	Not Substitutes	Not Substitutes	Decreased Market Share	Substitutes	Not Substitutes	No Change in Market Share
Superstar Films	Not Substitutes	Substitutes	Increased Market Share	Substitutes	Not Substitutes	Increased Market Share

High value consumers do not view these products as substitutes in either market setting. Superstar products on the other hand are observed to go from not being substitutable in a non-long tail market setting to being substitutable with long tail availability. For low value consumers, both superstars and niche products are very substitutable in a non-long tail setting, and loose that substitutability in a long tail setting.

Combining the results (summarized in table 4.4) paints a complex picture that can be explained by considering the subject positions of the consumers in each market they choose to engage in. High value consumers are consumers that value the viewing of a film enough to purchase the most sophisticated home exhibition technology (blu-ray player). Thus these consumers value films enough that in a non-long tail settings, they tend to view a majority of the films available, which is limited by physical shelf space. Thus, if a film were to no longer be available, regardless of the film type (niche, superstar, other), the likelihood of choosing any other film is the same, since film itself is what these consumers value. In a long tail market, where recommender systems are able to provide automated word of mouth, and the selection of superstar films, as well as the in-between-films (neither niche nor superstar), is much larger. This results in these film lovers becoming more selective about the films they choose to consume. Thus niche films are consumed less than before and superstar films are consumed more.

Superstar films become more substitutable, since these are the films that tend to have the most conventional enjoyable elements that the average consumer enjoys in a film.

Low value consumers in a non-long tail setting that are casual film consumers, view superstars and niche films as substitutes within their respective nests. If a superstar film is unavailable, these consumers are more likely to choose another superstar film than one that is not a superstar film. The same pattern is observed within the niche nest of films. If a non-niche film is chosen, they are more likely to choose another non-niche film than one that is niche. Essentially, with a limited selection, and a limited amount of films consumed, product type factors heavily into the consumption decision. These same consumers in a long tail setting, which in this case is the infinite inventory retailer of film rentals, Netflix, no longer have a limited selection to choose from where films are easily identified within their respective categories (niche, superstar, other). Instead, recommender systems help these consumers to consume the films they prefer most, which are not necessarily superstars, nor niche films. If a particular superstar film became unavailable then the chances of any other film being chosen is the same for all films available. Thus, niche films are chosen as much as they were before. The portion of consumers that preferred niche films in a non-long tail setting and are put into a long-tail setting, they continue to choose the same films they chose before, which is why niche market shares are not affected. Superstars wind up with increased market shares because these are the films that are most known, considered the most entertaining by the average filmgoer, and are likely highly prioritized in the recommender system algorithm.

Thus, as was demonstrated, the relationship between substitutability, product type, and long tail availability is determined by how much the consumer values the product in this market. There is no obvious pattern, but the results have a reasonable logic tying them together.

The most robust result from the analysis is the one that is more relatable to the existing literature and industry analysis. It is clear that superstars are becoming even bigger hits which implies that Anderson's original conception of the long tail effect did not completely take into account all aspects of the market changes. It's likely that Elberse's argument that studios are making better superstars to remain competitive against the larger selection of niche products, is the actual nature of the long tail effect in the long run.

4.7 Conclusion

Understanding the effects of the digital revolution on media markets has been and continues to be the best way for firms that operate in these markets to adapt and thrive. It is becoming clear that the long tail is a complex phenomenon that has varying results in varying market settings. The analysis in this paper has served to provide more insights into the effects which mainly support the dominant trend.

There are several other methods of distribution that have also been introduced which are playing a role in these markets. Specifically, there's the introduction of more SVOD services, like Hulu Plus and Amazon prime which are increasing competition in the SVOD markets. Their effects on the long tail effect are of interest and should be

explored as well. Unfortunately I did not have access to data from these sources for this paper.

The fact that superstars are becoming even bigger hits reflects a possible trend in media markets for the nature of consumption to remain closer to the pattern observed before the digital revolution. It would make sense that initially, during the scramble to adapt to change, and the lack of knowledge of the average consumer of new consumption options, that new patterns be observed. Over time though, once the novelty wears off, and the necessary information pervades every consumer's awareness, that consumption patterns will settle into an equilibrium that is naturally occurring, regardless of the state of technology. More work into this insight is necessary and should help the firms in these industries to continue to optimize profits.

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Appendix A⁵¹

In this appendix I derive the relationship between a film's market share and its attributes.

Let the set of u alternatives be partitioned into M nests with non-overlapping subsets denoted

$$C_1 = \textit{Inside Good}$$

$$C_2 = \textit{Outside Good}$$

Let the set of j films be partitioned into K non-overlapping subsets denotes

$$B_1 = \textit{Durable Nest}$$

$$B_2 = \textit{Non - Durable Nest}$$

Let λ_m denote the degree of independence among alternatives in nest C_m .

Let λ_k denote the degree of independence among alternatives in nest B_k .

Let the probability of choosing alternative $i \in B_k$ be expressed as the product of two probabilities

$$P_i = P_{j|B_k} \cdot P_{B_k} \tag{A1}$$

⁵¹ Time subscripts have been left out for simplicity

where $P_{j|B_k}$ is the conditional probability of choosing a film given that a durability nest has been chosen and P_{B_k} is the marginal probability of choosing a durability nest. Further let the probability of choosing a durability nest be expressed as the product of two probabilities

$$P_{B_k} = P_{B_k|D_m} \cdot P_{D_m} \quad (A2)$$

where $P_{B_k|D_m}$ is the conditional probability of choosing a durability nest given that a type of good nest has been chose and P_{D_m} is the marginal probability of choosing a type of good (either inside or outside). Combining A1 and A2 decomposes the probability of choosing a film into two conditional probabilities and one marginal probability

$$P_i = P_{j|B_k} \cdot P_{B_k|D_m} \cdot P_{D_m} \quad (A3)$$

each of which take the form of logit⁵² probabilities.

Mean utility can be expressed as

$$U_i = \delta V_i + \theta W_g + \tau Y_v + \varepsilon_i \quad (A4)$$

where

$$\delta V_i = \beta X_i - \rho(t - r_i)$$

, are the variables that describe film j ,

⁵² Logit probabilities are derived from the assumption that the idiosyncratic error is distributed extreme value allowing for a closed form solution for the choice probability.

$$\theta W_g = \alpha_i$$

describe nest k and

$$\tau Y_v = \gamma$$

describe nest m.

Given this specification, the probabilities can be expressed as

$$P_{j|B_k} = \frac{e^{\frac{\delta V_i}{\lambda_k \lambda_m}}}{\sum_{j \in B_K} e^{\frac{\delta V_j}{\lambda_k \lambda_m}}}$$

$$P_{B_k|D_m} = \frac{e^{\frac{\theta W_h + \lambda_k I_k}{\lambda_m}}}{\sum_{g \in D_m} e^{\frac{\theta W_g + \lambda_k I_k}{\lambda_m}}}$$

and

$$P_{D_m} = \frac{e^{\tau Y_l + \lambda_m I_m}}{\sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m}}$$

where

$$I_k = \ln \sum_{j \in B_K} e^{\frac{\delta V_j}{\lambda_k \lambda_m}}$$

and

$$I_m = \ln \sum_{g \in D_m} e^{\frac{\theta W_g}{\lambda_m} + \lambda_k I_k}.$$

Thus the probability of choosing a film is

$$P_i = \frac{e^{\frac{\delta V_i}{\lambda_k \lambda_m}}}{\sum_{j \in B_K} e^{\frac{\delta V_j}{\lambda_k \lambda_m}}} \cdot \frac{e^{\frac{\theta W_h}{\lambda_m} + \lambda_k I_k}}{\sum_{g \in D_m} e^{\frac{\theta W_g}{\lambda_m} + \lambda_k I_k}} \cdot \frac{e^{\tau Y_l + \lambda_m I_m}}{\sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m}}$$

Since all consumers come from the same distribution, it is equivalent to write the above probabilities in terms of a film's market share

$$s_i = S_{j|B_k} \cdot S_{B_k|D_m} \cdot S_{D_m}$$

Thus the market share for film i is

$$s_i = \frac{e^{\frac{\delta V_i}{\lambda_k \lambda_m}}}{\sum_{j \in B_K} e^{\frac{\delta V_j}{\lambda_k \lambda_m}}} \cdot \frac{e^{\frac{\theta W_h}{\lambda_m} + \lambda_k I_k}}{\sum_{g \in D_m} e^{\frac{\theta W_g}{\lambda_m} + \lambda_k I_k}} \cdot \frac{e^{\tau Y_l + \lambda_m I_m}}{\sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m}}$$

with its log being

$$\ln s_i = \frac{\delta V_i}{\lambda_k \lambda_m} - I_k + \frac{\theta W_h}{\lambda_m} + \lambda_k I_k - I_m + \tau Y_l + \lambda_m I_m - \ln \sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m}. \quad (A5)$$

The within group share of film j in durability group k is

$$s_{j|B_k} = \frac{e^{\frac{\delta V_i}{\lambda_k \lambda_m}}}{\sum_{j \in B_K} e^{\frac{\delta V_j}{\lambda_k \lambda_m}}}$$

with its log being

$$\ln s_{j|B_k} = \frac{\delta V_i}{\lambda_k \lambda_m} - I_k. \quad (\text{A6})$$

The within group share of durability nest k of the inside group nest is

$$s_{B_k|D_m} = \frac{e^{\frac{\theta W_h}{\lambda_m} + \lambda_k I_k}}{\sum_{g \in D_m} e^{\frac{\theta W_g}{\lambda_m} + \lambda_k I_k}}$$

with its log being

$$\ln s_{B_k|D_m} = \frac{\theta W_h}{\lambda_m} + \lambda_k I_k - I_m. \quad (\text{A7})$$

Assuming the utility of the outside good is 0, then the share of the outside good is

$$s_{D_o} = \frac{e^0}{\sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m}} = \frac{1}{\sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m}}$$

the log of which is

$$s_{D_o} = -\ln \sum_{v \in \{IN, O\}} e^{\tau Y_v + \lambda_m I_m} \quad (\text{A8})$$

Subtracting the log of the outside good market share s_{D_o} from the inside good market share s_i , we have

$$\ln s_i - \ln s_o = \frac{\delta V_i}{\lambda_k \lambda_m} - I_k + \frac{\theta W_h}{\lambda_m} + \lambda_k I_k - I_m + \tau Y_l + \lambda_m I_m \quad (\text{A9})$$

Rearranging A6 yields an expression for I_k

$$I_k = \frac{\delta V_i}{\lambda_k \lambda_m} - \ln s_{j|B_k} \quad (\text{A10})$$

Rearranging A7

$$I_m = \frac{\theta W_h \delta V_i}{\lambda_m} - \lambda_k \ln s_{j|B_k} - \ln s_{B_k|D_m}$$

and plugging in A10 yields an expression for I_m

$$I_m = \frac{\theta W_h}{\lambda_m} + \lambda_k I_k - \ln s_{B_k|D_m}. \quad (\text{A11})$$

Plugging A10 and A11 into A9 and simplifying yields the expression the derivation was targeting

$$\begin{aligned} \ln s_i - \ln s_o &= \delta V_i + \theta W_h + \tau Y_l + (1 - \lambda_k \lambda_m) \ln s_{j|B_k} \\ &\quad + (1 - \lambda_m) \ln s_{B_k|D_m} \end{aligned} \quad (\text{A11})$$

Appendix B – Supplementary Figure

Figure B1- UltraViolet Slip

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