The Growing Threat of Internet Piracy in the Movie Industry:

The Effect of Rapid Pirated Leaks on Motion Picture Revenues

An Honors Thesis for the Department of Economics

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Abstract

In 2005, the MPAA claimed that worldwide losses to movie piracy amounted to about $18.2 billion, with $6.1 billion of that missing revenue accounted for by MPAA affiliates alone. The difficulty in measuring piracy is that it is obviously illegal, making data collection and participant surveys skewed in results. In addition, the movie industry is a complex system, and any given movie has a large variability of success factors which amount to unpredictability in the expected revenue of motion pictures. This paper seeks to investigate how the speed of internet piracy affects industry revenues by creating a model for film revenue regressed against the number of days from theatrical release to first piracy leak, first screener leak, and first DVD leak, amongst several control variables. When including control variables, the impact of piracy is found to be negligible, particularly in comparison to the production budget variable. Without these controls, significance is found for days until first piracy leak and screener leak, implying the more days until first piracy leak the lower revenues will be and that more days until first screener leak leads to higher revenues, $t(124)=-2.91$, $p<.01$, and $t(124)=3.05$, $p<.01$. Finally, scatter plots of the data find that most films which end up making high worldwide revenues are pirated within the first week after theatrical release.

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I. INTRODUCTION

In 2005, the MPAA claimed that worldwide losses to movie piracy amounted to about $18.2 billion, with $6.1 billion of that missing revenue accounted for by MPAA affiliates alone. The existence of intellectual property piracy arose much earlier than this 2005 report in the form of music pirating, which devastated the record industry and has forced it to change and adapt in order to compete with the new era of technological thievery. Yet, movie piracy and music piracy are not the same. Movies are harder to pirate, more expensive to produce and purchase, and the quality of movie piracy is often dubious at best.

With this threat in mind, researchers in the movie industry and in the academic world have taken to investigating how piracy can affect this worldwide multibillion dollar industry. The difficulty in measuring piracy is that it is obviously illegal, making data collection and surveys skewed in results. In addition, the movie industry is a complex system, and any given movie has a large variability of success factors which amount to unpredictability in the expected revenue of motion pictures. Despite these frustrations, it remains important for the film industry to address the growing threat of piracy as technological progress continues to make piracy an easier activity.

In the past, studies about piracy have been carried out in a variety of innovative ways that have attempted to quantify this nebulous variable. One prevalent method is the use of surveys which question people about their pirating behavior and whether they would have legally viewed a movie if the pirated option were not available (Bounie, 2006; MPAA, 2005; Rafael & Joel, 2005) The most common critique of this method is that surveys are self-reported and participants in studies often falsely report illicit activity despite claims of anonymity. Furthermore, the retroactive claim of legally consuming a film in lieu of the pirated availability is a response that consumers might affirmatively answer but in reality may not have been very likely to have patronized the film, a kind of false 20-20 hindsight bias.

Other studies have attempted to create direct laboratory findings by emulating piracy choices in experiments in order to examine piracy behavior (Walls & Harvey, 2003). Of course, experiments like this are not perfect since the setting is controlled and

participants are well aware that they are in an experiment, meaning that participants likely harbor no fear of being legally reprimanded.

Another method that has been used is simply to accrue data on the availability of piracy and film revenues in order to directly measure the impact of illegal movies (DeVany & Walls, 2007). The largest problem with this is that, as stated above, the film industry is complex and attempting to measure revenue as affected by piracy makes it difficult to account for confounding variables.

The present study seeks to investigate how the speed of internet piracy affects industry revenues. What is meant by speed is the amount of days it takes for a film to be released in pirated form after U.S. theatrical release. For obvious reasons, pirated versions of films are not always available at the same time theatrical releases occur. The length of days from theatrical opening until piracy leaks range from largely negative, meaning the pirated film came out first, to very positive, meaning that the pirated film came out after the movie was no longer available at the box office. This paper will study the impact on revenues caused by this length of time from opening weekend until the option of internet piracy becomes available. Before even reviewing the literature it is a logical statement to say that movies which have early pirate releases are more subject to the negative impact of piracy, while movies that can avoid early piracy will manage to maintain a larger portion of legally deserved profits.

The research in this paper will begin by exploring the trends of the movie industry in order to determine if the movie has begun to struggle in recent years as the rate and ease of piracy, especially internet piracy, is increasing. Afterwards, the paper will investigate the factors that affect the gross revenue of a film using a collection of Oscar nominated films and information regarding how quickly these films were pirated. In this manner, the paper should be able to determine whether speedy piracy releases negatively impact the success of a movie. Admittedly, the pitfalls of measuring piracy in previous research, particularly in this erratic industry, will also apply to the findings of this paper, and like all reports on illegal activity it is important to account for what these findings mean and how they may be over or under counted depending on the context of this study.

In surveying the past data on the movie industry, this paper does indeed find that the film industry's growth has been decreasing in recent years. This decrease is not solely

domestic or foreign, it is a trend that is found throughout the entire world and the same trend is reflected by the MPAA's revenues, which account for about two-thirds to three-quarters of worldwide revenues. When investigating the explicit costs of the speed of piracy this paper finds two interesting and important results. The first is that the trend of days from theatrical release until first piracy leak, which is generally a low-quality copy referred to as 'cam' recordings, is negatively associated with worldwide gross. This means that the faster the movie is pirated, the higher the movie's grosses tend to be, which is the opposite of this researcher's and the literature's predictions of the impact of piracy. On the other hand, the second significant finding shows that there is a positive association between worldwide gross and days from theatrical release until screener leak, which is a higher-quality version of piracy. This finding suggests that film distributors should be cautious about insider leaks that can stem from the release of film screeners, which are generally used for awards ceremonies. Nevertheless, both of these findings disappear in light of the control variables, particularly the control variable of production budget.

The structure of this paper begins with the literature review in section II, which is split into three parts. The first part of the literature review simply explains the movie industry and what factors have been used to predict and influence the success of films in this inconsistent industry. The second part discusses movie piracy, how it occurs, and the effects on the motion picture business. Finally, the literature review discusses what aspects of anti-piracy can be employed in order to combat the spread of piracy and what the industry can hope to do. Section III will then present the data used in the paper and the variety of sources which were used to compose the two different datasets that are used. The paper then moves into section IV, where the theoretical models and expected findings are discussed before analysis. Afterwards, section V discusses the chief findings of the economic analysis and closes with section VI, the conclusion, which summarizes the findings and their implications.

II. LITERATURE REVIEW

a. How the Movie Industry Operates

In November of 1903, *The Great Train Robbery* became the first narrative film presented for audiences in several theaters throughout New Jersey (IMDB, 2008). Since then, the film industry has grown in leaps and bounds as one of the most commonly consumed leisure goods in the United States, pulling larger audiences than theme parks and major sporting events combined (MPAA, 2007; Vogel, 1998). In 2007, the worldwide box office sales reached $26.7 billion, an all-time high for the industry (MPAA, 2007). This growth in box office sales has occurred despite the recent shift in the market towards home video because of the convenience and growth of DVD technology. Currently, home videos account for more than 50% of studio revenues while box office revenues account for about 20% of studio income (MPAA, 2007; Vogel, 1998). Since the industry had its highest worldwide box office year ever in 2007 and that only accounts for about 20% of revenue, it is clear that the entertainment business is booming.

In the United States, there is a corporation that works towards increasing the power and wealth of the film industry: the Motion Picture Association of America, or the MPAA. The MPAA is a non-profit trade association that seeks to advance the business of the film industry. Members include the "Big Six" movie distributors which are Sony Pictures, Paramount Pictures Viacom, 20th Century Fox, Universal Studios, Warner Brothers, and Walt Disney Motion Pictures, which was formerly known as Buena Vista Motion Pictures (MPAA, 2007).

The MPAA was founded in 1922 and originally designed to improve the public image of the film industry. Since that time the MPAA has evolved into tenaciously advocating the necessary protection of privately-owned films (MPAA, 2007). The MPAA and its international counterpart the MPA, or Motion Picture Association, play an active role in copyright infringement and actively pursue anti-piracy activities and awareness programs all over the world. The MPAA regularly releases statistics and research findings in relation to the movie business. In particular relevance to the present paper is the 2005 MPAA Piracy Data Report, which was conducted by LEK Consulting for the

MPAA. The MPAA also releases data on movie-going demographics, admissions, pricing, and revenues.

Between 1995 and 2002 box office sales and ticket prices steadily increased, however, since 2002 box office admissions have begun to decline. This decrease in admissions is offset by a continually increasing ticket price resulting in an approximate 5% increase in box office revenues per year since 2005 (MPAA, 2007). With box office sales growing year to year and DVD sales exceeding a billion units domestically, it is clear that the film industry can be a lucrative source of revenue (MPAA, 2007). That being said, about 70% of the films released actually lose money, 10% break even, and only 20% of movies actually end up making a profit (Vogel, 1998). As a matter of fact, about 40% of the film industry's revenue in a given year is accounted for by the top 20 grossing films out of a pool ranging from 500 to 700 movies. That means that 5% of the films produced in a given year account for 40% of the box office revenues in that year and a huge majority of films only marginally commit to yearly gross industry revenues. Obviously, this means that the films that do succeed tend to wildly do so, seeing massive returns on original investment. These dismal figures largely result from growing production and advertising costs which plague the "all-in or nothing" mentality of Hollywood which throws more and more money into production budgets in hopes of creating the next smash hit (MPAA, 2007).

The general perception of the movie industry is that most money is made at the box office; however, this is far from the truth. In the past, the box office was indeed the greatest source of revenue for distributors, but as home video technology has increased the share of film industry revenue has shifted from the box office to home video sales (Vogel, 1998). In 1999, home video sales generated 16 billion dollars in revenue, which was 55% of MPAA studio revenues for the year, much higher than the 22% revenue share of box office sales (Mortimer, 2005). In the past decade DVD sales has continued to grow, in addition to alternative home media choices such as pay-cable (Mortimer, 2005; MPAA, 2007). The ease of use and market penetration of DVDs has spurned the film industry to grow by 39% between 2000 and 2004. So while discussions about box office profits are the most investigated aspect of the movie industry, it is important to take into account that DVD sales tend to be the main revenue stream of film studios.

The MPAA reports that in 2007 a movie produced by the major 6 distributors, Sony, Disney, Fox, Paramount, Warner Brothers, and Universal, cost an average $71 million dollars to produce and $36 million dollars to advertise. Oftentimes, budgets dwarf film revenues, and 3 of the top 20 grossing movies of all time actually ended up with a deficit (Sedgwick & Pokorny, 1999)! Why is it that distributors pay such excessive amounts of money for their movies?

A study by Boatwright, Basuroy, and Kakamura (2007) indicated that budget was one of the most influential factors in determining movie success, leading to greater opening week revenues and a slower decline in sales. On the other hand, when differentiating between wide-releases, more commonly known as nationwide releases, and platform releases, which open on 500 screens or less, Boatwright et al. (2007) found that budget becomes insignificant for platform release films, which generally have lower production costs to begin with. This implies that the most popular and highly funded movies are highly influenced by the budget variable, but the success of third-party, independent releases are not influenced by their production funding (Boatwright, et al., 2007). Indeed, increasing marginal returns to budget across all other variables explains the constant growth in production costs for blockbusters from year to year (Walls, 2008).

Another reason for the variable rate of success in the film industry is the "nobody knows anything" principle put forth by William Goldman (1983). The "nobody knows anything" principle states that in the unpredictable movie business producers, executives, and critics have no ability to predict what will succeed and what will fail. Considering the 70% rate of failure for films, this statement seems pretty accurate. In DeVany and Walls (1996), the researchers showed that film industry revenue is not distributed as a log normal distribution, because a large group of films cluster together in the negative profit area and then a select few group of films make astronomical profits. DeVany and Walls (1996) propose that film success distribution could be described by the complex Bose-Einstein system in which extreme positive values are possible, but there is a low probability of repeated positive values. This model does indeed reflect the film industry in which there tends to be one dominating film in a year followed by geometrically decreasing movies that perform dissimilarly to one another (DeVany & Walls, 1996).

Since the profitability of films is unpredictably distributed, variability is close to infinite, meaning that it is almost impossible to measure the likelihood of success, and a least-squares regression can lead to errors in gross revenue predictions (Walls, 2005). Instead, it may be easier and more efficient to model film success as a probability distribution, where certain factors make the likelihood of success higher or lower (DeVany & Walls, 1999). Although these factors have high variability, it is possible to maximize the chance of success based on film type and funding amongst several other production variables (DeVany & Walls, 1999). Successful films and unsuccessful films act very differently from each other once they open in the box offices, but industry executives fail to estimate how films will be received by the public.

Before films have their opening weekend a large amount of buzz and advertising surrounds the release, and in this way, demand preempts distribution (Krider, Li, Liu, & Weinberg, 2005). Of course, studios have already committed their funding to the movie, so even low-demand films are promoted (Krider, Li, Liu, & Weinberg, 2005). Unfortunately for film distributors, the pricing scheme of movies is inelastic, preventing distributors from attempting to mitigate low demand with low prices (Vogel, 1998). The only thing distributors can do is attempt to respond to their expected demand by determining on how many screens the movie opens (Elberse & Eliashberg, 2003; Moretti, 2008). Afterwards, distributors must simply observe as the market determines the quality of new films.

In the film industry there are three ways awareness can be raised for the release of a specific movie: advertising by the distributing company, reviews by critics, and public word-of-mouth effects. Simultaneously, many consumers make their binary decision to view or not view the movie based on the quality and interest of commercials viewed, the commentary of famous or local critics, and the opinions of their friends and family who have already viewed the given film. This cyclical relationship between success and awareness means that movie producers want to have the best possible publicity vehicles.

Advertising is the only distributor-controlled aspect of the marketing clout associated with a film. Distributors spend an incredible amount of money on advertisements, the MPAA reports that the average film costs about $36 million to promote, which is about one-third of the overall cost of the film (Elberse & Anand,

2007). In some ways, this massive marketing cost is a barrier to entry for independent film producers who cannot afford to spread the news of movie release as successfully as the major motion picture distributors (Vogel, 1998). Advertising is advantageous for films because it creates a large market potential for films leading to bigger opening weekends (Boatwright, et al., 2007; Elberse & Eliashberg, 2003).

The effect of advertising on the opening weekend is variable, and does not necessarily have appropriate returns to scale (Elberse & Anand, 2007). Advertising has a positive effect on expectation of success, but this effect is diminished for low quality movies and most powerful for interesting movies (Elberse & Anand, 2007). This means that distributors should invest in advertising for good movies to promote the opening weekend of their films, but should avoid spending too much money on poor films which will be costly to promote and not garner the appropriate level of interest to make money (Elberse & Anand, 2007). Obviously, the effect of advertising is highly sporadic and expensive, but distributors continue to commit high budgets to marketing because of the monopolistic competition of the film industry.

Critics tend to reflect the "industry recognition" value of a film. Theoretically, the view of critics should also reveal the opinions of the general population, but there is often a discrepancy between critical evaluation and market performance (Holbrook & Addis, 2008). As a matter of fact, a study by Holbrook and Addis (2008) found that critical evaluation was actually negatively associated with the strength of a movie's opening weekend. On the other hand, positive evaluation often led to more awards and recognition, which occasionally results in additional long-term revenue for the film. Even though critics do not perfectly reflect the populace, they do have an effect on them. In general, critics can be classified into two groups: predictive and influential. Predictive critics are capable of realizing the potential and qualities of a movie. On the other hand, the more powerful influential critics are actually capable of impacting the success of a film (Boatwright, et al., 2007). For the most part, critical review fails to predict market revenue and performance, but the opinions of critics do accurately portray the quality of a given movie.

So if advertising affects opening weekends, and critical evaluation predicts movie quality and industry recognition, how is the long-term life of a movie determined by the

film promotion vehicle? Word-of-mouth effects alone account for about 10% of the variance in overall film success (Moul, 2007). As a promotion vehicle, word-of-mouth has the largest impact on the weeks following opening weekends, either for better or worse (Elberse & Eliashberg, 2003). Good quality movies see less of a decrease in revenue or even an increase in revenue over time as friends and family encourage others to see the movie. On the other hand, the sinking ships of poor movies cause rapid losses to revenue as viewing of the movie is discouraged between consumers. This social learning effect takes into account both the opinions of close relations as well as the general populace, reflected in box office grosses and public forums (Moretti, 2008). Interestingly enough, the biggest word-of-mouth effects occur from "surprising" films, where expectations and actual movie quality differ from each other by wide margins (Moretti, 2008). It is clear that a positive "buzz" about a movie has a strong effect on market performance, and positive opinions about a movie can keep the movie in theaters for longer than originally anticipated.

A successful film is usually, but not always, greeted with massive opening weekends at the box office. Factors such as the film budget, advertising budget, the number of opening screens, and the public appeal are most influential on opening weekends (Boatwright, et al., 2007; DeVany & Walls, 1999; Walls, 2008b). In addition, movies that are sequels and that are rated 'R' or 'PG13' tend to be more successful. On the other hand, the influence of star-power, the actors in the film, is less powerful than distributors hope, in fact, most superstars cost so much to hire that the profitability of the actor is actually negative (Walls, 2008b). The effect of superstars is to "mark" that a film is strong by showing the strong budget put into the film, but this mark is often not enough for a film to change from unprofitable to profitable (Sedgwick & Pokorny, 1999). Several other competitive factors come into play, such as if two competing movies of the same genre or same MPAA rating are released simultaneously, then both movies tend to perform less well (Ainslie, Dreze, & Zufreyden, 2005). Once the opening weekend has occurred, the following weeks then contribute to the level of success of a film.

Except in very rare cases, a film's box office revenue will begin to decrease after the opening weekend as the pool of interested consumers shrinks (Boatwright, et al., 2007; Einav, 2007; Moretti, 2008). The slower the decay of revenues occurs, the

moresuccessful a film is. In the exceptional circumstances where revenue actually increases after the opening weekend it is often found that films perform incredibly successfully, because the increase in revenues occurs from a very positive word-of-mouth effect (Holbrook & Addis, 2008). The same variables that positively interact with opening weekend decrease the level of revenue decay, with the exception of advertising effects which are replaced by word-of-mouth (Boatwright, et al., 2007). Successful movies have slower decay rates in revenue and as a result also last longer in the box office (Einav, 2007). Once a movie has left the box office distributors must turn their attention to home videos of the film, but DVD sales tend to correlate very strongly with box office sales and a studio is already aware of the level of success of their movie (Mortimer, 2005). Obviously, there are a large variety of factors that contribute to the film industry's success as a whole, and these factors go hand-in-hand with the successful aspects of any single film.

Studios are generally interested in the two major kinds of successful movies: the artistic "sleeper" film and the blockbuster. There are other categories of films that can make money, but these two categories garner the most public and industry attention.

The term blockbuster should not be unfamiliar, it refers to flashy, star-studded, expensive movies that are released "in theaters everywhere" with advertising budgets that can reach $50 million and production budgets ranging from $75 million to $150 million. Blockbusters often begin with high expectations and high revenues but tend to see rapid revenue decay throughout their weeks in the box office, usually as the result of bad word-of-mouth (Ainslie, et al., 2005; Moul, 2007). For example, Paramount's *Transformers* (2007) had a production budget of $150 million, and an opening weekend of $70.5 million, which was almost a quarter of the movie's domestic lifetime gross in the first weekend alone. Amongst blockbuster movies, the marginal returns to big budgets and more opening screens have a significant positive effect on movie success (Boatwright, et al., 2007; Walls, 2008b). Famous actors often add this blockbuster effect to films, where the appeal of the performer mindlessly draws audiences until bad word-of-mouth deters the audience from attending.

Sleeper films succeed for completely different reasons. A sleeper movie is characterized by a more artistic appeal, low budget, little to no advertising, a small

opening, and a variable success rate (Ainslie, et al., 2005; Moul, 2007). These platform releases only open in a limited number of theaters that attempt to target specific demographics (Boatwright, et al., 2007). After release, an unsuccessful, poor-quality sleeper movie will decline in a similar manner as the blockbuster films. On the other hand, a successful sleeper movie will actually experience revenue increases over time as a result of good word-of-mouth effects, generally caused by surprisingly good film quality. Unlike blockbuster films, production budget does not have a significant effect on box office revenues of the movie (Boatwright, et al., 2007). The quintessential sleeper film example is *My Big Fat Greek Wedding* (2002), distributed by IFC, which had a tiny production budget of $5 million and an opening weekend of only $600,000. Despite a weak opening, strong word-of-mouth caused the movie to gross $241 million in the domestic box office market, a staggering 4800% return on original investment. Strong directors tend to have the sleeper effect on movies, but that is not to say that skilled directors, like Steven Spielberg, do not also release blockbusters (Ainslie, et al., 2005).

According to modern portfolio theory, movie distributors attempt to diversify their "portfolios" in regards to blockbuster and sleeper movies (Vogel, 1998). In general, the profitability of a blockbuster is more likely, however, the profit margins are smaller and blockbuster flops are extremely expensive for studios. Warner Brothers lost $26 million on *The Good German* (2006) which met with little success but a high budget due to the star-studded cast of George Clooney and Cate Blanchett. Conversely, sleeper films are less likely to be successful, but the returns on production budget can be staggering, as shown by the example with *My Big Fat Greek Wedding*. Large distribution studios often have to negotiate with smaller film companies to contract for groups of sleeper films, since it is difficult to determine which will succeed and which will fail (DeVany & Walls, 1996). This strategy has often led to the creation or acquisition of independent film studios which partner with the larger film distributors but remain as separate entities in operation (MPAA, 2007).

The attributes of blockbusters mean that in order to be successful they are released by big, competing distributors during the high-demand seasons of summer and the holiday season in December (Ainslie, et al., 2005; Einav, 2007). This is done to capitalize on the willingness of advertising-influenced consumers to see movies in the

high season. In 2008, the top 5 box office grossing movies of the year were all released between May and July. On the other hand, sleeper films are released by big and small distributors alike, during box office off seasons such as September (Ainslie, et al., 2005; Einav, 2007). These artistic films cannot compete against the advertising force of blockbusters and thus avoid the high season in order to stay afloat for long enough to generate a positive word-of-mouth effect. Nonetheless, no matter what season you go the movie theaters, the quality of the movie, or the type of film, either sleeper or blockbuster, the price paid to view the movie will always be the same.

In 2008, the average ticket price in the United States was $7.20 (Box Office Mojo, 2009). If you were to enter your local theater, the price you would be charged would be the same for the critical-acclaimed, highly-anticipated new blockbuster or the poorly-made, criticized film that has been out for several weeks. Orbach and Einav (2007) investigated why movie theaters utilize uniform pricing strategy when variable pricing may be more logical for theaters. The reason, in large part, comes back to movie distributors. Distributors are interested in releasing a diverse group of films ranging from popular, but expensive, blockbusters to variably successful, but cheap to produce, sleeper films. Therefore, distributors create agreements with movie theaters that they will charge a consistent price for all films in exchange for providing the theater with their films (Orbach & Einav, 2007; Vogel, 1998). The second reason movie theaters use uniform pricing is because of arbitrage issues. Unless theaters were willing to hire a larger work force, which would be expensive, it would be difficult to enforce what theater movie-goers entered. Therefore, customers would purchase the cheapest tickets and then attend the most expensive shows, an activity called “theater-hopping,” causing overcrowding in the most popular theaters (Orbach & Einav, 2007).

With regards to neighborhood competition, most theaters operate in microcosmic monopolies. The reason is that service is locally based and because it is unprofitable for theaters to compete with one another they tend to locate at substantial distances from one another (Davis, 2006). In this manner, consumers are prevented from price shopping movie theaters and simply choose the multiplex which is most convenient to attend (Davis, 2006). Furthermore, horizontal mergers between local theaters have had little effect on pricing, implying that the pricing scheme is demand-driven and not supply-

driven. All of these factors have contributed to an average price of $7.20 for an admission ticket at the box office, with small variability from movie theater to theater.

b. How Piracy Interacts with the Motion Picture Industry

With all of the unpredictability in the movie industry that already exists, it seems like there are few factors that could make things even more complicated, yet in the past 5 years the MPAA has begun to seriously turn its attention to the issue of movie piracy. The piracy of copyrighted materials, which has changed the music industry since the inception of Napster, has begun to take a noticeable toll on the film industry. Currently, the MPAA puts most of its efforts towards anti-piracy activity and awareness, showing a clear dedication to what they perceive as the largest growing threat to the motion picture industry (MPAA, 2005).

The 2005 report on piracy for the MPAA by LEK Consulting was a study conducted over 18 months which surveyed 20,600 consumers in 22 countries and attempted to estimate revenue losses based on legitimate movie sale decreases as the result of pirated versions being available. The report claimed that the six major U.S. motion pictures lost $6.1 billion in the worldwide market, and the total losses worldwide for all movies was $18.2 billion. Considering that the MPAA reports a domestic box office revenues at about $10 billion and foreign box office revenues at $17 billion, this claim of $6.1 billion is a massive suggested impact on the industry's success.

Of the $6.1 billion lost by U.S. studios, $2.4 billion dollars was the result of internet piracy and the remaining $3.8 billion was physical, hard disc piracy. About 80% of piracy occurred abroad and 20% of the losses were within the United States. The largest loss rates occur in the Chinese, Russian, and Thai markets, where predicted loss to piracy is 90%, 79%, and 79%, respectively. On the other hand, the piracy loss rate in the U.S. is only about 7%. The reason why that small piracy rate correlates with 20% of worldwide losses is because the domestic market for U.S. films is the single strongest market; in general, domestic revenue accounts for about 40% of worldwide box office revenues.

The findings of the piracy report released by the MPAA have come under criticism and scrutiny because the methods in acquiring data for the report are not fully

explained and recently, the MPAA admitted an error when reporting the demographics of the average pirate by overestimating the percentage of 16-24 year old, white male pirates by a factor of 3 (Pope, 2008). Furthermore, it is difficult to measure piracy, particularly considering the voluntary aspect of admitting illegal activity in a survey. A study by DeVany and Walls (2007) attempted to directly measure the losses of piracy in domestic box office sales without using volunteer surveys.

Theoretically, piracy increases the loss of revenue over time and will also decrease the number of screens in which a theater is playing (DeVany & Walls, 2007). However, as this paper discusses, this effect may be the result of demand fluctuations for bad movies. Using data for a specific, anonymous movie, DeVany and Walls (2007) investigated the internet pirate supply by checking a collection of pirate aggregating websites and P2P servers. Then using a time-series regression involving demand lags from previous weeks, the researchers found that active pirate sites do actually accelerate the loss of real supply, and by using this demand lag the researchers managed to isolate the piracy effect. More precisely, one additional pirate site led to a $621.88 decrease in box office revenues, although DeVany and Walls (2007) admit the supply of pirate sites is likely undercounted and using a correction factor claim that the losses are closer to $248.01. In the empirical case tested by DeVany and Walls (2007), the box office revenue loss was expected to be between $29.2 million and $49.5 million. Without using surveys the researchers managed to show that there were direct losses to movie revenue as the result of piracy supply, and although the findings are not specifically accurate and only represent one film, they do show that there is a definitively negative relationship between piracy and revenue.

The demand for movie piracy is directly correlated with the demand for movies (DeVany & Walls, 2007). This finding is unsurprising considering that piracy acts as a substitute for movies in the sense that it provides a similar, but not perfectly substituted, consumption of a legal viewing. When considering personal demand for movies compared to demand for piracy two important factors are considered: the cost of consumption and the willingness to substitute pirated goods for legal movies (Bae & Choi, 2006).

Dollar costs for pirated goods are incredibly low: internet piracy costs absolutely nothing and hard goods piracy costs around 5$, less than the price of a movie ticket (MPAA, 2005). It is the cheap nominal cost of piracy that encourages consumers to place themselves into the lowest price-discrimination category, and most supporters of piracy claim that pirates do not take away from the movie industry because those that pirate are not willing to pay the nominal cost of films (Slive & Bernhardt, 1998). The high cost of movie tickets and DVDs deter many buyers from the industry, and it has been found that more intense competition between movie distributors would lead to lower prices and decrease the amount of piracy (Bae & Choi, 2006; Belleflamme & Picard, 2007). Nonetheless, there are two costs associated with piracy. One is the time cost of pirating and the other is the legal cost of piracy.

Pirating does not occur instantaneously, and in general, it is not as convenient as going to the theater. Acquiring a pirated movie online requires time to search for and download the file. Most pirate viewers request to see a film upon movie release and when a quality pirated copy has been created, meaning that pirate demands have specific peak times (Kwok, 2004). In order to deter internet piracy, distributors can upload fake film files which will increase the time cost associated with searching for the movie file, in this manner, the implicit cost of piracy rises and discourages use (Kwok, 2004).

Legally-speaking, piracy can be quite expensive. Obviously, in purely nominal economic terms it is logical to pirate a movie if the probability of being caught multiplied by the penalty of being caught is below the actual price of the film (Walls & Harvey, 2003). Considering that in the United States the penalty for first-time pirate offenders can be $250,000, but piracy is still rampant, there appears to be an issue with this expected value calculation. In fact, most consumers, about 90%, would willingly pirate films in situations where the expected penalties are less than the cost of legally viewing a movie. Even so, some consumers, about a third, are willing to pirate films even if the nominal expected value of penalty suggests that a legal copy should be bought (Walls & Harvey, 2003). This is likely because consumers do not often feel that legal sanctions will affect them personally, and mindlessly disregard the legal threats that precede film viewings.

Nonetheless, it has been found that decreasing legal price will encourage the purchase of legitimate copies (Bae & Choi, 2006). In addition, an equivalent increase in

expected penalty and price will lead to a decrease in piracy as opposed to a stable equilibrium that might be expected (Walls & Harvey, 2008). For example, if the chance of being caught is 10%, a 1$ rise in price and a 10$ increase in penalty will lead to a decrease in pirating behavior, even though the economic value of pirating is the same, relatively speaking. This implies consumers are risk-adverse, which is beneficial for anti-piracy activity. Indeed, a study by Bezmen and Depken (2006) found that there was a negative relationship between piracy and income, tax burdens and economic freedom. More specifically, a 1% increase in income led to a .25% reduction in piracy. This finding was also replicated in Andres (2006) and Marron and Steel (2000), although in Andres (2006) an inverted U-relationship was established. This relationship arises from the fact that those with very low income are incapable of affording the technology required for internet piracy or even paying the discounted pirate good price for movies, an entertainment luxury good.

In terms of 'pricing,' when deciding to illegally consume films, consumers need to account for search costs and expected legal costs of piracy. In addition to the cost associated with piracy, the demand decision of consumers is influenced by the willingness to substitute goods.

Although a pirated film shows the same movie as the legal copy, the pirated copy is not the same. Software protection can cause frustrations for top-end and convenience pirates alike. Difficulties in cracking software protection cause the original perpetrators of piracy to have high fixed costs, and insufficient or complicated methods of cracking codes can be complicated for the final user of the illegal copy. A second factor in willingness to substitute is the quality of the pirated film. Most films are cam recordings, which are poor quality recordings with weak audio (Baio, 2008; MPAA, 2005). Occasionally, screener leaks are better quality pirated versions of the film, but they have irritating watermarks or writing on the screen, such as "For your viewing consideration only. Property of distributor." This makes the movie-viewing experience less enjoyable for consumers. This is a serious deliberation for viewers, and the unwillingness of ardent movie watchers to seek pirated copies of films exemplifies one of the greatest disadvantages of substituting the pirated good for the real thing (Bounie, 2006). Finally,

when deciding to pirate there is a certain amount of guilt or legal trepidation associated with the act.

Currently, there is very little social stigma associated with piracy, but it has been growing in the past several years (Balestrino, 2008). Cross-country analyses of piracy indicate that individualistic societies are less likely to pursue pirated goods, in part because the legal sanctions are likely to be stronger but also probably because consumers have more respect for copyright protection and intellectual property (Marron & Steel, 2000; Walls, 2008a).

The decision to pirate involves several factors. Consumers must consider the cost of the pirated good, even though the nominal value is very low. In addition, the substitution of pirated goods for legal goods is not perfect, and avid movie watchers will continue to pay for the legal goods regardless of the convenience or low cost of inferior pirate copies.

The original sources of piracy range from insider leaks to outsider copies (Byers, Cranor, Korman, McDaniel, & Cronin, 2004). An insider leak comes from an industry worker that managed to subvert the security measures at their place of employment. These copies come from editing rooms, critics with advance copies, promotional viewing for award consideration, copying the medium prior to distribution and release, or recordings by projectionists (Byers, et al., 2004). Generally, insider leaks result in higher quality pirated movies, the most common of which is a pirated screener, where a film that was sent for consideration for awards ceremonies or critic viewings is illegally copied (Baio, 2008). Outsider copies can be made from home video or a physical recording at the cinema, also known as "cam" recordings. These recordings are low quality bootlegs and the most common source of pirated films (Baio, 2008; Byers, et al., 2004). Higher quality cam recordings might have telesync, meaning that there is a direct audio feed which matches the low quality cam footage, but this often requires cooperation by an insider of the operation (Baio, 2008). Once a movie has been illegally recorded, there needs to be a vehicle for delivering the pirated copy to millions of criminal consumers.

Pirated movies come in several formats. There are two main categories of pirated goods: hard goods, such as DVD copies, and the sharing of files that occurring over the internet (MPAA, 2005; Waterman, Ji, & Rochet, 2007). Hard good piracy is most

commonly in the form of optical disc piracy, the mass copying of DVDs. According to the MPAA (2005) report on piracy, 62% of all piracy is in the form of hard goods, while the remaining 38% is internet piracy. Since the worldwide loss to piracy was expected to be $6.1 billion, this means that $3.7 million is lost to hard goods piracy and $2.4 million is lost to internet piracy.

Even though the MPAA and its associates managed to seize 81 million illegal copies of DVDs in 2005, the systems that protect pirate suppliers remain relatively secure (Walls & Harvey, 2008). An investigation by Walls and Harvey (2008) in Hong Kong found that pirated movie copies were not just sold on street corners; instead, they were commonly sold out of stores. These storefront organizations manage to avoid police notice by establishing a simple courier system. Customers come to these storefronts and ostensibly place an order for a movie, and then the consumers are given a location and an order number on a slip of paper. In this manner, store clerks can screen potential buyers for police activity without putting themselves at risk. The purchasers then move to the new location, which in the case of Walls' and Harvey's (2008) investigation, was at the top of a convoluted set of stairs with a mirror that allowed anyone at the pick-up spot to notice who was ascending the stairwell. The precaution of location allows the final seller one last chance to escape law enforcement. A second strategy is to have a courier bring the newly created pirate copy to the storefront, where the waiting customer can pick up their illegal, discounted purchase. Either way, the variety of buffers between the suppliers and the consumers allow for the prevalent selling of pirated goods.

File piracy, pervaded by the internet, works much differently. Since the internet is difficult to regulate and government has minimal intervention power, it is very easy for pirated files to slip through the figurative cracks of the law. According to the MPAA (2005), the general strategy for internet file-sharing of movies is as follows: first, an illegal copy is acquired via insider leaks in the form of screeners or outsider leaks in the form of cam recordings. The leak is then hosted by a "top site" where a collection of high-speed computers host sites containing the video (MPAA, 2005). One example of a top site is the popular FinnReactor. These top sites are then promoted by facilitator websites that are, in brief, search engines for pirated material. An example of a facilitator website would be alluc.org or Stage 6, which was shut down recently by DivX, a media

file compressor that was illegally used by Stage 6. Following these downloads, P2P (peer-to-peer) servers and direct file sharing spread piracy all over the internet. Popular examples of P2P servers are Kazaa and Limewire, which are used for movies, music, and a variety of other copyrighted materials (MPAA, 2005).

The difficulty with controlling internet piracy is the sheer magnitude of files that must be tracked in order to prevent file sharing. Only a small number of files, even just one, will result in large amounts of piracy and revenue losses (Waterman, et al., 2007). The reason is that each stage of transfers from top sites down to P2P servers has an exponential effect on the amount of illegal users. The overwhelming quantities of FTP (file transfer protocol) and P2P servers makes shutting down internet piracy an arduous and overwhelming task (MPAA, 2005). A study by Oksanen and Valimaki (2007) investigated the success of shutting down FinnReactor in 2004. For a month, internet piracy in Finland, where FinnReactor is based, decreased by a significant percentage, but after that month piracy returned to the same levels and continued to grow as regularly prior to the bust of the website.

The largest problem to film distributors with piracy is the displacement it causes. Theoretically, the LEK Consulting report on piracy was investigating the displacement caused by piracy, but once again, critics of the report would say that these things cannot be measured by survey. In pirating terms, displacement means the amount of legally-purchased product that is replaced by illegal product. Opponents of piracy would argue that the displacement values of piracy are very high and close to 1, meaning that for every product illegally downloaded one less product is legally purchased. Logically, displacement for piracy is somewhere between 0 (piracy has no effect on real sales) and 1 (piracy is a perfect substitute for real sales). While this may hold true in music piracy, since you either own the album or not, the issue of displacement is more profound in movie piracy.

Suppose someone enjoyed a film that they saw in theaters and later went to purchase the DVD when it was released, in this case, piracy can account for a displacement of 2 for a single person (Rob & Waldfogel, 2007). On the other hand, displacement could actually be negative. Suppose a consumer chose to watch a pirated movie that they had no intention of viewing (a displacement value of 0), and the

consumer unexpectedly enjoyed the pirated copy and decided to go see the movie in theaters or purchase the DVD for a better quality viewing. In this case, piracy has actually stimulated the sales of the film (Rob & Waldfogel, 2007). Further complications can arise when defining displacement if considering subsequent viewings. A movie consumer who viewed a film in theaters and then chose to view a pirated copy afterwards with a few friends may be displacing a second viewing, or it is possible that the second viewing would have never occurred unless it was free.

A study by Rob and Waldfogel (2007) found that about 1/3 of legal first-time viewers choose to watch the given film a second time. This value is about 3% less for unpaid first-time viewers, or pirates, who only have second viewings 30% of the time, meaning those who illegally consume movies are less likely to pursue a second viewing. This 3% figure is interesting because it is the same value that participants in the study claimed to illegally consume. This implies that the 3% loss of second-time viewers because of piracy consumption is caused directly by that illegal consumption. The study was performed by giving participants a list of movies released in the past year and asked about if they saw the movie once or multiple times, and which viewings were legal and which were illegal. Obviously, this study has the same reporting problems that the LEK Consulting report has; however, this study finds a significantly lower level of revenue loss. Rob and Waldfogel (2007) found that a first-time unpaid consumption leads to a 1.3 level of displacement, meaning a pirated version caused an average loss of more than one legal movie consumption for the MPAA's affiliated companies. Unpaid second-time consumption is less drastic, leading only to a 0.2 unit legal reduction per unit pirated. Furthermore, the researchers discovered that the average person displaced 2 paid units a year with piracy, leading to a 3.5% decrease in consumption because of the high rate of displacement (Rob & Waldfogel, 2007). Therefore, piracy has caused the average person to legally watch 2 less movies per year and has decreased spending by 3.5%. This low amount but high rate of displacement in movie piracy directly contrasts music piracy, which occurs in staggering amounts but with only approximately a 0.2 displacement rate (Rob & Waldfogel, 2006). A consideration of the findings in Rob and Waldfogel (2007) is required because there may be a bias: the study investigated Upenn students, who, according to the MPAA (2005), have a higher rate of piracy than other demographics.

Furthermore, the study only investigated the most popular movies, which are least likely to benefit from additional sales and increased awareness of their film that piracy can be produce.

Defenders of piracy often claim that consumers would not normally view a given movie if the pirated alternative was not available, or in other terms, that displacement of illicit viewings is close to zero. Some would even claim that piracy could have positive effects on a film's revenue: by raising awareness of a film through piracy, legitimate viewers might become interested in seeing the film of which they were previously unaware. In a market where the amount of independent films is rising, this increased awareness for unadvertised movies may actually assist the growing third-party industry.

A paper by Haruvy, Mahajan, and Prasad (2004) investigated the effects of piracy on the market penetration of subscription software and found that piracy could substantially improve the market share and revenues of new software. That being said, software and movies do not interact perfectly. When subscription software, like Microsoft Office, is employed, the advantages of that software are greater when more and more people use that software. Suppose one attempted to use Microsoft Word, but others did not have the technology to open .docs. The benefit of the software substantially decreases, which is why the penetration caused by piracy may actually be beneficial to the revenues of pirated software. This analogy is not perfect for movies, but the implication could be made that if independent studios can establish themselves as strong filmmakers it would help future productions by that studio. It might be better to compare movies to music, since both are independent, intellectual properties.

Hui and Png (2003) questioned the claims of the music industry's losses to piracy. During the course of their investigation, they found that piracy did have an effect on demand. As piracy rose, so did the legitimate demand for the product (Hui & Png, 2003). This might be the result of positive word-of-mouth of a musician that leads to higher sales. However, the study by Hui and Png (2003) also stated that this demand increase was outweighed by the losses to the industry for the overall effect of piracy.

So the defenders of piracy claim that it can increase demand, and this does seem to be the case. Nonetheless, the revenue loss from piracy is greater than the revenue gain

as an indirect result of piracy, and it remains in copyright owners' to continue attempting prevention of piracy.

The question that remains is does the displacement from films prevent people from attending the theaters or from purchasing home videos? Theater-going is expensive but has the advantage of being good quality, in addition to being a social event. Home video is similar to piracy in that both can be viewed from the comfort of home, although home video has better quality. Bounie (2006) found that piracy has a larger effect on video purchases than theater-going behavior, which is interesting considering a burgeoning home video market. This could be because the movie-going experience is not perfectly substituted by pirated videos, but pirated videos are almost a substitute for home video, since both are viewed at home and by the time of DVD release there is often a decent quality film leak (Baio, 2008). The findings of Bounie (2006) also indicated that piracy levels were highly influenced by consumer preferences. People that derive pleasure from movies and are the most likely to attend movies and purchase videos would rather pay the money for quality films rather than pirate. On the other hand, serious hackers continue to pirate and have a significant effect on decreasing movie attendance. So who are the people that tend to patronize movies and pirate the most?

A variety of demographic tendencies can be found in movie going trends. Movie distributors usually target a very specific age group, namely, teenagers. The reason is that the most frequent moviegoers are in the 12-24 age group which accounts for about 40% of admissions (MPAA, 2005). After the 12-24 age group the 30-49 middle age category is the most common type of movie attendee accounting for 35% of moviegoers. Older men are less likely to attend movies than women; however younger men are more likely to go to the movie theater (Collins & Hand, 2005).

Income is another important demographic in the movie going audience. In general, more rich people will patronize films, the average moviegoer makes over $50,000 a year (MPAA, 2005; Orbach & Einav, 2007). This is because movies are a luxury good, and although a specific instance of movie attendance is not particularly expensive, a habit of going to the theater is expensive.

The piracy demographic somewhat reflects the movie going demographics. According to the MPAA (2005), the typical pirate is a 16-24 year old urban male,

particularly university students, composing about 40% of all pirating behavior. Recently, the MPAA admitted that the results of its 2005 report may have been false in depicting the demographics of pirates, saying that only about 15% of piracy may occur in this 16-24 age group (Pope, 2008). This error has garnered the MPAA a lot of criticism from various skeptics of the piracy report who claim that this shows an example of how the report is inaccurate and misleading.

It is clear that serious hackers are the most frequent pirates, utilizing the internet for continuous downloading of movies (Bounie, 2006). Since the youngest generations are most familiar with the internet and how internet piracy works, it is still reasonable to argue that a large portion of piracy, particularly internet piracy, is carried out by a young demographic.

The pirate demographic for income is a bit more convoluted. The relationship between income and piracy is approximately an inverted U-relationship (Andres, 2006). The reason is that there is an increase in piracy usage as income increases, likely due to the availability and convenience of technology. More specifically, those with more income can afford faster internet connections and higher amounts of storage space on their computers for large movie files. That explains the first part of the inverted U-relationship, but then why does it begin to decrease? Apparently, at a certain level of wealth it is easier for consumers to purchase the films instead of spending time going through the piracy process, and in addition, the wealthier bracket of the movie going audience may be more legally adverse, preferring to pay for the legal product instead of risking potential embarrassment of legal infractions.

Of course, not all piracy occurs in the United States, as a matter of fact, most of it occurs abroad. The foreign market is massive for the all of the six major movie distributors in the MPAA. Sales abroad account for 51% of U.S. film revenue and movies are one of the few industries where American products are considered to be the best worldwide (6). The domestic and foreign markets are interrelated; in general, a movie that is successful domestically will also perform well abroad (Elberse & Eliashberg, 2003). Foreign release dates tend to be after the domestic releases so positive word-of-mouth creates a strong buzz when the movie finally opens in the various foreign markets.

Despite the great amount of revenue generated by the foreign market, it is also a large source of frustration for the MPAA, because the better majority of movie piracy happens abroad and is estimated to be about 80% of piracy losses (MPAA, 2005; Waterman, et al., 2007). Of the 18.2 billion dollars the MPAA estimates was lost worldwide in 2005, 2.7 billion was lost in China, 1.5 billion was lost in France, and 1.1 billion was lost in Mexico. For the MPAA specifically, Mexico, the United Kingdom, France, Russia, and China account for the largest revenue losses to piracy. These may be in part because of the weak legal atmosphere in regards to intellectual property, or IP, protection.

In the United States, the laws are distinct, powerful, and strongly enforced in regards to copyright infringement. Although the laws are similar throughout most of Europe, the enforcement of these policies is lax in a few countries, for example, the United Kingdom and France (MPAA, 2005). In Latin America, the laws are almost never enforced and the prevalence of pirated hard goods, which is the easier kind of piracy to prevent, shows the lack of legal commitment to halting the spread of piracy (MPAA, 2005). The laws are even worse in most parts of Asia, particularly China, which has the technology to undergo both hard goods and internet piracy but a lack of effort to prevent IP theft (MPAA, 2005). In Hong Kong, regular stores are used as fronts for the spread of piracy and the investigators in a paper by Walls and Harvey (2008) had no difficulty in finding illicit goods.

Cultural differences between countries are the probable cause of this large discrepancy in domestic and foreign piracy rates. In general, democratic and civil liberties countries have lower rates of piracy, for example, piracy rates in the U.S. are only 7%, in Italy they are 25%, and in Spain they are 32% (MPAA, 2005; Piquero & Piquero, 2006). Legally, these cultures also have higher levels of protection for IP (Piquero & Piquero, 2006). On the other hand, collectivist societies, which promote an increased sharing of resources between individuals, culturally encourage piracy (Walls, 2008a). This can be seen by the piracy rates in these countries: 90% in China, 79% in Russia and Tailand, and 54% in Taiwan (MPAA,2005).

A study by Walls and Harvey (2003) investigated the differences in cultural decisions to pirate by comparing the decisions of Las Vegas and Hong Kong students.

The researchers gave students choices between choosing pirated and legal versions of goods, and described in detail the legal costs and probability of being caught for using the non-pirated good. Theoretically, the price of a pirated good is the expected cost of the good which is the probability of being caught multiplied by the cost of being caught. The researchers investigated two scenarios: when it was logical to pirate because the expected cost of the pirated good was less than the actual cost of the legal good, and when it was illogical to pirate because the cost of piracy exceeded the benefit of pirating.

The researchers in Walls and Harvey (2003) found that students in Hong Kong were always more willing to pirate than those in the United States. Under the condition where piracy was economically rational between 86% and 95% of Hong Kong students purchased illegal copies, whereas only 84 to 91% of Las Vegas students chose illicit goods. This discrepancy became even larger in the economically illogical pirated purchase condition: 40 to 48% of Hong Kong students pirated while 23 to 40% of Las Vegas students chose to pirate.

The paper went on to investigate the effects of price changes on influencing students' decisions to pirate. A 1 unit increase in price led to a 0.0876 probability increase in piracy for Hong Kong students and a 0.142 probability increase in piracy for Las Vegas students. On the other hand, a 1 unit increase in expected penalty led to a .107 probability decrease in piracy for Hong Kong students and a .21 decrease in probability of piracy. Both kinds of students were more risk-adverse than price-adverse, meaning a 1 unit increase in both piracy and expected penalty would actually lead to more authentic purchases. Nonetheless, this effect was less pronounced in the Hong Kong students. The cultural differences between the subjects became much more salient once that actual prices of piracy were established, suggesting that students from Hong Kong were much more inclined to pirate than Americans (Walls & Harvey, 2003).

Several studies have been performed that investigated what factors other than cultural differences could be causing this massive discrepancy in piracy rates. Two separate studies found that income, individualism, and high enforcement costs were negatively associated with piracy rates (Marron & Steel, 2000; Walls, 2008a). This means that poor, collectivist countries with poor legal sanctions for IP protection are the most likely to have high piracy rates. In addition, a surprising finding by Walls (2008a)

showed that increased internet usage was actually correlated with less piracy, although this correlation may be caused by the confounding variable of income.

Geography plays an important role in the landscape of piracy; countries in the eastern world with collectivist attitudes tend to be the largest perpetrators of illicit movie copies. The collectivist mindset places less emphasis and value on intellectual property rights and therefore fails to discourage illegal activity for movie goods, leading to massive revenue losses. Although the MPAA's sister organization the MPA, Movie Picture Association, has been attempting to encourage countries to enforce legal sanctions protecting from copyright infringement, the differences in cultures and ideology will continue to make foreign piracy a looming shadow for the film industry.

c. What the Movie Industry Can Do Against Piracy

Although research on movie piracy has been limited to most of the papers discussed above, a lot of research has been done in regards to copyright infringement in the music industry. There are many lessons to be learned from the suffering music industry as the result of piracy: namely that protection is essential and responding to piracy in different ways is necessary for intellectual property companies if they intend on growing. The music industry has changed as a result of pirating, for example, the popular iTunes program allows users to download individual songs for just $.99. The versatility granted by the iTunes system and other similar music downloading services have helped prevent the spread of piracy. Nonetheless, the music industry has seen and reported the great losses to piracy, particularly resulting from internet piracy and P2P servers. Although a correlation exists between piracy for movies and music, it is important to note the differences.

The largest factor in the drastic negative effect of music piracy compared to a marginally less negative effect for movie piracy is the ease of access. Music files are very small, easy to find, and easy to download, in addition to being quick to acquire (Rob & Waldfogel, 2006). Movie files, on the other hand, are gargantuan and slow to download (Rob & Waldfogel, 2007). Music piracy also has the advantage of generally being high quality, since songs are easy to "rip" from CD to computer; the audio quality tends to be

good or excellent. Movie piracy actually suffers from low quality, and deters serious movie viewers (Rob & Waldfogel, 2007).

Differences between downloading are reflected in the displacement rates of movies and music. Music files have a displacement of about .2, meaning that for every five songs downloaded only one of those songs would have been legally purchased (Rob & Waldfogel, 2006). Displacement for films is around 1, however, meaning that every film illegally viewed causes a direct loss of that viewing to the movie industry. So why does the music industry suffer so much while the film industry continues to grow? The sheer amount of music downloads is so vast that even the small displacement rate results in a large amount of revenue lost. In a study by Rob and Waldfogel (2006), expenditures per consumer decreased from $126 to $101 per year, an almost 20% decrease, which is a massive loss to the industry. On the other hand, movie displacement occurs in very small quantities, leading to an overall consumption loss of just around 3.5%. (Rob & Waldfogel, 2007)

The losses reported by the music industry tend to be exaggerated, and a paper by Hui and Png (2003) showed that estimate of CD sale losses were much lower than industry estimates, although there was indeed a distinct decrease in CD sales. The researchers also argued that a decrease in pricing schemes would combat piracy effects. Considering the paper was released in 2003, the same year the iTunes store for individual songs was opened, the paper may have serious business implications. In regards to movie piracy, it seems reasonable to state that film industry losses to piracy may also be exaggerated and that a responsive pricing scheme may work towards combating the effects of piracy.

As a matter of fact, some distributors have begun to experiment with a format referred to as R5 (meaning region 5, which refers to Asia, where most piracy takes place). R5 films are DVD releases that occur during the film's opening weekend (Baio, 2008). Obviously, R5 releases detract from theatrical box office success, but they have also managed to decrease the amount of local piracy, implying that those who pirate for convenience may purchase R5 DVD's over poor-quality pirated versions (Baio, 2008). Since the movie industry has the advantage over the music industry of a technologically difficult product to copy, the MPAA should capitalize on this aspect of the pirate market.

Movie piracy can be directly combated on a technological frontier. Physical piracy is carried out by copying DVDs using a DVD burner, a feature which most modern computers have (MPAA, 2005). Higher-quality operations of illicit goods have banks of high-end computers that can churn out quality movies which compete with legitimate sales copies (MPAA, 2005). Movie distributors can attempt to increase the technological barriers that pirates face when copying by boosting the difficulty, and thus fixed costs, of pirating (Kiema, 2008). One such example is the technology of DRM (digital rights management) systems which comes in two packages: cryptography, which is enciphered info that makes cracking file codes difficult, and watermarking, which allows law enforcement to track the original source of pirated goods (Kiema, 2008). It has been found that technological protection is more successful at preventing piracy compared to legal protection, and that one of the two largest factors in piracy is software protection (Andres, 2006; Kiema, 2008). That being said, technological barriers are not as successful as movie distributors might hope.

DRM protection has come under heavy criticism because critics claim the systems do not actually succeed in stopping determined pirates. Once the original DRM code is cracked, the marginal cost of pirating additional movies drops to nothing (Kiema, 2008). Most pirates tend to be technologically savvy and are capable of cracking new anti-piracy technology. Several years ago movie distributors began using Content Scrambling System, or CSS, which is a technology that scrambled the data of copied movies. However, the protection device was cracked by a 16 year-old Norwegian high school student who wrote a program simply entitled DeCSS, which undid the effects of the content scrambling (Walls & Harvey, 2008).

Casual pirates are more deterred by technological limitations when using internet piracy (Waterman, et al., 2007). The reason is that the large file size of movies prevents casual pirates from rapid, convenient downloads (Rob & Waldfogel, 2007). The time associated with acquiring illegal internet copies of films is a heavy cost to potential pirates, and move distributors have an opportunity to seize upon this cost. It is possible for distributors to upload fake movie files that increase the search and time costs for potential pirates (Kwok, 2004). In this manner, pirating becomes less worthwhile and

illicit consumers may turn towards legal purchase, because the combined effect of search costs and legal sanctions discourage piracy.

"Piracy is theft, but not a crime" (Balestrino, 2008). This statement permeates the general attitude of the public towards piracy. The social stigma of piracy is not widespread; however, it has increased since the early days of piracy and Napster (Balestrino, 2008). The problem with establishing a moral issue with piracy, particularly in the United States, is the anonymity of internet file-sharing (Waterman, et al., 2007). The legal costs for piracy are astronomical; first-time violators can be sentenced to jail from three to five years and fined up to $250,000 (MPAA, 2005).

Despite this deterring legal factor, the anonymous populace seems largely unconcerned with lawful consideration and the chance of being caught (Oksanen & Valimaki, 2007). While lawsuits and anti-piracy advertisements by the MPAA have raised awareness of the illicit nature of downloading, there is not a similar rise in the ethical implications of piracy (Oksanen & Valimaki, 2007). Balestrino (2008) finds that as stigmatization of the "subtle" crime rises, it should become easier to combat piracy. An investigation of multinationals in China found that internally administrative and judicial actions could effectively combat piracy. In order for these practices to take effect, the confidence of managers in the power and capability of employing these administrative and judicial actions must be high (Yang, Fryxell, & Sie, 2008). In this manner, increased knowledge within the firms has succeeded in discouraging internal piracy leaks.

As is, the public's view of file-sharing has shifted slightly away from absolute ambivalence towards some level of awareness, but the behavioral tendency to pirate remains the same (Oksanen & Valimaki, 2007). The finding by Yang et al. (2008) which state that legal protection is less significant than technological protection, which was already established to be moderate at best, casts a further shadow of doubt on the capabilities of legal action in anti-piracy. The largest problem with legal action is simply that it is far too difficult for the government to establish pragmatic and realistic anti-piracy practices and costs (Slive & Bernhardt, 1998).

The difficulty of establishing a social stigma is, however, indicated by legal sanctions. In western cultures there is a larger tendency towards IP legislation, whereas

eastern cultures avoid or fail to enforce these kinds of laws. In this case, legislation is reflecting the cultural values of these communities.

III. DATA

There are two primary datasets used in descriptive and analytical manners in this paper. Both datasets were manually created using an amalgamation of data from a variety of sources. For this reason, the datasets each contain their own idiosyncrasies and lack of data points, with certain variables being more readily available than others. The two datasets will be referred to as the Time Series Industry Dataset and the Oscar Film Piracy and Revenue Dataset.

a. Time Series Industry Dataset

The time-series data in this set ranges from 1982 through 2008 on a yearly basis, creating 27 separate data points. The data are mostly pulled from the website Box Office Mojo, www.boxofficemojo.com, an online reporting service that investigates the box office success of movies in addition to several other industry-related factors.

Box Office Mojo produces a yearly chart recording domestic box office grosses dating back until 1980, although the data was not thorough for 1981 and 1982 so that information was dropped. The data is complete from 1982 to 2008 in reporting total domestic gross, number of tickets sold, average ticket price, and number of movies released. The data on total screens open in the country and average cost of production only carry up to 2002 and 2003, respectively. The website does not explicitly state why this is the case, however, I assume it is the result of difficulty in fully investigating those factors.

In addition to yearly summaries, Box Office Mojo offers a list of the top 50 movies in terms of domestic box office gross for the entire dataset. These data were recorded in the form of grosses in order to see trends in the top 20 movies in a year. Since the average amount of films produced per year is close to 500, these top 20 movies represent the top 5% grossing films, and in the movie industry these films' grosses add up to around 40% of revenues in a given year.

In order to investigate MPAA gross explicitly, domestic gross box office revenues for the big six movie studios, Paramount, Warner Brothers, Sony, Universal, 20th Century Fox, and Buena Vista/Disney were also recorded, although the data presented for these variables is only available for 2000 to 2008. Summing these six companies together, a variable for MPAA gross domestic box office revenues was also created, which accounts for around 70% of total gross domestic box office revenues.

Data on the home video aspect of sales is provided by the Digital Entertainment Group, which has listed yearly DVD sales since 1998. Considering that DVD sales overtook VHS home video sales in 2003, investigating the sales of DVD is a strong indicator of the home video market (Bakalis, 2003). Furthermore, the growth of DVD sales has increased almost exponentially since the turn of the century, asserting the value of this yearly data in the movie industry (Digital Entertainment Group, 2008).

Finally, a small dataset on piracy was incorporated based on the work of Baio (2008) from www.waxy.org. Baio's dataset is mostly used for the Oscar Film Piracy and Revenue Dataset; however, summary variables on Oscar piracy from year to year can be used as a proxy for overall piracy. The average and median lengths of days for various forms of film leaks were recorded and incorporated, in addition to the proportion of Oscar films pirated and proportion of screener leaks. The problem with this data, unfortunately, is that it only ranges from 2003 until 2008.

b. Oscar Film Piracy and Revenue Dataset

The basic structure for this dataset is based on the work by Andy Baio, a journalist and programmer, who operates a blog at www.waxy.org. The issue of Oscar piracy is something Baio has been tracking for the better part of this decade, and he has collected and analyzed data on the availability of pirated Oscar-nominated films. Baio amalgamated data using Yahoo! Movies and VCD Quality, a website which lists leak dates of various films and in what formats the films were illegally released. Although VCD Quality is listed as a "release news site," these kinds of sites are often used as a base point for pirates to find films to download, either by message boards or informed searches. Finally, Baio incorporated the official screener release dates from Ken Rudolph,

an Academy member, who lists the dates of screeners he has received. This collection of data forms the basis of this second dataset I am using and has 185 separate movies.

The first issue in this dataset arises from a variety of incomplete data. As the film industry would hope, not all films are perfectly pirated. It is true that 184 of the 185 films had some sort of piracy leak, generally cam leaks; however, there are not complete datasets for screener leaks and DVD-rip leaks. This means that analysis including those variables have smaller datasets.

I modified Baio's dataset in several ways to make it more thorough and effective for my purposes. The first thing I incorporated was creating a dummy variable that captured whether there was a screener leak or not, and then repeated the process for DVD leaks. In this manner, the full dataset could be used to test piracy with the exception of the one film that managed to completely avoid piracy, *The Savages (2007)*.

I began to incorporate more information about these films using both Box Office Mojo and The Numbers, websites which track movie releases. The reason for using both websites was because occasionally a specific film was neglected by one website while the other had data on the motion picture. As mentioned above, Box Office Mojo is an online reporting service that investigates domestic box office results; The Numbers is a similar website in that it tracks box office results. The Numbers is superior, however, in that it records several other film industry factors such as DVD sales. On the other hand, The Numbers is a much more restricted website in terms of data acquisition since it is built around a membership program of which I or Tufts University are not affiliated, although some free data still exists.

Between these two websites I investigated the 185 Oscar films from 2003 to 2008 and incorporated a variety of factors. The first and most readily available data included were domestic box office gross, international box office gross, and the resulting worldwide gross. In addition, I created dummy variables for MPAA movie ratings, G, PG, PG13, and R. The third factor added that had data available for all 185 films was a dummy variable I created for MPAA affiliates, namely, any movie produced by the Big Six studios or their affiliates was considered to be an MPAA affiliate.

Several other variables were also recorded, although the following variables are not complete for all of the Oscar films. Production budget is obviously an important

factor in film success, and for the most part this was reported by films; however, this information was not always disclosed and is sporadically unavailable, generally in the categories of independent films. A variable for advertising budget was also included but this data was overwhelmingly sparse, particularly for the most recent releases. Furthermore, data was often presented for US DVD sales for most Oscar films released since 2006, but earlier years have much more infrequent instances of reports for DVD sales.

Finally, I included critic ratings for the better majority of films as reported by Rotten Tomatoes, at www.rottentomatoes.com. Rotten Tomatoes is a critic aggregator which collects a variety of reviews for films from approved critics and combines them into one score. So, for example, if a film received a score of 70% from Rotten Tomatoes, it means that 70% of critics had a positive review of the movie and 30% has a negative review. This score will serve as a proxy for critics' evaluations, basically serving as the judgment of industry professionals on the quality of a film.

A definite issue with using this dataset is that all of the films in it are Oscar-nominated, meaning the dataset is not entirely random. While this is true, there are still a fair number of unprofitable films, even in this "successful" dataset of films, and the range of production budget is representative of all films. Furthermore, since Oscar nominations occur after film release, the box office revenues of these films should not be affected by their nominations. In investigating the U.S. theatrical release dates of these films, there were none that were released in January or February, the months in which Oscar nominees are announced and then awarded. In this manner, the fact that these movies are Oscar nominated is only a *posteriori* choice that should not affect film success in any real way, and the Oscar nomination is simply more likely to reflect the positive feedback of critics and the movie-going audience. That being said, the findings presented in this paper are still restricted to Oscar nominated films, seeing as how the sample is distinctly not random.

IV. MODEL

a. Time Series Model for Trend in Revenues

This paper seeks to investigate movie piracy on a broad scale, how it is affecting the movie industry and if film distributors are reacting to this threat in an appropriate way. Skepticism has been cast on the $6.1 billion claims of the MPAA, considering that the luxury market of movies has continued to grow in the past decade (Graph 1). Theoretically, the movie industry should be addressing piracy concerns by lowering the legal cost of consumption, but pricing has also grown continually over the past decade (Graph 2). Furthermore, ticket sales have been acting somewhat sporadically, and have been decreasing in recent years (Graph 3). If the movie industry is scared of piracy, why is it reacting in an economically contradictory fashion? Why does the movie industry continued to thrive while the music industry is struggling to stay afloat in the modern world?

The present work will attempt to study the trends in historical growth in order to determine if the growth rate of the industry is being curbed by the growth of piracy. Since the technological barriers to copying movies are becoming smaller and the prevalence of the internet allows casual pirates easy access to illegal goods, one would expect that the strength of piracy has been growing over time.

I will begin by investigating the yearly time trends in box office grosses for the movie industry. The film industry has been leaning towards the home video market in most recent years, but a large portion of profits and the better majority of research still focus on box office revenues (Vogel, 1998). This paper will test for trends in the growth of the movie industry. The paper will also compare growth trends prior to 2000 and after 2000 in order to begin getting an idea if the market is beginning to stagnate, possibly as a result of the rise of piracy.

Although the year 2000 is an arbitrary year, there are several reasons I chose that point. The primary motivation is technological advancement. In 1999, Napster became popular, bringing the issue of music piracy into the spotlight. With the growth and subsequent fall of Napster, it would be logical to assume that file-sharing for movies would also shortly follow; which of course, it did. Furthermore, the DVD format was released in 1995 and finally overtook the home video market as the prevalent medium in 2003, so the approximate midpoint of 2000 seems to be a good basis for the beginning of optical hard disc piracy (Bakalis, 2003; Digital Entertainment Group, 2008).

First, a basic model for movie industry gross revenue should be included in the analysis. The first variable will be time considering the potential time trends of the data, including population growth and GDP growth. In addition, the average ticket price, which is influenced by the industry, trends upwards and will obviously result in higher revenues. Production budgets, as well, should have a positive influence on gross revenues, and the average production cost of films per year will be used for this variable. Similarly, advertising costs should be included, but the data is sparse for this variable so it may be excluded from the models in favor of higher power. Furthermore, the number of movies released in a year does not vary much from year to year but controlling for this variable is also necessary since overall revenues should be higher in years where more movies were released. Finally, the number of screens open nationwide is a measure of how many theaters were open and running in a given year and should be positively associated with gross revenue. The resulting estimated model should look as follows:

$$Gross = \beta_1 Time + \beta_2 TicketCost + \beta_3 Budget + \beta_4 \#Films + \beta_5 Screens + \beta_6 + \varepsilon$$

Following, a basic model for piracy will also be created. Data on average and median length in days before pirated copies were leaked will be used to determine the influence of piracy. The faster pirated copies are leaked, the sooner the effects of decreasing returns to sales should occur, meaning that number of days until pirated copy release and gross revenues should be negatively related (DeVany & Walls, 2007).

The investigation was also going to include the percentage of movies that were leaked per year to determine if that had a significant effect on piracy, however, of the dataset available, which consisted of Oscar movies from year to year, all but one of the 185 movies were leaked at some point. Therefore, the prevalence of piracy will be explored by regressing on the percentage of screener leaks and DVD-quality rips. The variable representing percentage of higher-quality leaks should have a negative impact on gross revenues, so as the percent of quality leaks increases, the overall gross should begin to decrease. Finally, the analysis will be run twice, one time it will contain the time trend variable and the second time it will not. The basic piracy model should look as follows:

$$Gross = \beta_1 Time + \beta_2 FirstLeak + \beta_3 \%QualityLeaks + \beta_4 + \varepsilon$$

Ideally, a third model would then be instituted as an amalgamation of both of these models. In that manner, piracy would be controlled for by the various influencing factors in gross revenue. Unfortunately, the dataset being used is incomplete and data for piracy only exists in the last 6 years of the data whereas data for screens and production budget only run from 1982 to 2002 and 2003, respectively. This lack of overlap prevents any thorough analysis and is an unfortunate weakness of this paper. Nonetheless, it should still be possible to test for trends in the data and extrapolate to future years for the movie industry.

Finally, the same models will be tested for top 20 gross, which is the combined net gross of the top 20 grossing films in a given year, accounting for about 40% of the year's overall gross (Vogel, 1998). Similarly, this process will be carried through for the MPAA yearly gross revenues, an amalgamation of the yearly gross revenues of the Big Six movie distributors. This analysis however will be modified since the data for MPAA revenues only carries on from 2000, meaning that there are insufficient data points if production budget and screens are included in the model. The last dependent variable this paper will investigate is DVD sales, but because this data has only been made available for recent years it will also be tested using the limited model that the MPAA regression used.

b. Oscar Film Model for Time of Piracy Effect

The present paper will then investigate the effects of piracy based on the success and revenues of a specific cluster of films: Oscar-nominated movies. While this sample of movies is not random, and therefore not ideal, there is a strong scattering of relevant data. For the 185 movies listed the worldwide gross ranges from $3.3 million to $1,133 million. In addition, the number of days until the first pirated copy of a film was leaked had the fastest release of 164 days before the film even opened in theaters and a very slow pirated copy at 203 days after the film opened in U.S. theaters.

One distinct advantage of using Oscar films is that they all have an opportunity for pirated screener leaks to occur, since the film distributors must send out videos for

awards considerations. The added variable of screener leaks allows an investigation of internal leaks in comparison to outsider leaks. In addition, there is a variable which accounts for the number of days difference between screener leak and screener release, which can be negative, meaning academy members were not the source of the leak, or positive, meaning it is likely that academy members were the source of the leak. This investigation is relevant because the MPAA has recently begun to encourage some studios to stop releasing awards screeners in order to combat piracy, which obviously has created some controversy within the industry.

This paper will begin by creating scatter plots of the piracy data, showing length of days until leak in relation to several variables like production costs, worldwide gross, and critic ratings. The first series of regressions run will be testing worldwide gross as the dependent variable accounted for by the piracy variables and a variety of control factors. The regressions will depend on the results of the scatter plots and correlation matrices created between piracy and the other variables. I expect that variables such as production budget and critic ratings will see specific clusterings in the data and I will test the regressions within those clusterings to see if there are differences between groups. Theoretically, movies with high production costs are more likely to get pirated because of the larger number of possible insider leaks in addition to a higher demand for blockbuster films. In regards to critic rating, one would expect that movies with good reviews would draw higher levels of demand and thus higher levels of piracy. The preliminary model therefore looks as follows:

$$WWGross = \beta_1 FirstLeak + \beta_2 ScreenerLeak + \beta_3 DaysScreenerreleasetoLeak + \beta_4 DVDLeak + \beta_5 Budget + \beta_6 CriticRating + \beta_7 MPAA + \beta_8 PG + \beta_9 PG13 + \beta_{10} R + \beta_{11} Year + \beta_{12} + \varepsilon$$

The variables PG, PG13, and R are dummy variables accounting for the film's MPAA viewer rating, and the variable MPAA is a dummy for whether the movie was released by an MPAA affiliate or an independent motion picture distributor. Finally, the year factor is included to account for any possible time trends resulting from the data since the set of Oscar films ranges from 2002 until 2007. The primary variables of interest are the leak variables. Leaks that occur faster should result in higher losses to

worldwide gross, as more customers opt for the early-release pirated films. This idea holds for all kinds of leaks. The first leak variable refers to the length of days until the first of any kind of leak, generally in the form of cam leaks. At the same time, screener leaks are higher quality pirate films which are superior at substituting for legal consumption over cam leaks. The days until screener leak variable refers to the number of days from screener release to screener leak, which should also have an impact on gross because it shows how quickly insider leaks occur. DVD-quality rips are of an even better quality, although in many cases they may not be released early enough to affect box office grosses. With the whole group of leak variables there should be a positive relationship, namely, the longer it is until movie leak the higher box office grosses should be.

The same model above will be repeated with the exception of replacing worldwide gross with DVD sales, in an attempt to investigate the effects of piracy on the home market. The process will also be repeated for domestic and international grosses. Hypothetically, a larger percentage of foreign gross is taken by piracy, so the piracy variables should be more drastic in the international model. It is important to note, however, that the data for days until release is not wholly accurate for the international market, considering that U.S. films tend to be released domestically weeks before they are released internationally. Nonetheless, the amount of days until release will still be the same in relative comparison so while the magnitude of the effect may be biased the significance of the variable should be unaffected. The DVD revenue variable may be highly influenced by the fact that these films were Oscar nominated, and generally the DVD release will have followed nomination and possible award. Therefore, the findings of the DVD analysis will be strictly confined to Oscar films.

This dataset will also be used to test a different series of hypotheses related to what causes piracy. I will primarily investigate days until first leak as the dependent variable of interest. The analysis will be done multiple times using the following parts of the dataset: every film with a pirated leak, films with leaks prior to theater release, films with leaks up to one week after theater release, and films with leaks more than a week after theatrical release. The model is:

$$FirstLeak = \beta_1 Budget + \beta_2 CriticRating + \beta_3 MPAA + \beta_4 PG + \beta_5 PG13 + \beta_6 R + \beta_7 Year + \beta_8 + \varepsilon$$

The most influential variable here should be the production budget with a negative relationship, meaning that the larger the production, the more likely it is to get leaked earlier because of the potential of insiders getting their hands on copies. In addition, high budget films have higher levels of demand and are also more likely to have outsider leaks. Critic rating should also have a negative relationship with first leak, it would be expected that demand for the film is highest if the critic rating is high, and pirates will respond with faster leaks. I do not expect that the variable for year will have any significant effect on the speed of leaks, but there are two possible relationships. First, the relationship could be positive because as technology increases it becomes easier to pirate films. On the other hand, the relationship with time could be negative because anti-piracy activity by governments and the MPAA has been successful in stemming the tide of piracy. Finally, the MPAA, PG, PG13, and R variables are dummy variables. The rating variables are included as controls, if there is a relationship it is more likely to be caused by a confounding variable, for example, the confound of gross caused because PG13 movies tend to make the most money. The MPAA should hope that the MPAA dummy variable is positive, meaning that MPAA films are leaked more slowly than other films. My expectation is actually the opposite because the large organizations affiliated with the MPAA produce highly-desirable films to be pirated.

V. RESULTS

a. Time Series Industry Dataset Summary Statistics

The movie industry has distinctly grown in the past twenty years, with an average growth rate of 4.3% since 1982. Ticket price and ticket sales have also grown, although by smaller margins at an average rate of 3.0% and 1.3%, respectively. When investigating the difference of growth rates before the year 2000 and since the turn of the century, very different results are seen. The overall gross revenues grew by 4% prior to 2000 and only be 2.2% after the year 2000, a significant difference in growth rates, $t(25)=11.29$, $p<.001$.. As a point of interest, the R^2 value drops drastically in the post-2000 model from .94 prior to 2000 down to a variability estimator of .64. Similar

significant trends are observed in ticket sales, with a yearly increase of 1.5% in ticket sales from 1982 to 2000 but an average yearly 1.2% decrease in ticket sales during this decade, $t(25)=11.84$, $p<.001$.

Interestingly enough, this trend is reversed when observing ticket price. Before 2000 ticket price increased by 2.5% each year but since the new millennium it has significantly increased by 3.4% per year, $t(25)=16.33$, $p<.001$. This result is especially disconcerting considering that if the movie industry intends to react rationally to the rise of piracy, then the pricing of tickets should be decreasing. In this scenario, the unexpected rise in prices should actually encourage customers to turn towards the substitute of piracy.

Finally, when investigating the time trends of gross for the top grossing 20 films per year the results are very similar. The average growth of the top 20 films of a year's combined gross revenue over the entire dataset is 4.2%. For the top 20 films prior to 2000 the growth rate is 4.3%, dropping to 1.8% yearly growth rate after the year 2000. These results mirror the findings for overall gross, although the separated data sets are more extreme in their growth rates from year to year. Finally, when investigating the growth rate of the combined Big Six studios of the MPAA, data of which is only available for 2000 and afterwards, the growth rate is found to be 4.5%. This finding means that despite the fact that the top 20 films of a year and the overall gross revenue growth rate have only been growing around 2% each year since 2000, the Big Six studios continue to see a growth rate over 4%, indicating an increasing domination of the movie industry. Summary statistics for the entire dataset can be found in Table 2.

b. Time Series Industry Dataset Model Analysis

The results for the first regression model can be found in Table 5. The model is incredibly significant and accounts for 96.23% of the variability in gross revenue, which is relatively unsurprising considering the data is both time trended and includes the highly significant variables of ticket price and production budget, $F(5,15)=78.27$, $p<.001$. A graph depicting the predicted gross using this model against the observed gross revenues is shown in Graph 4. The variable for time was not significant, in addition to the variables for number of movies and screens. These results are not particularly surprising

with the exception of time. It seems that the significance of ticket price and production budget, $t(20)=4.38$, $p<.01$ and $t(20)=2.46$, $p<.05$, overwhelm the effect of time since both of these variables are increasing rapidly over the years. These results are relatively intuitive, as the pricing of the box office increases; we would also expect that gross revenues should increase across years. It is possible that this increase in pricing is actually a response to GDP growth, but nonetheless it has clearly had a positive effect on revenue. The increase in production budget reflects the majority of previous research, and considering the highest-revenue producing movies in a given year are a collection of blockbusters, this finding is especially unsurprising.

The second model for overall gross revenue was the simple piracy model which ended up being insignificant, $F(3,2)=1.67$, $p>.05$ (Table 6). None of the variables, including time, were significant in predicting overall gross revenue in this model. Part of the issue may be that when observing the data for these 5 years there is the distinct dip in industry revenue, which would confuse the variables in this very small dataset. When regressing without the time trend, the entire model simply becomes weaker while continuing to lack any kind of significant effects either individually or as an overall model.

This entire process was repeated for the top 20 grossing movies in a given year. As in the model for overall gross revenue, the basic industry revenue model was highly significant, however the variables of ticket price and production cost were marginally less significant, $F(5,15)=29.28$, $p<.001$, $t(20)=2.05$, $p=.06$ and $t(20)=2.02$, $p=.06$ (Table 5). The simple model for piracy on the top 20 films was much more interesting (Table 6). The entire model was still insignificant, $F(3,2)=8.06$, $p>.05$, resulting from the low number of observations. Nonetheless, the individual effects were significant at the 10% level, the most significant of which was time, followed by days until first leak, and finally percentage of quality screeners leaked, $t(5)=4.61$, $p=.044$, $t(5)=-3.75$, $p=.064$ and $t(5)=3.07$, $p=.092$. The positive effect for time was expected, however the effects for both piracy variables are in the opposite prediction expected. The negative relationship with days until first leak implies that the longer until a first leak the lower the revenues of the top 20 movies and the positive relationship with percent of quality screener leaks means that as more quality screener leaks were released the higher revenues of the top 20 films

in a year. These findings are likely caused by confounding factors occurring from this limited model, but the finding is somewhat surprising. When dropping the time trend variable for this data, the independent pirate proxies lose significance, suggesting that time confounds were the cause of this unexpected result.

Once again these models were created for the MPAA gross variable, the summation of the revenues of the Big Six distributors. For the limited basic industry model the only variables are time, ticket price, and number of movies released and it ended up being significant, $F(3,5)=14.57$, $p<.01$ (Table 5). Interestingly enough, none of the independent variables in this model were significant, including the commonly significant ticket price variable. This could be the result of the very small dataset used; however, it is more likely that the lack of the significant controlling variable of production budget caused the rest of the variables to lose significance. The models for simple piracy with and without the time trends were both insignificant with insignificant independent variables, $F(3,2)=3.26$, $p>.05$ and $F(2,3)=1.88$, $p>.05$ (Table 6). Once again the issue of a small dataset contaminates the results; however, these findings imply that the percentage of quality leaks and the number of days until first pirated leak have no significant effect on MPAA revenues, which is not the result that was expected.

The final analysis using the time series data investigated the dependent variable of DVD sales. The limited industry model used for the MPAA model was also used for the DVD sales model and it was also significant with one significant independent variable, the number of movies, $F(3,7)=69.92$, $p<.001$ and $t(10)=2.25$, $p=.06$ (Table 5). This result means that the more movies that were released in a year the higher the sales of DVDs were, which is unsurprising considering it simply means that the supply of DVDs was higher. The piracy model for DVD sales was only significant when the time trend was included, and this is likely the result of a very drastic upwards trend in DVD sales from year to year (Table 6). For this reason, in addition to the insignificance of the independent variables, I am discounting this model in my analysis.

c. Oscar Film Piracy and Revenue Dataset Summary Statistics

The variables of interest in this dataset are the leak variables in relation to the gross revenues of films. Furthermore, the categorization of films into MPAA and non-

MPAA is of special interest to the United States film industry and yields some interesting findings. A series of scatter plots were created and can be found in the Appendix of graphs. These scatter plots compare worldwide gross to days after U.S. release until first leak (Graph 5), days after U.S. release until screener leak (Graph 8), and days after U.S. release until DVD release (Graph 11). The variable for days from screener release to screener release was not included because the findings would not relate to the three scatter plots created above, in addition to being a very widespread scatter plot. For the three scatter plots created, they were also reformed under two other conditions: one of which was whether the films were MPAA-affiliated (Graph 6, 9, & 12), and the other was whether the films were independently produced (Graph 7, 10, & 13). Finally, scatter plots for domestic gross, international gross, and DVD gross were all not included because the plots almost perfectly reflect the worldwide gross plots. The likely reason for this is the high levels of correlation between all of these variables which can be seen in the correlation matrix in (Table 7).

The shapes of the scatter plot distributions are very surprising. Theoretically, we would expect the revenues of films to be increasing as the length of days before leaks decreased. However, the data is shaped more like the normal distribution over time, with the highest grossing movies in the center of the data. The median for days until first leak is 3 while the mean is 14.42, indicating that this data is positively skewed. The data for days until screener leak and days until DVD leak appear to be more normally distributed since their medians are 43 and 108.5 compared to the slightly different means of 46.655 and 110.574, respectively. According to this data, the majority of all highest grossing movies have piracy releases on or very close to the day of U.S. opening in theaters. Furthermore, the only significant correlation between worldwide gross and the leak variables is for days after U.S. release until first leak, and the correlation between the two variables is actually negative instead of positive as predicted!

Interestingly enough, when comparing the scatter plots between all movies and MPAA-affiliated movies the results appear to be very similar. On the other hand, when the scatter plot is created for independently-released films the bell-shape disappears and the data becomes much more flat with a few outliers across the period of time. There still remains no linear relationship for these models, but the shape of the potentially nonlinear

relationship also disappears. This means that the leaks in independently-released films occur over a more random period of time whereas the MPAA leaks are concentrated in a small period of days with many outlying observations.

Summary statistics for all of the variables used in this dataset can be found in Table 4 and the correlation matrix for the revenue and piracy variables are all shown in Table 7.

d. Oscar Film Piracy and Revenue Dataset Model Analysis

Several variations of the model presented in the theoretical model section were employed in order to analyze the difference between including various variables in the model (Table 8). First, the inclusion of the advertising budget variable decreases the significance and variance accounted for by the model because of all the observations missing, so that variable can be readily dropped from the analysis, although a complete analysis including that variable would be desirable.

The most readily apparent factor in determining worldwide gross revenue is that production budget matters. Models which include the production budget variable all find incredible significance at far below the 1% level. For example, in the full model the production budget is the most significant variable, $t(103)=6.29$, $p<.01$, and when regressing for production budget alone against worldwide gross significance is even more exaggerated, $t(174)=10.32$, $p<.01$. Furthermore, the R^2 values fluctuate greatly with the inclusion or exclusion of the production budget variable, where the full model has an R^2 of .6051 compared to .3603 when the production variable is not included. This finding is not particularly surprising, it reflects the literature and the time trend analysis previously performed, however, the strength of association with production that consistently holds from movie to movie is quite impressive. It does indicate why film distributors are willing to spend so much on production budgets and why they are increasing at more rapid rates as time goes by.

The second finding is that the higher the Rotten Tomatoes rating, the meta-score created from the amalgamation of a large base of professional critics, has a positive, significant effect on worldwide gross. In the full model, critic rating is only significant at the 10% level, and it remains this way as the control variables are dropped from the

model, $t(103)=1.67$, $p=.099$ and $t(103)=1.75$, $p=.083$. On the other hand, if the production variable is removed and the critic variable remains then it is actually found to be an insignificant factor, $t(108)=0.22$, $p=.827$. Furthermore, the removal of the critic variable in the full model only causes the R^2 value to drop from .6051 to .5792. So while the critic variable has been found to be significant in many regressions it seems possible that the power of the critics is more predictive rather than influential as discuss by Boatwright et. al (2007). It is also necessary to keep in mind that the data used in this analysis is a collection of Oscar nominated films, and the reflection of the industry's opinion on critical evaluation has been found to be more powerful than the impact of critical evaluation on gross revenues (Holbrook & Addis, 2008). As a final note, in this dataset the Rotten Tomatoes scores tend to accumulate at the higher end of the spectrum, probably because the films are Oscar-nominated and there is an obvious lack of random sampling and variance in regards to this variable in particular.

The variety of control variables such as MPAA, the parental rating dummies, and the year of release all appear to have very little impact on the model since they are always insignificant. In addition, the removal of these variables has almost no effect on the overall *F*-score of a model or the R^2 results. Although the inclusion of these variables strengthens the model, their effects are so marginal that the model will function well without them.

The piracy variables are all insignificant in the complete model, although days from U.S. release until screener leak begins to approach significance, $t(103)=1.66$, $p=.100$. If the insignificant control variables mentioned above are removed then days from U.S. release until screener leak becomes significant and positive at the 10% level indicating that the longer amount of time from release until a quality pirated copy, the larger revenues will be, $t(103)=1.90$, $p=.061$. In the absence of the critic variable, days from screener release until screener leak becomes significant and negative, $t(118)=-2.31$, $p=.023$, while days from U.S. release until screener leak maintains its 10% positive, significant status. If the production variable is dropped and the critic variable is replaced, suddenly all leak variables become significant. This finding is replicated if both the production and critic variables are dropped from the model, so the new regression only tests the leak variables against the worldwide budget. The two most significant piracy

variables are also the most interesting: with days from U.S. release to screener leak becoming significant at the 1% level in the same positive direction as expected, $t(124)=3.05$, $p<.01$. On the other hand, days from U.S. release until first leak is negatively significant, a finding that is opposite of this paper's expectation, $t(124)=-2.91$, $p<.01$. This means that as pirated leaks become available sooner, worldwide gross revenue actually trends upwards! A similarly surprising effect is found for days from U.S. release until DVD leak, which is also negatively associated.

For the most part, the findings in worldwide gross are reflected when the models are repeated using domestic and international grosses. Still, there are several interesting, significant differences between these models that are worth investigating.

In the domestic market, the proxy variable for critic rating which is the Rotten Tomatoes score is always insignificant (Table 9). For some reason, critics seem incapable of predicting or influencing the consumption of films in the U.S. market. It is possible that this is because the United States market is so strong that the opinions of third parties, or critics, are readily discounted. In replacement, the dummy variable for MPAA-affiliated films gains significance. In the full model MPAA is positively significant at the 10% level and becomes even more significant at 5% when included in the restricted model that excludes the insignificant control variables, $t(104)=1.95$, $p=.054$ and $t(104)=2.09$, $p=.039$. This finding is not surprising considering almost all domestic films are created by the MPAA or their affiliates and their footing in the domestic market is much stronger than any kinds of foreign films. Furthermore, U.S. consumers are familiar with the MPAA-affiliated companies and may simply prefer to patronize their services in some kind of brand loyalty stemming from previously enjoyed movies.

The significant effects for production budget and most of the piracy variables directly reflect the findings in the worldwide gross model with the exception of one leak type: days until DVD leak. It is possible that U.S. pirates are unaffected by the leaks of DVD because other high-quality releases are available in the form of screener leaks. Furthermore, since the per capita income in the United States is very high, it is more likely that consumers will have their own manner of utilizing DVD technology and are willing to pay the relatively low price for permanent ownership of the DVD as opposed to constantly risking legal repercussions.

The findings in the international models also strongly reflect the findings in the worldwide model (Table 10). The only real difference in this model is that the significance of days until DVD leak is positive instead of negative and in more full models or the model including only the various forms of piracy leaks, the variable is significant at the 5% level, $t(124)=-2.31$, $p=.022$. Once again, however, this variable is significant in the opposite direction of expectation, where the sooner the DVD leak becomes available the higher the international gross levels are. This is especially surprising considering that hard disc piracy is most prevalent abroad and the highest quality leak should increase the quality of the pirated optical disks, discouraging legal consumption.

The regression findings for domestic DVD sales are less convincing and much more sporadic (Table 11). This could be the result of only 47 complete observations in the model due to a lack of DVD sales data. In the full model the variables that are significant are critic rating at 10% significance, and if the movie was rated PG or PG13 at 5% and 1% significance level, respectively. As the model is made smaller very few variables of interest are revealed. The one interesting finding is when the model is parsed down to only including leak variables, where the only significant finding is that days until DVD leak has a negative, significant relationship, $t(51)=-2.05$, $p=.046$. This once again is a result in the opposite direction expected, because it suggests that if DVD leaks occur sooner the market for DVD sales is higher, whereas the opposite is implied by the literature.

Following the investigation of gross sales and revenue, the models for what caused the first leak were tested (Table 12). The overall model for all leaks was significant as a whole, but only had one significant variable, production, $F(7,142)=2.90$, $p=<.01$ and $t(149)=-1.84$, $p=.067$. The negative relationship with production cost means that the higher the budget of the film, the faster the film was leaked, which was what I predicted in my model. This is a logical conclusion considering there are more possibilities for internal leaks in long production process. Furthermore, the demand for the film, and thus pirated demand, is very high. All of these factors encourage the acquisition of outside pirate leaks.

Analysis investigating grouping the specific timing of the leaks was also carried out (Table 12). For leaks that were released before theatrical openings, the entire model, including production budget, was insignificant in predicting leak days, $F(7,23)=1.20$, $p=.34$. These findings show that very early leaks occur for a potential variety of reasons, none of which were predicted by this model. Similarly, no significant effects were found for any films leaked within the first week of theatrical opening, $F(7,44)=0.64$, $p=.7164$. On the other hand, a significant model was found for movies leaked more than a week after their opening with production budget being incredibly significant and negative, $F(5,51)=3.19$, $p=.014$ and $t(56)=-3.60$, $p<.01$.

VI. CONCLUSION

Like many studies in the past, the present paper has met with some difficulty in trying to investigate the black market of copyrighted material piracy. Due to the limited resources of the researcher in investigating illicit behavior, trends in available market data was used to examine the possible effects of piracy.

In analyzing the time series data for trends in box office grosses a definitive decrease in revenue gross was found. In the current decade, movie sales have been growing but at much slower rates than previous years. It would seem that the rise of piracy and pirating capabilities in the past ten years have had a negative impact on the industry as a whole. That being said, there are definitive other factors that are combating the box office market which could account for these losses.

First, we know that a good portion of the theater market has been moving towards the home video market as consumers opt for the comfort of their homes thanks to the advances in technology such as high-definition televisions and DVD players (Bakalis, 2003; Vogel, 1998). In addition, while rising prices may be reflecting a growth in GDP, the increase in price would also deter consumers from choosing to patronize films. In the face of growing piracy, the ever-increasing price of a movie ticket threatens to discourage more and more consumers.

The piracy model in the time-series regression yielded no significant results, implying that the amount of time it takes pirated films to release has no significant effect on gross revenues. This could simply mean that movie pirates are patient people or it

could imply that piracy does not have the devastating effect on the movie industry that it previously claimed. Nonetheless, this finding should be viewed with serious caution since the power of detecting an effect in this model is very small given the lack of observations for the simple piracy model.

This paper then moved on to investigate the effect of times until piracy releases on individual films. Perhaps the most interesting finding of this analysis was in the data investigation of time after U.S. release until pirated film release. This extremely spiked scatter plot with long tails showed that 56.6% of films making over 100 billion dollars in the world wide box office had film leaks within the first week of release, most of which occurred in just the first three days, or more specifically, the weekend of release. Theoretically, according to DeVany and Walls (2007) films with early pirate leaks suffer the most from piracy in the form of rapidly decreasing box office revenues from week to week. The present paper's findings do not necessarily contradict this statement, but it is curious to see that the majority of successful movies are pirated very early, and despite the effect described by DeVany and Walls (2007), these films continue to make very large profits.

In this manner, it seems that piracy is actually trying to directly emulate the legal movie market, by providing early copies of high demand movies. This trend is not as strong in the days until screener leaks data, but there does appear to be a specific point where the majority of very profitable films also have high-quality pirated videos.

If this is the case, why are movies that get leaked prior to U.S. release generally so unsuccessful, and why do the most profitable movies not get released until just after the U.S. release date? Obviously, films that are leaked prior to U.S. release are subject to insider leaks, whereas films released afterwards can either be insider leaks, generally as screener leaks, or outsider leaks, in the form of cam leaks. When observing the data of what kinds of leaks occurred within the first week, we find that 94.4% of films released were in the cam format and only 5.6% were in the quality screener format, meaning that pirates knew there was a high demand and sought to externally copy the film as quickly as possible. On the other hand, the leaks that occurred very late or very early had 55.8% released as cam copies and 44.2% that were released as screener or DVD-quality leaks, suggesting a much larger source of insider copying.

Throughout this paper I have argued that films with high production budgets were most likely to have insider leaks because of the large range of production assistants that could pirate the film, but it is possible instead that the opposite is true. The data indicate that high budget films usually experience primary leaks in the form of cams, an outsider leak. This suggests that films with higher production budgets may have better security measures for their movies, considering movie distributors are very aware that piracy is an issue that they face. Following this logic, films with low budgets probably have several operational "holes" that allow for easy internal piracy.

The last group of movies, films whose pirated versions are released more than a week after theatrical release, is a bit more complex to understand. These films tend to have lower production budgets and lower worldwide grosses. As a matter of fact, the trend of days after theatrical release to piracy release and worldwide gross is significantly negative. This may simply reflect low levels of demand for the film, however, if demand levels are so low for these films, why bother pirating them at all? Part of the solution may be in the fact that all of the films in this data set are Oscar nominated. In this manner, a good portion of these late pirate release films may be sleeper films that met with some word-of-mouth popularity and an Oscar nomination, increasing the demand for the given film.

In the models analyzed for Oscar films there was only one constant factor that affected worldwide gross: production budget. According to previous findings by Boatwright et. al (2007) and others, there is a clear indication that this is what is to be expected. Further, this paper found that with this control of production, the effects of days before piracy release were always significant. When the control variable of production is removed, there is some significance found for the variables of piracy leaks. The two most important findings are that worldwide gross and days before screener release are positively associated, as predicted earlier in the paper, but worldwide gross and days before first leak, generally cam leaks, was negatively associated. As discussed above, this finding is not very logical in terms of the findings of DeVany and Walls (2007) and the claims of the MPAA (2005), and more likely represents a trend in the positively skewed data.

This trend is simply as follows: if pirates have high demand for films, then the pirated film will be released earlier. It is not until the quality screener leak is released that box office grosses really begin to suffer, hence the positive relationship between days to screener leaks and worldwide gross. These findings really emphasize the point that piracy is a substitute for films; however, that substitution, or displacement, may be relatively small when referring to poor quality cam leaks. On the other hand, the displacement of films is quite high when the quality of the pirated footage almost parallels the quality of the in-theater film.

Of course, the data in this paper is simply analyzing the amount of days until piracy release. If the nominal effect of piracy is equal across all movies, then this paper has no manner in measuring that. Instead, the present study has shown the effect of piracy on worldwide gross in terms of the time it takes for pirated films to be released. While the trends in data have yielded interesting results, the inclusion of all control variables, especially productions costs, dwarfs the effects of speedy or slow piracy leaks.

In conclusion, this paper is not refuting that piracy is a serious problem in the film industry; the researcher realizes how important this issue is. That being said, the rising price of tickets in the box office shows a lack of economic effort on movie distributor's behalves in attempting to mitigate the amount of consumer losses to piracy. Furthermore, the impact of all kinds of piracy may not be as substantial as purported by the MPAA, at least, not in terms of the speed in which piracy is released. This holds especially true for cam leaks, where the poor quality of the footage only seems to interest the marginal film consumer. Considering that cam leaks were available for 184 of the 185 films in the Oscar Film Piracy and Revenue Dataset, the movie industry may want to focus on fighting anti-piracy in economic terms rather than simply trying to stop it, seeing as how they seem unable to prevent piracy worldwide.

On the other hand, the MPAA's concerns about screener leaks may be more founded in business logic, and before releasing screeners for their films movie distributors may wish to consider how recently their film opened in theaters. Of course, movie distributors are loathe to pass up Oscar or Academy Award opportunities, but the benefit of the prestige and subsequent interest in the film should be weighed against the serious possibility of revenue loss to piracy.

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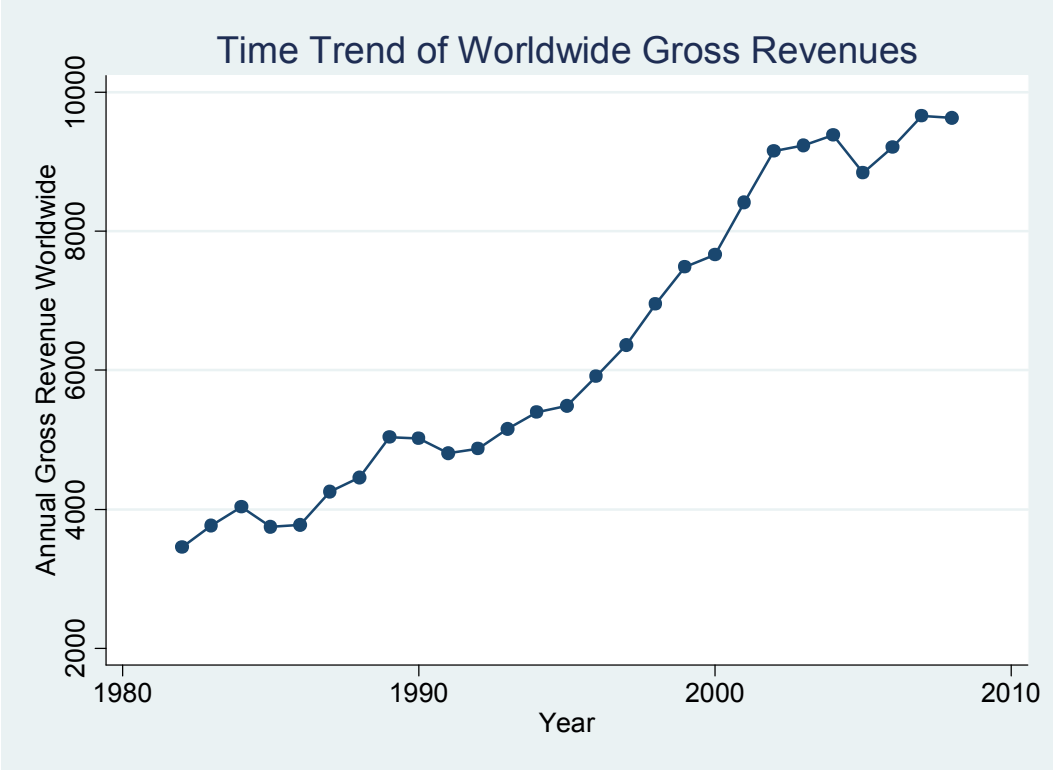
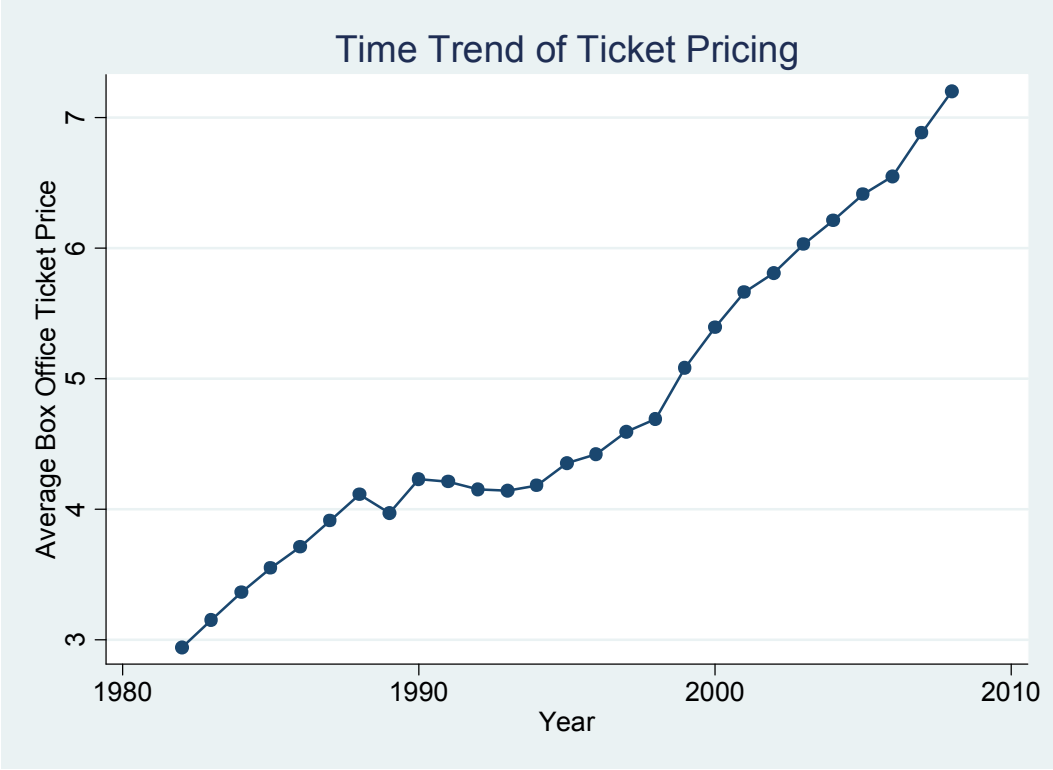
Appendix

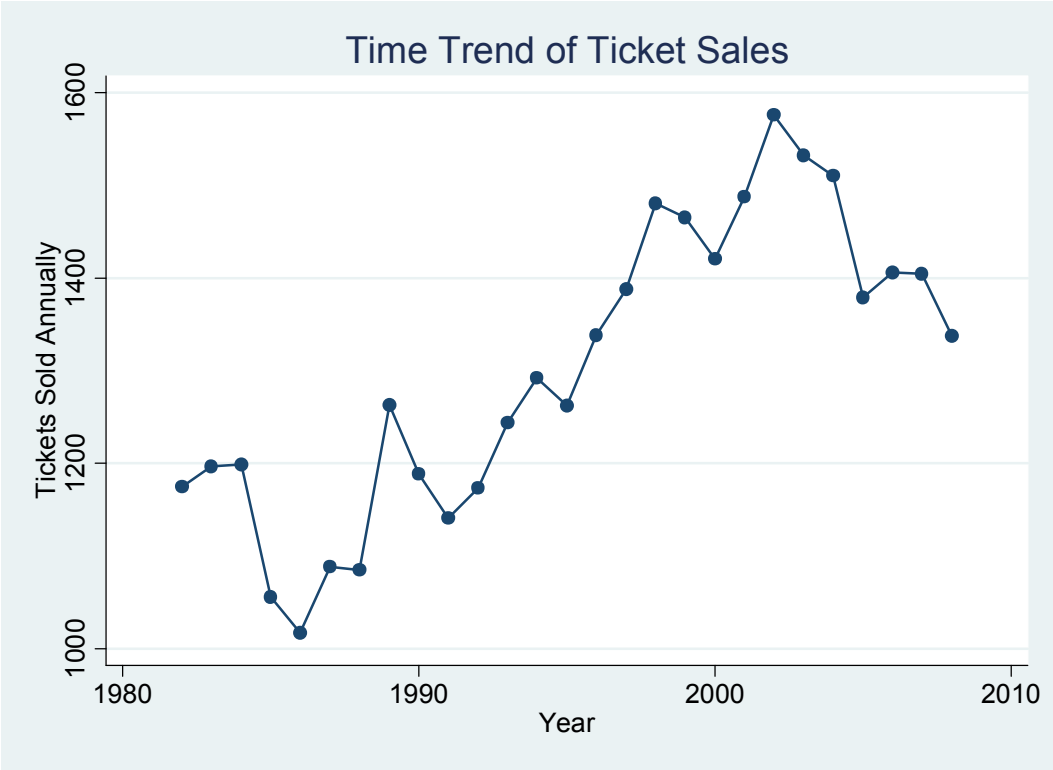
Graph 1: The Growth of Worldwide Revenues



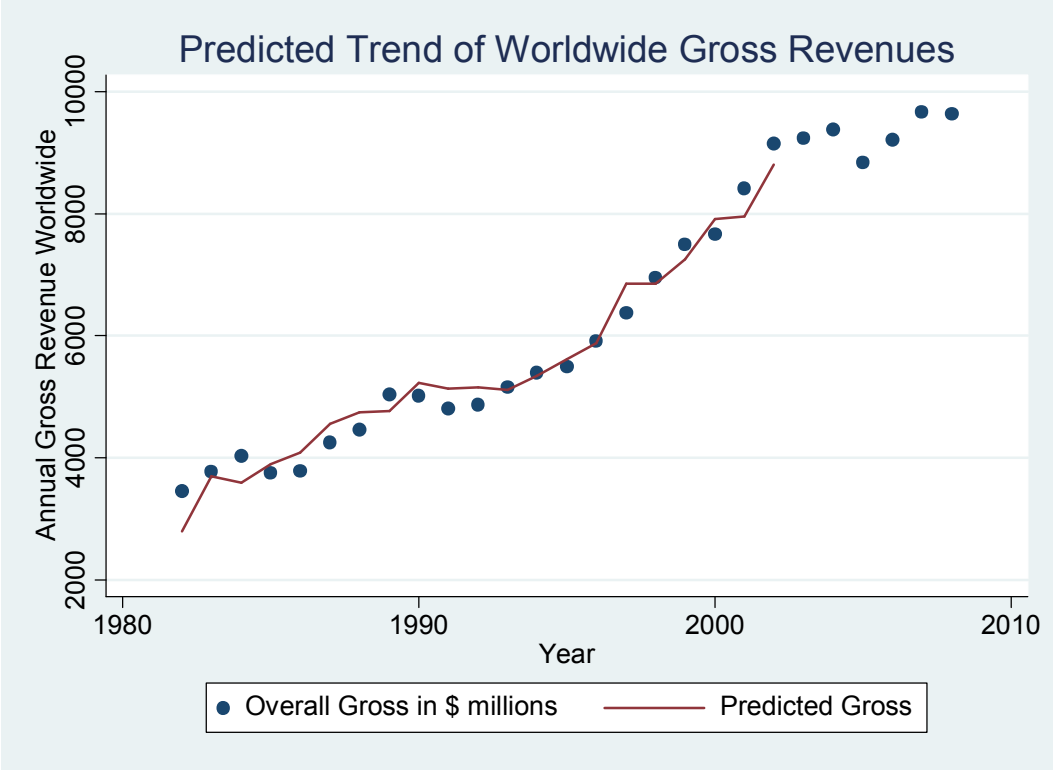
Graph 2: The Rise in Ticket Pricing



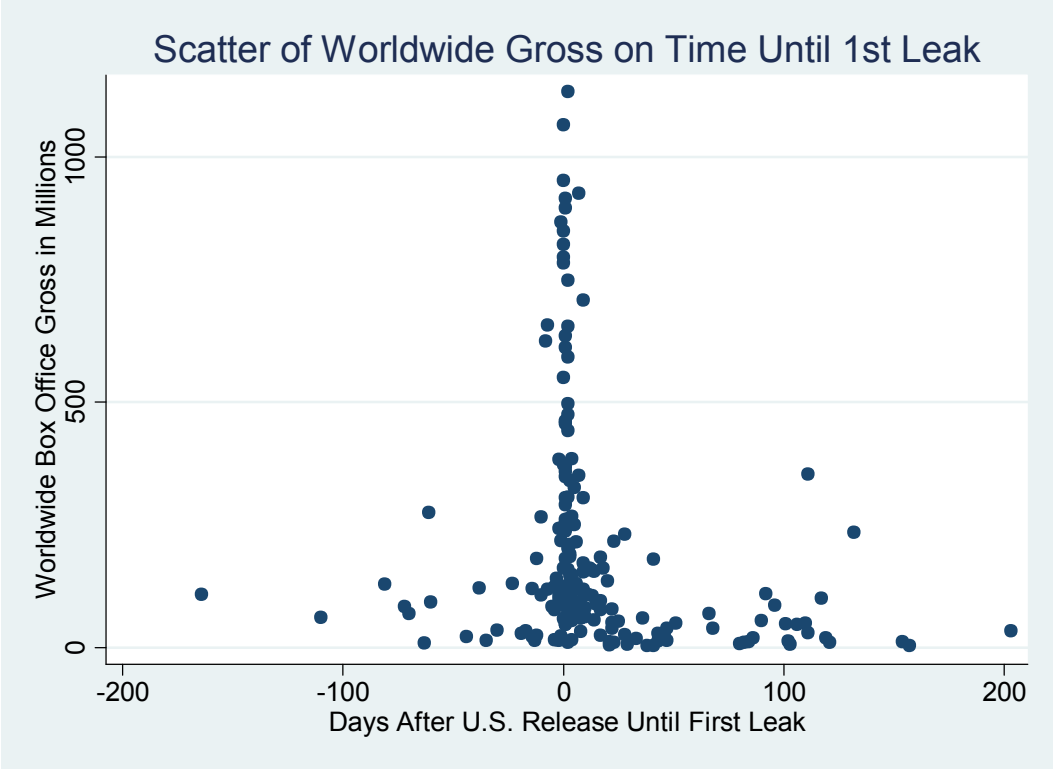
Graph 3: Number of Box Office Tickets Sold Annually



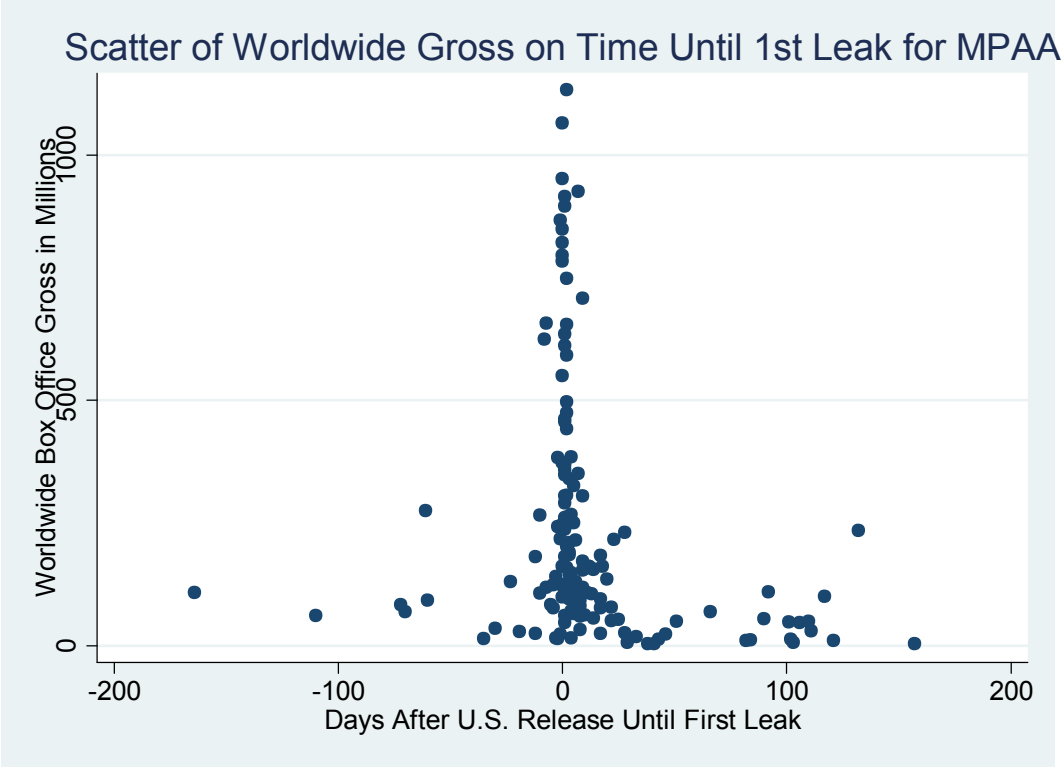
Graph 4: Predicted Model of Revenues Compared to Observed Until 2002



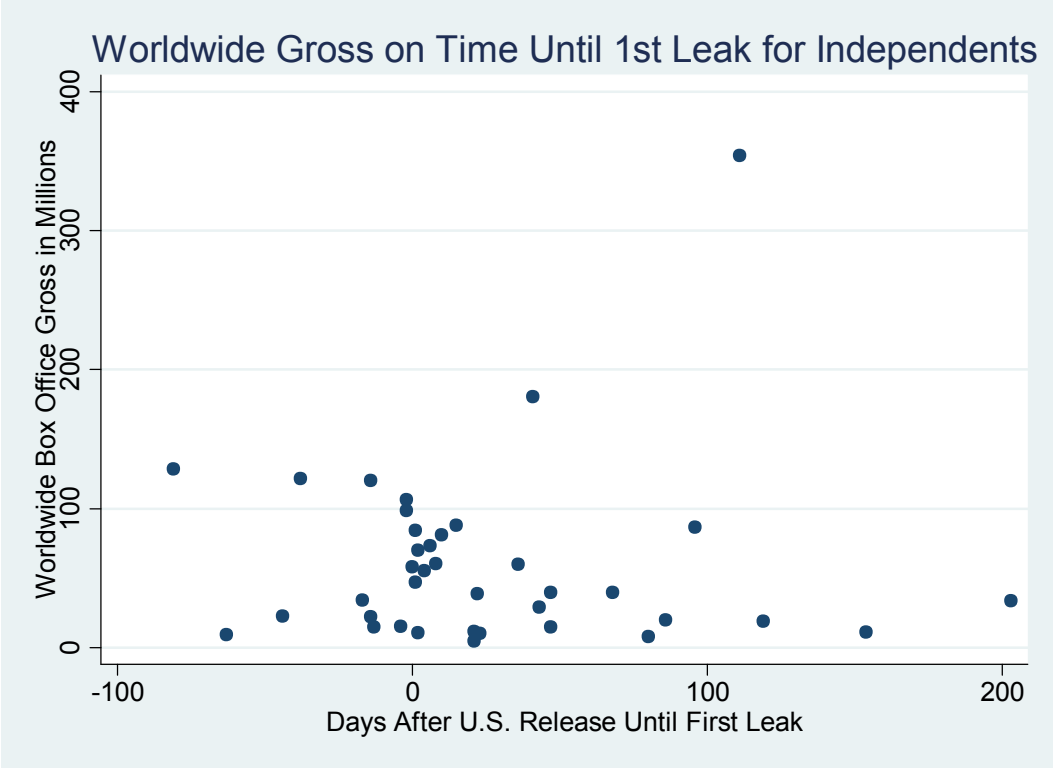
Graph 5: Scatter of Worldwide Gross Against Days Until 1st Leak



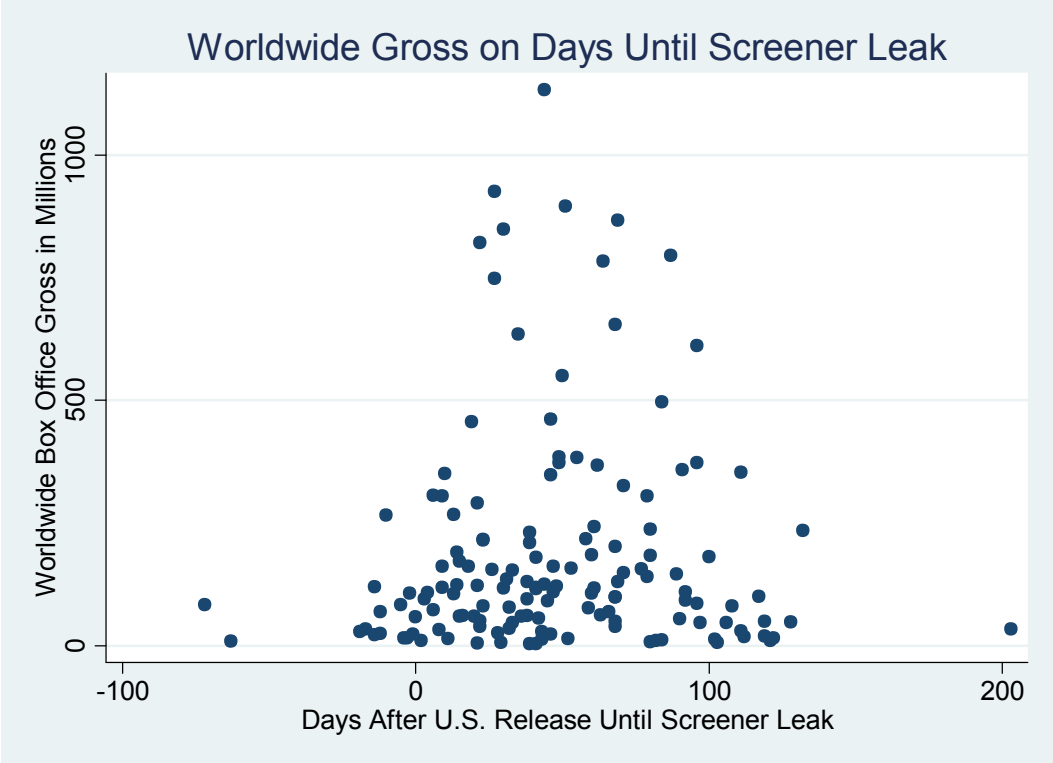
Graph 6: Scatter of Worldwide Gross Against Days Until 1st Leak for MPAA Films



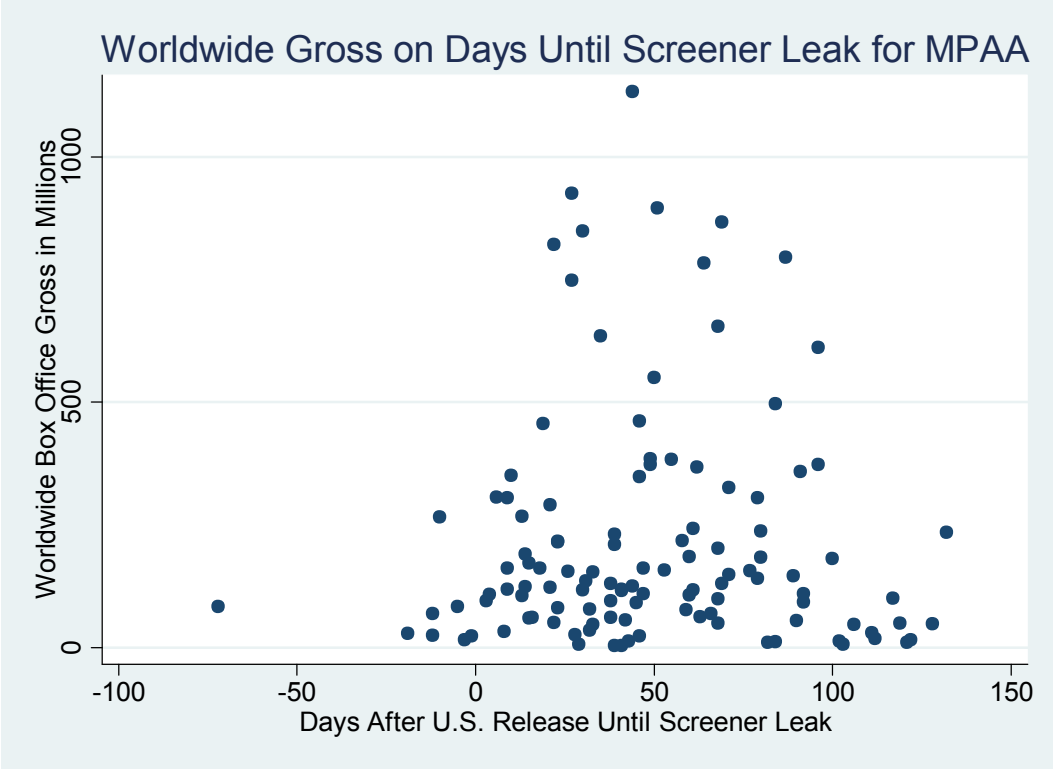
Graph 7: Scatter of Worldwide Gross Against Days Until 1st Leak for Independents



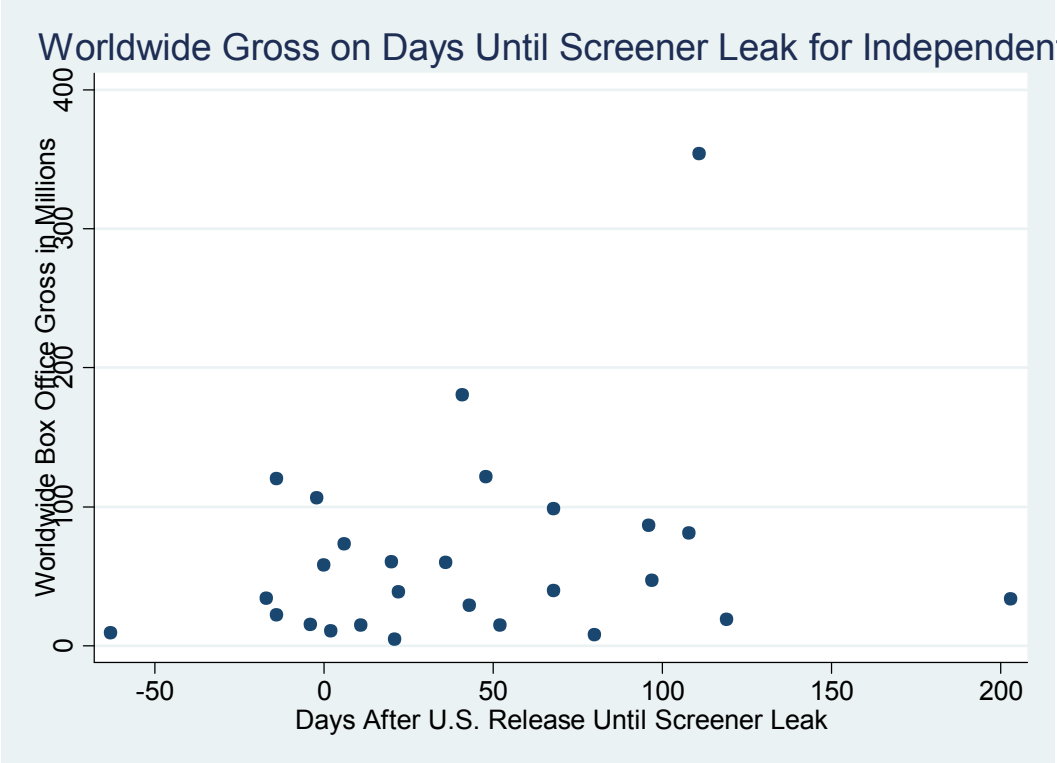
Graph 8: Scatter of Worldwide Gross Against Days Until 1st Screener Leak



Graph 9: Worldwide Gross Against Days Until 1st Screener Leak for MPAA Films



Graph 10: Worldwide Gross Against Days Until 1st Screener Leak for Independents



Graph 11: Scatter of Worldwide Gross Against Days Until 1st DVD Leak

Graph 12: Worldwide Gross Against Days Until 1st DVD Leak for MPAA Films

Graph 13: Worldwide Gross Against Days Until 1st DVD Leak for Independents

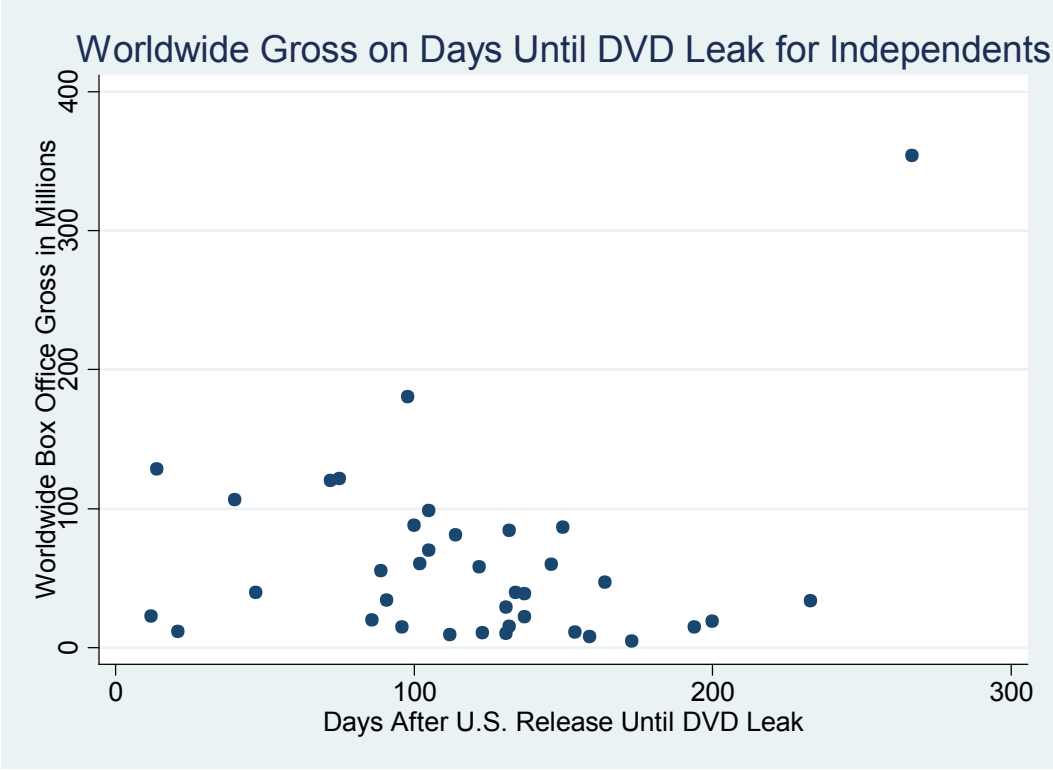


Table 1: Explanation of Variables for Time Series Industry Dataset

Variables	Explanation
Box Office Gross	The overall box office gross revenue for all movies released for year in millions of $
Top 20 Gross	The sum box office revenue for the top 20 grossing films of the year in millions of $
MPAA Affiliate Gross	The sum box office revenue for the Big Six motion picture distributors
DVD Sales	The domestic sales counts of DVDs in millions of units
Average Ticket Price	The average price of a box office ticket for all theaters in $
Tickets Sold	The quantity of tickets sold at the box office for the year
Average Production Budget	The average production budget for all films released in millions of $
Number of Films Released	The total number of films that were released in the year
Theater Screens Available	The number of film screens that were open in the United States
Average Days from Theatrical Release Until First Leak	The average number of days between theatrical release and the first instance of internet piracy for Oscar-nominated films
Percentage of Films with Screener Leaks	The percentage of Oscar-nominated films which experienced an internet screener leak
Time	The year, ranging from 1982 to 2008

Table 2: Summary Statistics for Time Series Industry Dataset

Variable	Observations	Mean	Std. Deviation
Box Office Gross (in millions $)	27	6339.552	2168.716
Top 20 Gross (in millions $)	27	2661.848	904.193
MPAA Affiliate Gross (in millions $)	9	6553.678	853.931
DVD Sales (in millions of units)	11	3699.582	3737.581
Average Ticket Price (in $)	27	4.773	1.188
Tickets Sold (in millions)	27	1300.263	158.084
Average Production Budget (in millions $)	22	33.591	16.674
Number of Films Released	27	496.667	55.455
Theater Screens Available	21	26185.380	8118.650
Average Days from Theatrical Release Until First Leak	7	17.286	9.725
Percentage of Films with Screener Leaks	7	0.788	0.1348

Table 3: Explanation of Variables in Oscar Film Piracy and Revenue Dataset

Variables	Explanation
Worldwide Gross	The film's worldwide gross revenues at the box office in millions of $
Domestic Gross	The film's domestic, or U.S., gross revenues at the box office in millions of $
International Gross	The film's international, all non-U.S., gross revenues at the box office in millions of $
Domestic DVD Sales	The film's domestic, or U.S., revenue from DVD sales in millions of $
Days Until First Leak	The number of days between theatrical release and the first instance of internet piracy, in any form
Days Until Screener Leak	The number of days between theatrical release and the first instance of a pirated screener on the internet
Screener Release to Screener Leak	The number of days between screener release to judges and the first instance of a pirated screener on the internet
Days Until DVD Leak	The number of days between theatrical release and the first instance of a pirated DVD film on the internet
Production Budget	The production costs of the film in millions of $
Advertising Budget	The advertising costs of the film in millions of $
Rotten Tomatoes Rating	The Rotten Tomatoes score of a film; used as a proxy for critic evaluation of the film
MPAA Affiliation Dummy	A dummy variable where a score of '1' indicates the film was produced by one of the Big Six, and '0' indicates the film was produced by an independent
'G' Rating Dummy	A dummy variable where a score of '1' indicates a 'G' rating; not included in the analyses because only 3 rating dummies required for this 4 variable set of data
'PG' Rating Dummy	A dummy variable where a score of '1' indicates a 'PG' rating
'PG13' Rating Dummy	A dummy variable where a score of '1' indicates a 'PG13' rating
'R' Rating Dummy	A dummy variable where a score of '1' indicates a 'R' rating
Year	The year in which the film was released

Table 4: Summary Statistics for Oscar Film Piracy and Revenue Dataset

Variable	Observations	Mean	Std. Deviation
Worldwide Gross	183	199.403	240.658
Domestic Gross	185	84.709	100.488
International Gross	183	113.880	147.245
Domestic DVD Sales	82	71.100	91.803
Days Until First Leak	184	14.424	44.288
Days Until Screener Leak	145	46.655	40.943
Screener Release to Screener Leak	134	-17.507	69.340
Days Until DVD Leak	176	110.574	50.634
Production Budget	177	51.994	48.503
Advertising Budget	61	36.761	14.883
Rotten Tomatoes Rating	157	77.732	18.302
MPAA Affiliation Dummy	185	.789	-
'G' Rating Dummy	179	.039	-
'PG' Rating Dummy	179	.145	-
'PG13' Rating Dummy	179	.352	-
'R' Rating Dummy	179	.469	-
Year	185	2004.649	1.710

Table 5: Regression Results for Time Series Industry Gross Revenue Variables

Independent Variables	Overall Box Office Gross	Top 20 Grossing Films	MPAA Affiliate Gross	Domestic DVD Sales
Time (in years)	-43.687 (78.151)	-25.523 (55.909)	311.373 (541.980)	197.327 (1227.890)
Average Ticket Price (in $)	1666.971 (380.612)***	558.561 (272.291)*	-222.859 (2176.579)	1715.829 (4591.281)
Average Production Budget (in millions $)	55.799 (22.726)**	32.834 (16.259)*		
Number of Films Released	1.079 (2.574)	-.681 (1.841)	1.485 (6.758)	31.038 (13.795)*
Theater Screens Available	-.032 (.022)	-.009 (.016)		
Constant	83933.93 (154351.9)	50283.88 (110423.9)	-616854.3 (1070645)	-418344.2 (2426062)
Observations	21	21	9	11
F-score	78.27***	29.28***	14.57***	69.91***
Adjusted R^2	.951	.876	.836	.9539

Standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%

Table 6: Regression Results for Time Series Simple Model of Piracy

Independent Variables	Overall Box Office Gross	Top 20 Grossing Films	MPAA Affiliate Gross	Domestic DVD Sales
Time (in years)	180.158 (116.170)	221.745 (48.111)**	370.005 (206.050)	1636.985 (28.763)***
Average Days from Theatrical Release Until First Leak	-30.895 (18.309)	-28.487 (7.583)*	3.443 (32.475)	.826 (4.533)
Percentage of Films with Screener Leaks	178.027 (1295.754)	1648.054 (536.628)*	621.383 (2298.284)	645.615 (320.827)
Constant	-351662.9 (233613.6)	-441780.1 (96749.47)**	-735633.1 (414361.3	-3277132 (57842.42)***
Observations	6	6	6	6
F-score	1.67	8.06	3.26	3662.83
Adjusted R^2	.2869	.8089	.5753	.9995

Standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%

Table 7: Correlation Matrix for Revenue and Pirate Variables in Oscar Film Piracy and Revenue Dataset

	Worldwide Gross	Domestic Gross	International Gross	Domestic DVD Sales	Days Until First Leak	Days Until Scr. Leak	Scr. Release to Scr. Leak	Days Until DVD Leak
Worldwide Gross	1.000 *p*=N/A n=183							
Domestic Gross	.9566 *p*=.000 n=183	1.000 *p*=N/A n=185						
International Gross	.9799 *p*=.000 n=183	.8794 *p*=.000 n=183	1.000 *p*=N/A n=183					
Domestic DVD Sales	.8841 *p*=.000 n=82	.8918 *p*=.000 n=82	.8415 *p*=.000 n=82	1.000 *p*=N/A n=82				
Days Until First Leak	-.189 *p*=.011 n=182	-.172 *p*=.020 n=184	-.188 *p*=.011 n=182	-.176 *p*=.114 n=82	1.000 *p*=N/A n=184			
Days Until Screener Leak	.0381 *p*=.652 n=143	.062 *p*=.462 n=145	.029 *p*=.734 n=143	-.065 *p*=.619 n=61	.657 *p*=.000 n=145	1.000 *p*=N/A n=145		
Screener Release to Screener Leak	-.2594 *p*=.003 n=132	-.292 *p*=.001 n=134	-.222 *p*=.011 n=132	-.374 *p*=.004 n=58	.218 *p*=.011 n=134	.106 *p*=.222 n=134	1.000 *p*=N/A n=134	
Days Until DVD Leak	-.059 *p*=.441 n=174	.004 *p*=.960 n=176	-.106 *p*=.165 n=174	-.138 *P*=.233 n=76	.424 *p*=.000 n=176	.375 *p*=.000 n=137	-.146 *p*=.102 n=127	1.000 *p*=N/A n=176

Table 8: Regression Models for Worldwide Gross Revenue Using Oscar Film Piracy and Revenue Dataset

Model Number	1	2	3	4	5	6	7
Days Until First Leak	-.082 (.909)	-.133 (.304)	-.374 (.262)	-1.575 (.619)**	-.279 (.309)	-1.680 (.578)***	
Days Until Screener Leak	1.602 (1.865)	.854 (.514)	.974 (.513)*	2.024 (.689)***	.860 (.481)*	2.040 (.668)***	
Screener Release to Screener Leak	-1.083 (.686)	-.458 (.322)	-.483 (.314)	-.621 (.373)*	-.562 (.244)**	-.639 (.334)*	
Days Until DVD Leak	-1.113 (.650)	-.585 (.398)	-.408 (.382)	-1.036 (.517)**	-.425 (.398)	-.881 (.479)*	
Production Budget	.799 (.960)*	2.774 (.441)***	3.177 (.450)***		3.132 (.399)***		3.559 (.345)***
Rotten Tomatoes Rating	4.104 (2.700)	2.340 (1.403)*	2.575 (1.471)*	.307 (1.400)			
Advertising Budget	.703 (4.884)						
MPAA Affiliate Dummy	174.114 (106.020)	34.414 (25.542)					
'PG' Rating Dummy	-91.368 (144.421)	-57.750 (148.517)					
'PG13' Rating Dummy	-53.119 (130.974)	-83.506 (134.782)					
'R' Rating Dummy	-181.621 (114.805)	-122.967 (131.114)					
Year	-10.484 (32.190)	-13.540 (10.117)					
Constant	20842.05 (64388)	27097.29 (20286.7)	-178.542 (132.17)	197.640 (109.45)	32.93 (42.295)	204.055 (49.37)***	17.955 (12.864)
Observations	36	104	104	109	119	125	175
F-Score	9.09***	9.28***	16.37***	3.16**	17.91***	4.38***	106.41***
Adjusted R^2	.600	.605	.578	.184	.559	.162	.502

Robust standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%

Table 9: Regression Models for Domestic Gross Revenue Using Oscar Film Piracy and Revenue Dataset

Model Number	1	2	3	4	5	6	7
Days Until First Leak	.112 (.388)	-.046 (.169)	-.166 (.136)	-.699 (.283)**	-.181 (.166)	-.782 (.275)***	
Days Until Screener Leak	.675 (.817)	.384 (.279)	.457 (.256)*	.842 (.295)***	.406 (.238)*	.876 (.285)***	
Screener Release to Screener Leak	-.570 (.283)*	-.248 (.170)	-.255 (.160)	-.292 (.171)*	-.261 (.121)**	-.285 (.153)*	
Days Until DVD Leak	-.367 (.196)*	-.168 (.143)	-.098 (.143)	-.337 (.231)	-.079 (.139)	-.266 (.205)	
Production Budget	.359 (.326)	1.016 (.190)***	1.230 (.186)***		1.234 (.166)***		1.408 (.149)***
Rotten Tomatoes Rating	1.263 (1.128)	.736 (.693)	.807 (.697)	-.073 (.616)			
Advertising Budget	.205 (1.818)						
MPAA Affiliate Dummy	89.229 (50.934)	22.628 (11.619)*					
'PG' Rating Dummy	-60.633 (49.822)	-22.944 (56.337)					
'PG13' Rating Dummy	-30.624 (47.298)	-28.115 (49.940)					
'R' Rating Dummy	-111.633 (40.005)	-53.835 (50.375)					
Year	4.247 (11.161)	-4.862 (4.089)					
Constant	-8514.355 (22295.3)	9740.053 (8848.55)	-55.488 (61.177)	91.041 (47.926)*	7.751 (15.050)	75.446 (21.749)***	14.399 (6.556)**
Observations	37	105	105	110	121	127	177
F-Score	21.23***	9.96***	16.24***	2.86**	17.64***	4.13***	89.53***
Adjusted R^2	.5959	.5675	.528	.192	.520	.177	.451

Robust standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%

Table 10: Regression Models for International Gross Revenue Using Oscar Film Piracy and Revenue Dataset

Model Number	1	2	3	4	5	6	7
Days Until First Leak	-.221 (.510)	-.086 (.162)	-.207 (.150)	-.877 (.357)**	-.099 (.170)	-.899 (.322)***	
Days Until Screener Leak	.996 (1.114)	.483 (.267)*	.526 (.282)*	1.194 (.417)***	.454 (.269)*	1.182 (.401)***	
Screener Release to Screener Leak	-.504 (.442)	-.209 (.170)	-.228 (.169)	-.329 (.217)	-.300 (.135)**	-.356 (.190)**	
Days Until DVD Leak	-.771 (.473)	-.423 (.272)	-.315 (.257)	-.706 (.296)**	-.343 (.265)	-.630 (.273)**	
Production Budget	1.426 (.700)*	1.762 (.304)***	1.948 (.302)***		1.899 (.260)***		2.155 (.218)***
Rotten Tomatoes Rating	2.768 (1.767)	1.589 (.804)*	1.758 (.850)**	.365 (.862)			
Advertising Budget	.666 (3.135)						
MPAA Affiliate Dummy	78.527 (58.596)	10.690 (14.985)					
'PG' Rating Dummy	-32.357 (110.503)	-35.365 (98.000)					
'PG13' Rating Dummy	-21.218 (103.484)	-55.457 89.826					
'R' Rating Dummy	-71.319 (97.350)	-69.978 (86.634)					
Year	-14.796 (21.950)	-8.391 (6.135)					
Constant	29492.78 (43937.1)	16786.43 (12295.8)	-122.397 (77.941)	107.820 (67.953)	24.856 (29.097)	129.176 (28.708)***	3.102 (7.390)
Observations	36	104	104	109	119	125	175
F-Score	4.83***	7.01***	12.34***	2.97**	15.03***	4.11***	97.57***
Adjusted R^2	.576	.581	.560	.166	.542	.145	.492

Robust standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%

Table 11: Regression Models for Domestic DVD Sales Using Oscar Film Piracy and Revenue Dataset

Model Number	1	2	3	4	5	6	7
Days Until First Leak	-3.214 (2.814)	.079 (.155)	-.054 (.177)	-.190 (.236)	-.039 (.181)	-.208 (.240)	
Days Until Screener Leak	-.942 (3.197)	-.057 (.342)	.452 (.246)*	.513 (.270)*	.319 (.306)	.371 (.290)	
Screener Release to Screener Leak	-.155 (.624)	-.075 (.223)	-.266 (.247)	-.370 (.233)	-.127 (.248)	-.316 (.231)	
Days Until DVD Leak	-.281 (1.207)	-.075 (.240)	-.217 (.219)	-.522 (.235)**	.005 (.236)	-.479 (.234)**	
Production Budget	-.710 (1.278)	.318 (.535)	.585 (.523)		1.006 (.501)*		1.270 (.287)***
Rotten Tomatoes Rating	3.983 (4.031)	1.113 (.646)*	.204 (.609)	-.126 (.421)			
Advertising Budget	-3.882 (3.880)						
MPAA Affiliate Dummy	Dropped	35.533 (26.727)					
'PG' Rating Dummy	171.111 (153.481)	116.722 (46.069)**					
'PG13' Rating Dummy	7.190 (79.630)	64.735 (23.174)***					
'R' Rating Dummy	Dropped	26.910 (16.067)					
Year	-44.064 (95.471)	-11.791 (10.558)					
Constant	88453.05 (191370)	23534.86 (21162.27)	13.901 (81.956)	99.456 (27.123)	-5.583 (38.640)	97.024 (30.451)***	.058 (11.844)
Observations	14	47	47	49	50	52	80
F-Score	N/A	N/A	1.94*	2.42*	1.52	2.29*	19.66***
Adjusted R^2	.697	.450	.304	.203	.378	.118	.425

Robust standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%

Table 12: Regression Models for Days from Theatrical Release Until First Leak Using Oscar Film Piracy and Revenue Dataset

Model for Days Until First Leak	All Observations of First Leak	First Leak Prior to Theatrical Release	First Leak within First Week of Theatrical Release	First Leak More than One Week After Theatrical Release
Production Budget	-.154 (.077)**	.119 (.284)	-.015 (.006)**	-1.032 (.255)***
Rotten Tomatoes Rating	.165 (.131)	-.014 (.370)	.015 (.012)	-.320 (.416)
MPAA Affiliate Dummy	13.786 (9.549)	-14.018 (14.276)	1.028 (1.078)	5.732 (12.633)
'PG' Rating Dummy	-9.041 (7.160)	-15.192 (24.442)	.275 (.625)	Dropped
'PG13' Rating Dummy	-1.808 (6.422)	-44.772 (34.242)	.259 (.482)	-.395 (10.956)
'R' Rating Dummy	14.093 (7.020)**	-5.277 (21.407)	-.077 (.608)	Dropped
Year	2.673 (2.120)	-3.549 (4.710)	.052 (.175)	3.954 (3.203)
Constant	-5368.668 (4250.974)	7108.033 (9441.525)	-103.238 (350.977)	-7838.253 (6418.133)
Observations	150	31	62	57
F-Score	3.85***	3.45**	1.17	3.61***
Adjusted R^2	.125	.267	.116	.238

Robust standard errors in parentheses, * significant at 10%; **significant at 5%; *** significant at 1%