Theatrical Movies As A Capital Asset

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Abstract

In 2002, I estimate that studios spent $10.1 billion producing original theatrical movies. These movies were shown in theaters in 2003 and will be sold on DVD and broadcast on television for decades to come. Because of their long working life, the international guidelines for national accounts, System of National Accounts 1993, recommends that countries classify production of movies and other entertainment, literary and artistic originals as an investment activity and then depreciate those movies over time. However, BEA does not capitalize this category of intangible assets at the present time. As a first step in considering the treatment of this category of intangibles as a fixed asset, I collected data on movie production and calculate what GDP statistics would be if theatrical movies were classifed as a capital asset.

To preview, my empirical results are: 1)Theatrical movies have a useful lifespan of at least 80 years; 2)The motion picture production industry has been growing rapidly since 1980. Real GDP growth averages 0.001% higher per year since 1980 when theatrical movies are treated as a capital asset. 3)Investment in the motion picture industry is quite volatile. For example, my data appears to show that movie production plummeted by 50% in the last half of 2001, and then recovered completely in 2002.

Introduction

The motion picture industry started at the end of the 1800s when Thomas Edison introduced the Kinetescope. Over the next decades, movies improved in quality and became a very popular source of entertainment. By the 1929, Americans were spending $720 million per year on movie tickets, 0.7% of nominal GDP. The size of the movie industry diminished in the 1950s and 1960s when television became widespread. However, the movie industry has made a comeback in recent decades with the introduction of video cassettes and DVDs. In 2002, studios earned $25.8 billion from theatrical movies, 0.2% of nominal GDP.

In 2002, I estimated that studios spent $10.1 billion producing original theatrical movies. These movies were shown in theaters in 2003 and will be sold on DVD and broadcast on television for decades to come. Because of their long working life, the international guidelines for national accounts, System of National Accounts 1993, recommends that countries classify movie production as an investment activity and movie copyrights as capital assets (SNA 1993 10.94), along with other entertainment, literatry and artistic originals.

However, BEA has not yet implemented SNA's guideline for the treatment of movie production or other entertainment originals. Instead, movie production is classified as an intermediate expense and therefore not counted in GDP. This accounting method creates a mismatch between studio revenues and studio costs. Accordingly, the reported productivity of the motion picture industry is reported to be higher than its true productivity in quarters where studios release more movies than they film. Conversely,

the productivity of the motion picture industry is reported to be lower than its true productivity in quarters where studios film more movies than they release.

In order to provide a more accurate depiction of the movie industry, I collected data on movie production and calculate GDP when theatrical movies are classifed as a capital asset. To preview, my empirical results are: 1)Theatrical movies have a useful lifespan of at least 80 years. In this paper, I calculate that copyrighted movies decline in value by only 2.5% per year. 2)The motion picture production industry has been growing rapidly since 1980. Real GDP growth averages 0.001% higher per year since 1980 when theatrical movies are treated as a capital asset. 3)Investment in the motion picture industry is quite volatile over individual quarters. For example, studios spent 0.11% of nominal GDP producing theatrical movies in the first half of 2001. Investment then plummeted to only 0.06% of GDP in the second half of 2001, reducing GDP growth by 0.05%.

This paper will consist of four sections. In section 1, I describe my data on nominal production costs for theatrical movies and calculate the nominal value of movie production back to 1929. In section 2, I describe my price index and calculate the real value of movies production back to 1929. In section 3, I describe the various stages in the lifecycle of a theatrical movie after production and estimate the revenue received by studios at each stage. Finally, in section 4, I estimate the total stream of revenue received and costs paid by a studio for each quarter after theatrical release. I then estimate the depreciation schedule for movie copyrights and use that depreciation schedule to construct a historical time series measuring the aggregate value of copyrighted movies from 1929 to 2006.

1. Nominal Production

In this paper, I will study only the production of theatrical movies. This category includes any movie shown in theaters, even if it earns the majority of its revenue from DVD sales or television licensing. This category also includes a small number of direct-to-video movies. However, this category does not include movies that were first shown on TV. In a future project, I will study the production of television programs. That project will include made-for-TV movies as well as regularly scheduled TV shows. Because this project is focused on the United States national accounts, I will restrict my sample to US movies. Even if a movie is filmed abroad, it is still included in my analysis if a US corporation or resident originally owned the copyright.[1]

Movie production starts with a script. Writers often spend years preparing a script and looking for a producer to make it. In most cases, very little money is expended at this stage. If a studio decides to use a script they buy it from the writer and start preproduction work. At this stage, the director selects the actors, negotiates salaries and arranges for them to get any training necessary. Directors also decide where and when the shooting will take place.

[1]A small number of movies are co-owned by a US studio and a foreign studio. I include those movies in my sample. I use data from The-numbers.com and IMDB.com to determine country of ownership. Studios often structure their production to take advantage of government subsidies for movie production in a variety of foreign countries. For example, Germany used to offer large tax incentives for expenses incurred during movie production. As a result, German investors set up deals where they were the nominal owner of many US motion pictures. However, these movies are still reported in the industry literature as American productions, and the studios do not report the supposed royalty flows to BEA's trade in services survey. Therefore, I will ignore the tax arrangements.

The most expensive part of production is the actual shooting. In 2000, shooting cost an average of $165,000 a day (Epstein 2005). Depending on the movie, shooting might take anywhere from a couple of weeks to a couple of months. After shooting is completed directors then add special effects like sound and computer generated images. The cost of these special effects varies tremendously, depending on the type of movie and the director's vision. Finally, the director picks the exact shots he or she needs for the final movie.

The primary dataset for this project is the Economic Census. The Economic Census reports that studios received $23.9 billion in 2002 from the theatrical motion pictures. Studios also earned an additional $0.98 billion from the sale of direct-to-video movies, $0.19 billion from the sale of merchandise, and an estimated $0.69 billion from the the sale of movie soundtracks. In total, studios earned $25.8 billion from the movie industry. In comparison, studios also earned $13.1 billion that studios earned from television programs). The Economic Census does not report expenditures by the motion picture industry, only revenues. Therefore, I must supplement the Census Data with other data to estimate the production expenses for theatrical motion pictures. According to the Census Bureau's Service Annual Survey of 2004, companies in the motion picture production industry spent only 85 cents for every dollar in revenue they received.[2] The spending ratio was similar in 2005 and 2006. I will therefore assume that the spending ratio in 2002 was also 85 cents for every dollar in revenue. Therefore, I estimate that studios spent $21.9 billion producing, advertising and selling their movies in 2002. Based on the industry literature, I estimate that 46% of a studio's non-overhead costs are

[2] These revenue statistics include royalties from old movies, so studios may be earning a return on their assets rather than monopoly profits.

devoted to the production of movies (this industry literature will be described in much more detail in section 4). I then allocated overhead costs according in proportion to the non-overhead costs. Hence, I calculate that studios spent $10.1 billion on the production of motion pictures in 2002.

If the Economic Census had been conducted quarterly back to 1929, and had followed the same methodologies as 2002, then it would be straightforward to calculate nominal investment. However, the Economic Census is conducted only once every five years. And even when it is conducted, it follows a different methodology than the 2002 Economic Census. For example, the 1997 Economic Census reports that studios received 10% of their revenue from the home video market, only one quarter of the home video share given by the industry literature. By comparison, the 2002 Economic Census reports a home video share of 40%, close to the industry literature. Because of these discrepancies, I will not use the Economic Census before 2002. Instead, I will use industry data.

The industry data used in this paper are taken from the websites IMDB.com and The-numbers.com. These two websites are provide a wide variety of information on movies for fans. The-numbers.com is focused on reporting daily box office revenue for major motion pictures, but it also provides a MPAA rating, a plot description, reported budget and other useful information. In contrast, IMDB.com is more eclectic. IMDB.com collects trailers from the film, a list of actors and production crew, camera type used in filming, filming dates and other information. IMDB.com also allows users to rate a film. I use these two websites to collect micro-data for a sample of movies released between 1929 and 2007. I also supplement my industry data with a review of

the industry literature. Table 1 contains a description of the datasets used in my analysis and the figures they are used in.

Quarterly Production 1980-2006

To start, I downloaded a list of movies released between 1980 and 2007 from the website The-numbers.com. That list gives release date, US box office (ticket sales in movie theaters), distributor, country of production and sometimes reported budget for every major motion picture released between 1980 and 2007. If no budget was reported I imputed a budget based on box office revenue and year of release. The list also contains a partial listing of minor motion pictures, with better coverage since 2000. In total, there are 5,165 movies listed on The-numbers.com that were produced in the United States. These 5,165 movies account for 87% of the total box office revenue earned by all movies in the United States. Most of the remaining revenue was earned by films from other English speaking countries such as Britain or Australia. I then looked up the filming dates for a stratified subsample of 3,349 movies from IMDB.com, with an oversample of big movies.[3] My subsample accounts for 97% of all box office revenue and an estimated 88% of production spending over the 1980-2007 time period.[4] Table 2 shows summary information for this dataset.

I then used my hand-collected dataset to estimate quarterly production between 1980 and 2007. My formula for estimating animated production spending is very simple: I assume that production takes approximately four years from start to finish (Bettis 2005)

[3]My subsample includes all movies in the Top 200 box office for their year of release, all movies with any reported budget going back to 2000, all movies in the Top 100 reported budget back to 1980 and an 8% skip sample of remaining movies. I excluded movies produced by non-US studios (based on The-numbers.com data) and movies with unknown box office revenue.
[4]The sample of movies from The-numbers.com does not include any porn movies.

and production concludes one quarter before theatrical release. For example, suppose that a $100 million animated movie was released in April of 2003. I assume that the studio spent $6.25 million on production for every quarter from the winter of 1999 to the fall of 2002. Because the production pipeline for animation is so long, not all movies in production during 2004, 2005 and 2006 have been released yet. In my production estimates, I adjusted the animation production for those years upwards to account for this missing data.

I used a more complex formula for live action movies. Based on the industry literature, I assume that 90% of production spending for live action movies occurs during filming (Epstein 2005). For example, suppose that a movie with a $100 million budget was filmed from February 1st, 1999 to April 30th, 1999. Therefore, filming costs $1 million per day, and so production in the first quarter is $59 million and production in the second quarter is $31 million. The remaining 10% of the production spending is devoted to preparation work such as writing scripts, composing music and selecting actors. I will assume that those costs are also incurred uniformly over a four year period before theatrical release in order to be consistent with my assumptions for animated movies.

In recent years, many movies have combined live action and animation. For example, Prince Caspian used human actors for the human characters and then produced the animal characters on computer. In that case, I assume that 60% of the production budget was spent on filming, and that fraction was incurred during filming. The remaining 40% was spent on animation and preparation work. That money is spent according to the animation schedule.

IMDB.com does not have filming dates or production budget on all 3,349 movies in my stratified subsample. Coverage is better for movies with high box office revenue, high production budgets, live action films and recent releases. I used box office revenue to impute production budgets for movies in my sample with missing data. The R^2 for a regression of log box office revenue to log budget is about 0.37, suggesting that high production budgets are consistently correlated with high box office revenue. I imputed production budgets by estimating the equation[5]

$$\text{Log(US Box Office/Budget)} = \alpha + \beta_{\text{Year 1}} * \text{Dummy}_{\text{Year 1}} + \beta_{\text{Y 2}} * \text{Dummy}_{\text{Y 2}} + \ldots + \varepsilon$$

I weight the movies by their production budget. I then used the point estimates from this regression to predict production budgets for films with missing data. My historical estimates are very sensitive to the particular regression used to impute missing budget data. However, in recent years there is far less missing budget data. Therefore, the imputation rule has little effect on quarterly production estimates.

I also imputed production dates for 20% of live action movies with missing filming dates by assuming that those movies have the same production dates as the other live action movies released at that time. For example, suppose that half of all movies released in the spring of 2007 report production dates in the fall of 2006 and half report production dates in the summer of 2006. I would then split the production budget for movies that do not report any production dates evenly into the summer and fall of 2006.

[5] According to econometric theory, the error terms for a regression like this must be adjusted to account for a log-normal regression. However, the average ratio of US Box Office to Production Budget is close to 1, and therefore the log-normal distribution is similar to the normal distribution.

Figure 1 shows my estimate the of aggregate quarterly production from 1980 to 2006, using the stratified subsample of 3,349 movies and the quarterly allocation rules described earlier. I find that nominal movie production rose from $150 million per quarter in 1980 to $1.7 billion per quarter in 2006. However, the growth in movie production between 1980 and 2006 is not steady. The most striking result is for 2001. During the summer and fall of 2001, movie production collapsed to less than one third of what is had been in the first two quarters. The collapse started before 9/11, so it is unlikely to be related to the terrorist attacks. Movie production recovered completely by the end of 2002, and so there is no long-term change in the nominal GDP.

My data on quarterly production does not match the quarterly revenue data at all. Revenues for the movie industry show a strong seasonal pattern. Studios typically release their high budget films at the beginning of the summer or over the winter holidays. This release pattern creates higher movie theater attendance at those times (Einav 2007). And home video revenue tends to peak during the Christmas shopping season (Chiou 2006). In contrast, filming expenditures are much less seasonal. In a regression analysis, I found no significant seasonal differences over the period 1980 to 2006. However, I do find that filming expenditures are significantly lower during the winter for the last five years of my dataset (2002 to 2006). This may reflect an actual change in the seasonal pattern of movie production. In this analysis, I am only counting filming expenditures, but not non-filming costs such as advertising, shipping and manufacturing.

The aggregate production spending calculated from the industry micro-data does not match my earlier estimates of production spending. Based on the industry data, I

estimate that the total production budget for all movies produced in 2002 is only around $5.9 billion. At the same time, I calculate from the Census data and the industry literature that studios spent $10.1 billion producing the movies they sold. There are a number of possible reasons for this discrepancy:

(1) Reported movie budgets do not include studio overhead or interest paid by studios. In the 1980s, the standard profit-sharing contract added a 15% surcharge to production cost for studio overhead and set the interest rate at 125% of prime (Weinstein 1998).[6]

(2) Reported movie budgets generally do not include the value of profit-sharing agreements with directors or star actors. One study found that more than 40% of a sample of major movies paid their actors a share of the profits, and the rate of profit-sharing has been growing over time (Chisholm 1997).

(3) The dataset from The-numbers.com excludes unfinished movies and other failed projects that never were released to theaters.

In this paper, I will increase the reported budgets by 72% to account for the portion of studio overhead allocated to movie production, profit-sharing contracts and failed projects. In particular, I use the allocation rule:

$$\text{Overhead in Quarter}_Y = 0.72*[(\text{Filming in } Q_{Y-4}) + (\text{Filming in } Q_{Y-3}) + \ldots (\text{Filming in } Q_{Y+4})]$$

[6]This standard contract was challenged in court as unfair to the supposed beneficiaries and studios were ordered to pay additional profits in one case. Major stars typically negotiate better deals.

Figure 2 shows the resulting estimate of production with the value of allocated overhead included in total movie production. Alternative quarterly estimates using different rules for allocating overhead are available upon request. Between 1980 and 2006, nominal movie production rose from 0.040% of nominal GDP in 1980 to 0.081% of nominal GDP in 2006. Therefore, the nominal GDP growth rate is revised upwards by 0.002% per year when when movie production is classified as an investment.

Quarterly Production 1929-1979

The dataset from The-numbers.com starts in 1980, so I cannot use it to construct a production index before then. Instead, I use the advanced search feature on IMDBPro to construct a list of all movies released between 1929 and 1979. This list includes not only major motion pictures, but also B-movies, news-reels and cartoons which were shown in theaters. In total, IMDB.com lists more than 128,000 movies produced in the US, and 37,000 of those movies were produced between 1929 and 1979.

IMDB provides almost no data on box office revenue before 1980. For most movies in the dataset, IMDB gives only gives the name of the movie, date of release, quality of the movie (as rated by IMDB.com voters) and the number of votes received. Because IMDB does not give box office before 1980, I could not oversample the most watched movies directly. Instead, I oversampled the movies which received many votes on IMDB, regardless of the average rating.[7] In general, classic movies like Star Wars,

[7] This procedure probably oversamples movies popular among heavy Internet users. It may also oversample movies where viewers have strong opinions, such as political film or controversial actors.

Cinderella, Ben-Hur, etc. receive many more votes on IMDB than low budget films or high budget flops. My sample covers an average of 37 movies per year.

I then looked up the filming dates, cast and crew listings and production budget for a stratified sample of major motion pictures. From that list I calculate movie production for 1929 to 1979 with a two step process. I first estimate the nominal spending using the IMDB.com data only. I then match the 1929-1979 time series to the quarterly production estimates shown in Figure 3 by assuming that spending from 1979 to 1980 grew at the same rate as spending from 1980 to 1981. That procedure will avoid any breaks in trend between 1979 and 1980.

I calculated quarterly production spending according to the same general assumptions outlined earlier for the 1980-2007 sample of movies. However, IMDB.com does not report box office revenue consistently, and so I could not use box office revenue to impute production budgets for movies with missing data. Instead, I used the number of workers reported to predict production budget. The R^2 for a regression of log box office revenue to log # workers is 0.29. I imputed production budgets with the equation:

$$(\text{Budget}/\text{Number of Workers}) = \alpha + \beta * (\text{Controls for year of release}) + \varepsilon$$

In this regression, I weighted the movies by their number of workers and their inverse sampling probability. I also assumed that films not sampled had production budgets equal to the weighted average budget for sampled films.

The quality of the production spending estimates rises over time. In the 1930s, less than 10% of all movies listed on IMDB.com are included in my sample. And of

those movies sampled, only 60% report any budget data (weighted by # of workers). I impute production budgets for the remaining 40% of the market. Because movies with missing budget data comprised such a large share of the sample, my production estimates for the 1930s are very dependent on the rules for imputing production budgets for movies with missing data. In contrast, my sample provides much better coverage for the later period. By the 1970s, my sample covers 40% of all movies released and 90% of those movies sampled report production budgets. Therefore, the rules for imputing missing budget data are much less important.

Because so few movies in my sample had known filming dates, I did not use the same method of imputing filming dates for movies with missing data. Instead, only I assumed that all movies filmed in a given quarter had the same delay between filming and release. For example, suppose that one third of all movies released in the spring report production dates in the fall before, one third were filmed in the summer before and one third were filmed one full year before release. I would then split the product budget for those moves that do not report any filming dates equally into the summer, fall and spring of the prior year. This allocation method produces much smoother production than I would get from following the same rules for 1980-2006. I also imputed release dates for films that only report year of release. I assumed that ¼ are released in winter, ¼ in spring, etc. The exact stata program used to smooth are available upon request.

Figure 3 shows the quarterly production spending estimated from the IMDB.com micro-data. Based on the IMDB.com micro-data, I estimate that quarterly production of movies is about $200 million per quarter in the late 1970s. By comparison, I estimated in Figure 1 that quarterly production of movies was $150 million per quarter in 1980. In

Figure 4, I adjust the time series data in Figure 3 to match the time series data in Figure 2. I first multiplied all spending in 1929 to 1979 by 0.75 to match the 1980 to 2006 data, and then added a 72% surcharge for studio overhead, following the same smoothing rules discussed earlier.

The share of GDP devoted to movie production has changed dramatically over time. Between 1929 and 1979, the nominal production of movies rose from $0.6 billion per year to $1.3 billion per year. At the same time, total GDP grew by 2,000%. Therefore, the share of nominal GDP devoted to movie production fell from 0.57% to only 0.05% of GDP. Nominal GDP growth falls by approximately 0.01% per year when movies are classified as an investment. Between 1980 and 2006, the nominal production of movies rose from $1.3 billion to $11.6 billion per year. At the same time, total GDP grew by less than 400%. Therefore, the share of nominal GDP devoted to movie production rose from 0.05% to 0.089%.

These historical statistics are consistent with BEA's pre-existing data on box office revenue, as shown in Figure 5. In 1929, box office revenue was $720 million in the United States, 0.7% of total US GDP.[8] The share of GDP spent at movie theaters rose briefly during the Great Depression, and then fell steadily for the next forty years. By 1980, box office revenue was only 0.1% of GDP. Since 1980, box office revenue has remained steady at approximately 0.1% of GDP. However, the introduction of home video early in the 1980s led to consumers substituting from movie theaters to home

[8] Studios generally receive about half of the box office revenues from movie theaters. Therefore, it might seem that box office revenue was insufficient to cover studio production costs, let alone advertising costs and failed projects. In fact, studios have historically earned about half of their box office revenues from abroad, which is not counted in this time series.

video. Therefore, total studio revenue has roughly doubled as a share of GDP, consistent with the increase in spending observed.

It is important to note that some of the decrease in movie production between 1940 and 1980 was caused by a shift from theatrical movies from television programs. Total spending on motion picture production may not have changed so dramatically. In a future paper, I hope to measure the spending on television programs historically.

2. Real Production

It is difficult to develop a price index for copyrighted movies. Each movie is a unique artistic creation, and so I can never compare the cost of producing two identical movies at different times. In this paper, I will use a labor-based price index to calculate a quantity index from 1929 to 2006. In my labor-based index, I assume that each production worker of a specific type produces the same amount of artistic capital over time. In other words, doubling the number of workers in the motion picture production industry will double the real production of theatrical movies.

I have also experimented with a hedonic price index to measure the cost of producing a movie of constant quality over time. However, the only measures of quality available historically are length of the movie, animated versus live action and color film versus black and white. None of these quality measures capture what audiences really care about: dramatic special effects and high quality computer animation. In contrast, the labor-based quantity index performs reasonably well at measuring these shifts. Even with powerful supercomputers, high quality computer animation still requires an

enormous number of artists to program the computers. And non-computerized special effects require set builders, stuntmen, explosives experts, etc. Therefore, a labor-based price index is actually better at capturing special effects than a hedonic price index.

I drew my dataset of labor inputs from IMDB.com. IMDB.com lists the cast and crew for all major motion pictures in their dataset. Their list provides not only each an individual's name, but also his or her work categories and their specific job title. In total, IMDB.com provides 28 separate work classifications and hundreds of separate job titles. In order to calculate a quantity index, I collapsed these job titles into three separate categories: creative management, actors and production workers. I define creative management as the individuals listed by IMDB.com as directors, writers, editors or other individuals with creative control. I define actors as the individuals listed by IMDB.com under the cast list. This cast list includes not only star actors, but also minor characters. The remaining job titles are classified as production workers. I then ran a regression analysis to estimate the equation:

Log (Production Budget/# of Workers) = $\alpha+\beta$(# Production Workers/# Total Workers)+ γ(#Creative Managers/# Total Workers) + Controls for Year of Production.

Based on that regression analysis, I calculate that the typical actor costs 53% less than a production worker and the typical creative manager costs 160% more.[9] I then used those coefficients to create an index measuring the total value of labor for each movie in my dataset:

Real Movie Production = (#Workers)+1.6*(#Creative Managers)-0.47*(#Actors)

[9] These numbers are sensitive to the exact regressions used. In particular, my figures for management may be driven by the fact that movies with many workers tend to have a lower share of managers. Those films with a high number of workers also cost less per person to film.

Figure 6 shows the resulting quantity index for every year from 1929 to 2006. Because my dataset is relatively small, there is a great deal of year to year variation. I therefore smoothed the quantity index across several years.[10] Even after smoothing, there are still some unexplained humps. However, I am primarily concerned with producing a good estimate of real production for recent years, and so the early bumps are less important.

I also estimate an implicit price index by dividing the nominal production spending estimated in Figures 2 and 4 with the quantity index in Figure 6. I find that the labor-based price index tracks reasonably well with the pre-existing service price index, though the labor-based price index does jump around from year to year. The only significant divergence between the two occurs for the time period 1955 to 1975. I am not sure why the two price indexes diverge so much over this time period. However, total movie production was very low over the time period 1955 to 1975. Therefore, changing the price deflator for that time period has little effect on total GDP.

It is important to note that the quantity index shown in Figure 6 does not track at all with BEA's pre-existing estimate of the total employment in the motion picture and sound production industries. My quantity index shows that real production doubled between 1977 and 2006. Over the same time period, BEA's employment index increased by only 37%. The main difference between the two series is how they handle overseas production. BEA's employment statistics are part of GDP, and so they only measure the workers in the United States. In contrast, my analysis includes workers around the world as long as a US studio owns the movie copyright Over the last 30 years, domestic studios

[10]I do not have the # of workers for all films in my sample. Therefore, I imputed # of workers by taking their nominal production budget and dividing by the average production budget per worker.

have moved much of their production out of the US (McDonald 2006). Therefore, an index based on US employment only will underestimate the total value of movies owned by US studios.

It might seem that the production estimates presented in this paper are very sensitive to the methods BEA uses to track overseas production of theatrical movies. After all, a large portion of movie spending occurs overseas. In fact, the problem of tracking overseas production is almost irrelevant to my research. Overseas production of US movies is currently classified as an import of services in the national accounts. This treatment holds regardless of whether theatrical movies are a capital good or not. If studios report inaccurate amounts of spending abroad, then BEA's estimates of GDP will be biased. However, the size of the bias remains exactly the same when movies are re-classified as capital goods. Therefore, my estimates are not sensitive to any problems measuring international transactions properly.

Section 3: Revenues Earned By Copyright Holders

Movie copyrights earn revenue for the studios in a variety of venues. The standard order for a movie release is first US theaters, then foreign theaters, then DVD sales and finally television. If a movie is successful, studios will make a sequel and start the whole process over again. I will not include small revenue sources such as direct-to-video sales, merchandising or song licensing in my analysis. Instead, I will simply assume that those revenue sources decrease at the same rate as the larger revenue sources. According to the Economic Census, these revenue sources accounted for less than 10% of

studio revenue in 2002, so it is unlikely that including those revenue sources would change my estimated depreciation rate significantly. I will also exclude speculative revenue sources from technologies that are not yet commercially available.

In this paper, I will use three separate datasets to estimate the rate at which studios receive revenue from their copyrighted movies: 1) worldwide box office charts ; 2) a consumer survey of home video purchases and rentals within the United States; 3) A historical dataset listing the dates and stations selected theatrical movies shown on British television stations. Appendix 1 contains more information on the source of the datasets used and the data cleaning rules. I have not been able to locate any consumer surveys of home video purchases and rentals by non-US consumers. Conditional on watching an American movie, I will assume that non-US consumers watch the same movies as US consumer. I was also unable to buy a historical dataset providing the times and stations theatrical movies are shown on United States television. Conditional on showing an American movie, I will assume that US television stations show the same movies as British television stations.

Revenues from Movie Theaters Worldwide

The first stage of a movie's lifecycle is theatrical release. In 2002, studios earned 20% of their revenue from theatrical release. Since the 1948 Paramount antitrust ruling, studios are not allowed to own movie theaters and display their films directly. Instead, studios rent their films to movie theaters in return for a share of the ticket sales (Gil 2007). The industry norm is that theaters pay 70% of their box office revenue to studios in the first week after theatrical release and a smaller share for later weeks (Vogel 2004).

I found that the typical movie has a very short lifespan in theaters worldwide, as shown in Figure 8. Foreign theaters now release major movies within a few days of the US theatrical release, and so there is no lag between US revenue and domestic revenue. Between 2004 and 2007, the typical movie earned box office revenues equal to 60% of its real production cost in the first week after theatrical release. Movies earn about the same amount in the next week after theatrical release, and then revenue start decreasing at the rate of 15% per week. Only 6.0% of ticket sales occur more than four months after US theatrical release.[11]

Home Video Revenue

The next stage in a movie's lifecycle is DVD release. In 2002, studios earned 47% of their revenues from DVD sales. In the past, studios released their movies to VHS approximately six months after theatrical release. This gap has been falling steadily over time, and by 2006 studios waited only 4 months between theatrical release and DVD release (Hettrick 2007). Movies are almost never withdrawn from the home video market, and consumers continue to buy old movies years after initial release.

I found that the typical movie has a long lifespan on home video, but most of the sales occur within the first few years after theatrical release, as shown in figure 9. The typical movie earns almost 75% of its real production costs from home video sales in the first quarter after a movie is released on VHS or DVD.[12] Sales then decrease by 50%

[11] The-numbers.com website provides a list of only the Top X movies for each week, and X changes from week to week. I assume that all movies not on the list have 0 sales. This assumption will bias my estimates of the movie lifespan downward slightly. I also excluded all movies released after July 1, 2007 to allow the full lifespan to be observed. Occasionally movies earn revenue before US theatrical release, I moved that revenue to the first week after release.

[12] I do not actually know the DVD release date for movies in my sample. Instead, I match quarterly sales to a non-linear regression that incorporates a fix lag between theatrical release and home video release and

per quarter in the first few years after a movie is released on VHS or DVD. By the end of the third year after theatrical release, real sales are only 4% of the real production budget each quarter. However, the decrease in sales virtually stops after the fourth year. I estimate that real revenues from a movie copyright decrease by less than 1% per quarter.

I find a similarly small depreciation rate when I track a fixed sample of classic movies, as shown in Figure 10. I define a classic movie as one released before 1980, regardless of quality. These movies accounted for a little more than 10% of total studio revenue between 1988 and 2002. The exact rate of decrease depends on the functional form used, but it is clearly only a few percent per year. In all of my empirical work, I deflate revenues and costs by the labor-based price index developed earlier in section 2. The exact point estimate for my depreciation rate changes when I use a different price index, but the general trend remains very similar.

Because the long-term revenues for home video are so steady, it is difficult to estimate the exact lifespan of a copyrighted movie. However, current copyright law protects movies for only 95 years.[13] Therefore, the maximum possible lifespan for a copyrighted movie must be no more than 95 years. Consistent with that assumption, I will assume that the real revenue earned by classic movies decreases by 2% per year until they are 95 years old. At that point, the real revenue from the movies drops to 0.

Television Licensing Revenue

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geometrically decreasing sales thereafter. I then use the parameters estimated to predict average sales in the first quarter after theatrical release.

[13] This copyright period has been extended multiple times over the past few decades, and it may be extended again.

The final stage of movie's lifecycle is television licensing. In 2002, studios earned 33% of their revenue from television. Studios first release their movies to pay-per-view channels, then premium cable, then broadcast television, and finally regular cable (Vogel 2004). Television licensing is also extremely low cost for studios – they do not need to manufacture and ship a DVD or handle customer service (Epstein 2005). Therefore, future revenue from television licensing represents more than 33% of the value from a copyrighted movie.

I was not able to obtain any data on the licensing fees paid by networks to studios. Instead, my estimates of television licensing revenue are based on a dataset that lists only the time, date and channel each individual movie is aired on. That dataset is described in more detail in Appendix 1. In a preliminary analysis, I will assume that studios charge the exact same licensing fee for all movies aired in the same quarter.

I found that most of the sales from television occur well after theatrical release, as shown in figure 11. The typical movie in my sample is first shown on television about one year after theatrical release. It then earns 2.4% of its real production costs from television licensing each quarter for the next four years. This revenue stream is steady over the four-year period after theatrical release. The revenue from television licensing then starts to **increase** over the next two years. Between seven to twenty-two years after theatrical release, a typical movie earns 4.6% of its real production costs every quarter. Because of the small sample size, the earnings rate jumps around quite a bit from quarter to quarter, but it does not decrease consistently over the entire time period. Appendix 1 contains more discussion of my exact formulas for imputing earnings by quarter.

I find a similarly small depreciation rate when I track a subsample of classic movies produced before 1980, as shown in Figure 12. Looking at Figure 12, I can see a clear seasonal pattern – classic movies are shown most often during the fourth quarter.[14] But there is no clear downward trend in real revenue over time. However, I am only tracking these movies over a five year time period, and so it would be difficult to distinguish between a small depreciation rate and a zero depreciation rate. Consistent with a depreciation rate close to 0, I also find that classic movies accounted for 40% of the television licensing from my sample. By comparison, these same movies only accounted for 17% of home video revenue over the same time period. In the remainder of the paper, I will assume that television revenues decrease by 2% per year in the long term, just like I did for home video revenue.

One possible problem with my estimates of the television revenue shown in Figures 11 and 12 is that I assumed studios charge the same price for every movie shown on television. However, it is possible that studios charge a higher licensing fee for new movies than old classics. If that were true, then the depreciation rate for copyrighted movies would be higher than it appears from figure 11.

I will test for the possibility that studios charge a higher licensing fee for new movies by looking at the exact time a movie is aired. Television viewership is highest between 6:00 to 10:00 in the evening, after people have gotten home from work and before they go to bed. Networks generally run the most popular new television programs during the evening prime time. Suppose that studios charge a higher licensing fee for new releases than classic films. Then, I would expect that television networks only

[14] In my imputations, I assume that the total revenue from television licensing is the same for every quarter within a given year. I do not know if the same seasonal pattern would hold if I relaxed that assumption.

license the most popular new movies and they show those popular new releases during prime time when the potential audience is largest.[15] In contrast, television networks will show cheap films at all times of the day and night.

Figure 13 shows the average audience size by quarter since theatrical release. Overall, I do find some evidence that recent movies are broadcast at more popular times – but the change in timing is relatively small. In Figure 14, I use that measure of audience size to adjust my estimates of quarterly revenue. I find that the revenue stream from television starts out one year after theatrical realse at 4% of real production costs. Because my sample size is small, the exact quarterly earnings rate jumps around, but there is no clear downward trend. I will assume that that television revenue decreases smoothly by 2% per year, and all of the quarterly variation seen in Figures 12 and 14 is just random noise.

Combining the Revenue Streams

In the graphs given earlier, I divided revenues by reported production budget to estimate the revenue stream for a film from theatrical release, home video and television licensing. However, the revenue stream for television was based on a sample of 1,000 **successful** movies. Therefore, figure 14 over-estimates the profitability of a randomly chosen movie. Furthermore, all of the graphs need to be adjusted for the fact that I used reported production budget rather than actual production costs to calculate the earning rate for copyright movies. The discrepancies between reported budget and actual production costs were discussed in much more detail in section 1.

[15] This argument does not hold if the licensing fee charged by studios depends on the time of day a movie will be shown. However, the industry literature suggests that networks have control over scheduling decisions (Epstein 2005).

Figure 15 shows the lifecycle of movie revenue after adjusting for the problems mentioned earlier. I use the quantity index given in Figure 7 to calculate what revenue would have been in 2002 if the unadjusted graphs shown in Figure 9, 10 and 14 had actually held. I then adjusted the revenue streams to match the actual revenue reported in the 2002 Economic Census. For example, the graph in Figure 14 predicts that US produced movies earned $18.9 billion from television licensing worldwide. In fact, the 2002 Economic Census reports that studios earned only $7.6 billion from television licensing. Therefore, I multiply television revenues by 0.40 to get the true earnings rate for a $1 of movie production spending. Finally, I adjust all three revenue sources upwards by 19% to account for the fact that movie theaters, television and home video only account for 84% of studio revenue in the Economic Census. The remainder of revenue is from 'distributors and exchanges', 'other theatrical movie revenue', 'direct-to-video' sales, merchandising and soundtracks sold on CD.

If a movie is successful enough, studios will often make a sequel. The fraction of movies that are sequels has been rising steadily over time, from 2.8% in 1980 to 17.0% in 2005. Because sequel rights are so speculative, BEA's policy is to exclude them from the estimates of capital stock and depreciation rate. Even if sequel rights were classified as an asset, that classification would not change the value added by the movie industry. Instead, the change in classification simply raises the value of capital inputs to movie production and the capital value of movies produced by the exact same quantity.

The estimates of capital stock and depreciation rate presented later in this paper will not include any value for sequel rights. As a robustness check, I experimented with valuing sequel rights by comparing revenues for sequels and original movies. I find that

sequels have higher box office revenue than original movies, but lower home video sales soon after release and slightly lower long-term television sales. Holding production costs fixed, the net difference in revenues is relatively small, and so the fair price for sequel rights must be relatively small. [16] Therefore, my estimates of capital stock and depreciation rate would not change significantly if I included sequel rights in my analysis.

4. Depreciation Rate of Movie Copyrights

Because television licensing revenue is so long-lived, it drives the depreciation schedule for theatrical movies. Even after the introduction of DVDs, studios still receive the majority of their long-term revenue from television licensing rather than home video. Therefore, technological changes like blue-ray DVDs or downloaded movies have a surprisingly small effect on the depreciation rate for theatrical movies. The major impact of DVDs is on short-term revenues. Since 2000, movie viewers have increasingly chosen to skip going to theaters and bought a DVD instead. This change shifts a big chunk of studio revenues from the first quarter after theatrical release to the second quarter after theatrical release. I will show that this one quarter shift has little impact on the depreciation schedule for movies.

In this paper, I define the value of a copyrighted movie as the expected present value of future revenues minus future costs. I define the depreciation schedule as the rate

[16] It is possible that sequels require a lower advertising budget because consumers are already familiar with the movie. If this is true, then sequel rights have more value than revenues would suggest.

at which a movie copyright declines in value over time. There are many possible reasons why a copyright might decrease in value over time. For example, all consumers in a target market might have already bought the DVD. In this paper, I will not attempt to distinguish between obsolescence of the special effect technology, depreciation of the plot as cultural norms change, physicial depreciation of the film reel itself, or any other reason why consumers stop buying an old movie. I will simply attempt to estimate the schedule at which studios earn revenue from their copyrighted movies and the costs associated with those revenues.

In order to estimate the depreciation rate of movie copyrights, I need to know not only studio revenue from the sales of movies, but also studio non-production costs. Studios only earn a return on their assets if their revenues are higher than their non-production costs. In this analysis, I will consider two separate non-production costs for studios: advertising their new releases and manufacturing their DVDs. I will also discuss the payment made by studios to directors and actors as part of a profit-sharing agreement.

Movie studios spend enormous amounts of money advertising their films right around the theatrical release. In fact, these advertising costs are often larger than the studio's share of theatrical revenue (Epstein 2005). This advertising has an immediate impact on sales (Wilbur and Renhoff 2008). Studios also spend money printing the film reels to be shown in movie theaters and then shipping them nationwide. For the typical movie released in 2007, studios spent about half of their production budget on advertising and printing in the US (MPAA 2007 report)[17]. The industry literature did not give any estimates of advertising expenditure abroad. However, the Census Bureau's Service Annual Survey reports that movie studios receive about 50 cents in revenue overseas for

[17] This figure includes the cost of printing reels for theaters

every $1 in US revenue. I will assume that advertising follows the same ratio, and so studios pay 50 cents in advertising abroad for every $1 of advertising in the US. Therefore, total advertising expenditures are 75 cents for every $1 in production costs, 50 cents in the US and 25 cents abroad. This 75 cents includes not only the money spent directly on advertising, but also the overhead necessary to support the publicity work.

On average, studios spend more money advertising their new films than they earn from theatrical release. If all of this advertising were treated as a current expense, then it would appear that studios could raise profits by skipping the theatrical release entirely. In fact, the advertising also raises demand for DVDs when the movie is released to the home video market. I will follow BEA's policy and assume that advertising spending is a current expenditure, and therefore should only be deducted against short-term revenue. In particular, I will deduct all the cost of advertising against revenue received in the first year.[18] For example, suppose that studios paid $100 million to advertise a new film and got $100 million from box office and $200 million from DVD sales. Then I calculate that the return on production costs is $66 million from box office revenue and $132 million from DVD sales.

Movie studios spend relatively little of their revenue on manufacturing DVDs. In "The Big Picture", Epstein reports that one studio executive estimates that studios spend about $4-$5 for each individual DVD on manufacturing and sales. These manufacturing costs and sales expenses represent around 33% of the wholesale price for DVDs. Epstein also reports that it only costs $30,000-$50,000 for a studio to prepare the master DVD

[18] I assume that studios spend almost no money advertising past 1 year. On rare occasions, studios re-release an old movie with lots of fanfare, but studios normally do not advertise classics.

file from a pre-existing film reel (2005)[19], less than 0.1% of filming costs for a major motion picture. I will assume that 67% of the revenue from DVD sales represents a return on the investment filming a movie.

Movie studios spend even less money on television licensing. In "The Big Picture", Epstein that it costs only around $150,000 for a studio to prepare a pre-existing film for television release. And when a movie is released on television there is no manufacturing cost and the television network pays all of the advertising and customer service costs itself (2005). I will assume that 99% of the revenue from television licensing represents a return on the investment filming a movie.

The final cost to studios is residual payments to fulfill profit-sharing contracts between the studio and workers. From the studio's point of view, profit-sharing arrangements represents a significant cost. Depending on the contract, actors and directors may be legally entitled to portion of the revenues earned from box office, home video sales and television licensing. However, from the standpoint of national accounts, these payments are simply a delayed wage payment.[20] In section 1, I adjusted my estimates of production expenditures upward to account for the fact that some workers are paid a portion of studio profits rather than a straight salary. The investment activity is the same regardless of when the workers are paid or how the payment is structured.

[19] This only measure the cost of transferring a pre-existing file. It is common for studios to include additional material on DVDs such as interviews with actors, extra scenes, etc. The cost of this material might be considerably larger than $50,000.

[20] An alternative method to account for profit-sharing agreements would be to assume that studios only own a portion of the movie and actors own the rest. In that case, I would calculate the actor's share by estimating the net present value of future royalty payments. However, that procedure would complicate my calculations without changing the aggregate value of theatrical movies.

Figure 16 shows the annual revenue net of advertising and manufacturing costs.[21] Because the advertising and manufacturing costs are front-loaded, the difference between gross revenue and net revenue is much larger immediately after release. Therefore, using net revenue rather than gross revenue to estimate the depreciation schedule will result in a lower depreciation rate for copyrighted movies. Figure 17 shows the present value of this revenue stream for every year after theatrical release (using a 10% discount rate). I cannot match the depreciation schedule shown in Figure 17 precisely with a simple geometric curve. The value of a theatrical movie declines by 10% in the first quarter after theatrical release, and then declines by an average of 1.3% per quarter for the next three years. The rate of decrease then slows to only 0.5% per for the next decades. Nevertheless, a simple geometric curve that declines by 2.5% per year does an adequate job of matching the overall shap. In the remainder of the paper, I will use that rate to estimate aggregate capital stocks Aggregate capital stocks do not change much when I use a more complex depreciation profile. Aggregate capital stocks also remain similar when I include the inventory value of work-in-progress or completed movies not yet released.

Comparing My Depreciation Schedule to Other Estimates

To the best of my knowledge, no previous researchers have estimated the depreciation rate of movie copyrights from empirical data. Most European countries currently include movie copyrights in their NIPAs, but I have not been able to locate any

[21] I focus on annual revenue because quarterly revenue in the first year is heavily dependent on the exact timing of DVD release. In addition, net revenue by quarter is also affected by the rules for subtracting out advertising spending.

scholarly economic paper describing how they estimated their depreciation rates. And only two countries have responded to my questions about how they account for movie copyrights. One country used a service life of three years for movie copyrights because that is the lifespan they use for other assets without known depreciation rates. Another country used a service life of fifteen years, but they did not describe how they arrived at this lifespan. The closest existing empirical research used renewal rates for patents to estimate their value (Schenkerman and Pakes 1986). However, that research required very strong functional form assumptions. Therefore, I cannot compare my estimate of the depreciation schedule with any previous literature.

I can double-check the depreciation schedule estimated above by comparing the actual price paid for film libraries with my estimates of the fair market value. I was able to locate eight transactions where a media company purchased a film library and the price is public (Vogel 2004). I used data from IMDB.com to identify the films that comprised each library. I then valued each film according to the following formula:

Value of film X released in year Y = (Total Value of all films from year Y)*
(# of votes for film X)/(Total # of votes for all films released in year Y)

This formula assumes that studios value a movie based on future revenues rather than production costs. Therefore, a small budget hit like 'The Blair Witch Project' is an extremely valuable asset. In contrast, a big budget flop like 'Waterworld' is not.

I then applied my depreciation curve and estimated the fair market price for each film library if the depreciation rate estimated above had held. Results are shown in Table

3. I find that my estimates of the fair market value for a film library is reasonably close to the actual price paid for the two transaction that occurred during the 1990s. However, the match is not so close for a 2003 deal.[22] And the prices paid for classic film libraries are much lower than my estimates of the fair market value. I believe that the films produced in the 1930s and 1940s depreciated at a significantly higher rate than modern films. This may reflect technological changes in movie production, or it may reflect differences in the type of movies produced over time.

The depreciation schedule estimated earlier in this paper does not match the depreciation schedule used by studio accountants. The American Institute of Certified Public Accountants requires that studios write down new films completely within ten years of theatrical release (AICPA 2000). In contrast, I calculate that new films still retain more than 75% of their original value ten years after theatrical release. The accounting rules are different when studios purchase a library of films at least three years old. In that case, studios are required to write down the entire library within twenty years of purchase. In contrast, I calculate that film libraries still retain about 60% of their original purchase price twenty years later. However, it is common for accounting rules to diverge from economic value. By itself, the discrepancy does not suggest any problems with my empirical work.

The depreciation schedule estimated above also does not match the IRS regulations governing the writedown of films. At the present time, IRS treats small films, large films and unfinished films very differently. Studios are allowed to write down their

[22] This deal was especially complex to value because Artisan owned only the home video rights for many of the films in their library. Based on my empirical research, I estimated that home video rights accounted for 27% of the long-term value from a movie copyright. If this estimate is wrong, then my estimate of the fair market value for Artisan is also flawed.

expenses on films with a production budget under $15 million immediately (Triplett 2007). Large films are depreciated over a period of ten years according to the income forecast method. The income forecast method requires studios to estimate the total revenue they will receive from the film in the ten years after it is produced and the salvage value after ten years. Studios then depreciate the film by the decrease in expected revenue each year (IRS Publication 946). If a film is never produced at all, studios must amortize their expenses over a fifteen year period starting with the date the studio writes off the film for accounting purposes (U. S. Master Depreciation Guide 2007). Like the AICPA guidelines, the IRS depreciation curves under-estimate the value of old movies.

Constructing A Time Series of Capital Stock

Figure 18 shows my estimate of the aggregate real value of copyrighted movies for every quarter from 1929 to 2007. I started out with the quantity index developed in Figure 7. I then applied the 2.5% depreciation rate developed earlier in this section. I find that the aggregate stock of movies follows an S curve. The total value of copyrighted movies increases rapidly from 1929 to 1950 and then levels off at $40 billion from 1950 to 1980. The capital stock of movies then started increasing rapidly in 1980 and reached $130 billion by 2006. In my calculations, I assume that the aggregate stock of movies was 0 at the beginning of 1929. If I change that assumption, then the entire curve is shifted upward. I also experimented with assuming a faster depreciation rate for movies released between 1930 and 1950. In that case, the aggregate capital stock of

movies was much lower early in the sample. But the general shape overall remains similar.

It might seem that the aggregate value of movies is bounded by some maximum total value for the entire entertainment industry. The American public has a limited amount of time available for leisure, and so there must be some upper bound to the amount of movies they can watch in a year. At that point, the demand for movies is saturated and new movies will drive old movies from the market. However, the data suggest that Americans are nowhere near any hypothetical saturation point. Between 1988 and 2002, real production spending for new movies increased from $3 billion to $9 billion per year (2000 $'s). Over that same time period, home video rentals and sales of pre-1980 movies remained steady at around $1 billion per year (2000 $'s). Similarly, television licensing for a sample of pre-1980 movies remained steady at around $2 billion per year (2000 $'s) between 1997 and 2002. There is no way to tell whether movie viewers will ever reach a saturation point, and when such a point might occur.

Conclusion

In this paper, I constructed NIPA estimates when production of theatrical movies is treated an investment activity rather than an intermediate expense. This change helps bring the NIPAs in line with SNA 93, which recommended that artistic originals be treated as capital assets.

Contrary to the current studio accounting, I find that theatrical movies have a very long lifespan. According to the AICPA's guidelines, studios are required to amortize new films over a period of ten years or less. In contrast, I estimate that films have a

lifespan of 80 years, and ten-year-old films are worth approximately 75% of their original value. A number of European countries are currently including theatrical movies as capital assets in their national accounts. At the moment, these countries are assuming a lifespan much closer to the AICPA's guidelines than my 80 year estimate.

I also found that investment in theatrical movies has been growing rapidly since 1980. In 1980, studios spent less than 0.04% of nominal GDP on movie production. By 2006, movie production had grown to 0.08% of nominal GDP. Real GDP growth averages 0.001% higher per year between 1980 and 2006 when theatrical movies are classified as a capital asset.

Finally, I found that movie filming is an extremely volatile industry. Therefore, it has a more significant affect on aggregate growth rates than a larger industry with steady production. For example, movie production was 0.11% of nominal GDP in the first half of 2001. Movie production then fell by 50% to only 0.05% of GDP in the second half of 2001. Therefore the growth rate between spring of 2001 and summer of 2001 is 0.06% less when theatrical movies are classified as a capital asset.

Table 1: **List of Datasets Used and How They Are Used**

Dataset	Description of Dataset	Used to Create
2002 Economic Census	The Economic Census is conducted every 5 years by the Census Department. It surveys businesses in the United States.	Nominal Movie Production, Real Movie Production & Depreciation Schedules
2006 Service Annual Survey	The Service Annual Survey is conducted every year by the Census Department. It surveys businesses in the service sector. However, it is less detailed than the Economic Census.	Nominal Movie Production, Real Movie Production & Depreciation Schedules
The-numbers.com	This website provides weekly box office earnings back to 1983. It also provides a list of major movies and their production budget 1980-2007.	Nominal Movie Production, Theatrical Revenue Schedule & Depreciation Schedules
IMDB.com	This website provides a list of all movies movies produced back to 1929. It also provides details about each movie such as cast and crew, length of film, and sometimes production budget and filming dates.	Nominal Movie Production, Real Movie Production
BEA's Gross-Domestic-Product by Industry Accounts	This table estimates the total employment for the entire motion picture and sound recording industry.	Real Movie Production
Survey by Alexander and Associates	This is a consumer survey that tracked rentals and purchases. Every week, a new sample of 1,000 households were called and asked which movies they had rented or bought	Home Video Revenue Schedule & Depreciation Schedule
RedBee Media Services Dataset	This is a dataset of American movies shown on British television stations. The dataset records the name of the movie, the date it was shown and the channel it is shown on.	Television Licensing Revenue Schedule & Depreciation Schedule

Table 2: **Summary Information on The-numbers.com Dataset of Major Movies**

		Millions of $'s (Nominal)		Each Movie is Weighted by Box Office Revenue		
Year of Theatrical Release	# of Movies in Dataset	Mean Box Office Revenue	Mean Production Budget[23]	included in Sample	Production Budget is Reported	Filming Dates are Reported
1980	97	21.06075	10.91296	98%	45%	31%
1981	82	21.68486	11.68036	100%	48%	35%
1982	104	22.3061	15.21539	99%	50%	46%
1983	117	18.24238	10.82	98%	36%	55%
1984	139	21.9888	14.00641	96%	58%	48%
1985	140	19.38796	14.88886	97%	58%	46%
1986	150	18.75166	14.9041	96%	48%	58%
1987	154	20.83879	14.42361	96%	42%	58%
1988	160	20.75432	15.76346	95%	60%	70%
1989	159	24.55764	18.33842	97%	50%	70%
1990	167	25.63697	25.36838	96%	58%	72%
1991	161	25.70489	25.8661	96%	48%	72%
1992	145	29.46865	27.9303	97%	43%	67%
1993	177	26.3847	24.38444	94%	44%	72%
1994	173	27.61621	31.32918	94%	60%	68%
1995	213	23.88336	34.81325	93%	74%	62%
1996	195	22.59016	36.22542	93%	74%	67%
1997	176	30.1179	41.57933	97%	85%	85%
1998	183	25.21129	40.03916	94%	87%	71%
1999	183	27.53599	38.97022	96%	94%	87%
2000	207	28.69929	38.34664	100%	98%	82%
2001	207	30.69562	37.24042	100%	99%	81%
2002	216	31.98306	34.50807	100%	97%	81%
2003	223	37.41774	44.0711	100%	91%	94%
2004	243	35.08011	46.68942	100%	91%	94%
2005	273	28.47275	41.25174	100%	91%	97%
2006	333	25.40797	36.94841	100%	81%	93%
2007	388	23.82037	42.33979	100%	82%	95%

[23] The smaller movies are less likely to report production budgets. Therefore, a simple average will over-estimate the mean production budget. In my empirical work, I correct for this problem by imputing production budgets for movies with missing data.

Table 3: **Selected Film Library Sales**

Year	Description of Deal	Predicted Price	Actual Sale Price
1957	Warner Brothers sold their pre-1948 library to United Artists	$1,036 million	$30 million
1958	Paramount sold their pre-1948 library to MCA	$1,008 million	$50 million
1979	American International Pictures sold their entire library to Filmways	$66.9 million	$25 million
1982	Warner Communications bought back the rights to its pre-1948 library	$1510 million	$75 million
1985	MGM/UA Entertainment sold their film library and studio property to Turner Broadcasting. Turner Broadcasting then sold back the studio and the trademark, keeping only the MGM library.	$3,943 million	Net price of $720 million
1993	Turner Broadcasting acquired New Line studio	$675 million	$500 million
1997	Metro-Goldwyn-Mayer acquired Orion/Samuel Goldwyn studios	$462 million	$573 million
2003	Lions Gate acquired Artisan. In addition to its own movies, Artisan also owned the home video rights for Republic Pictures, Vestron and Carolco. I valued those home video rights at 27% of the capital value.	$757 million	$210 million

Figure 1.

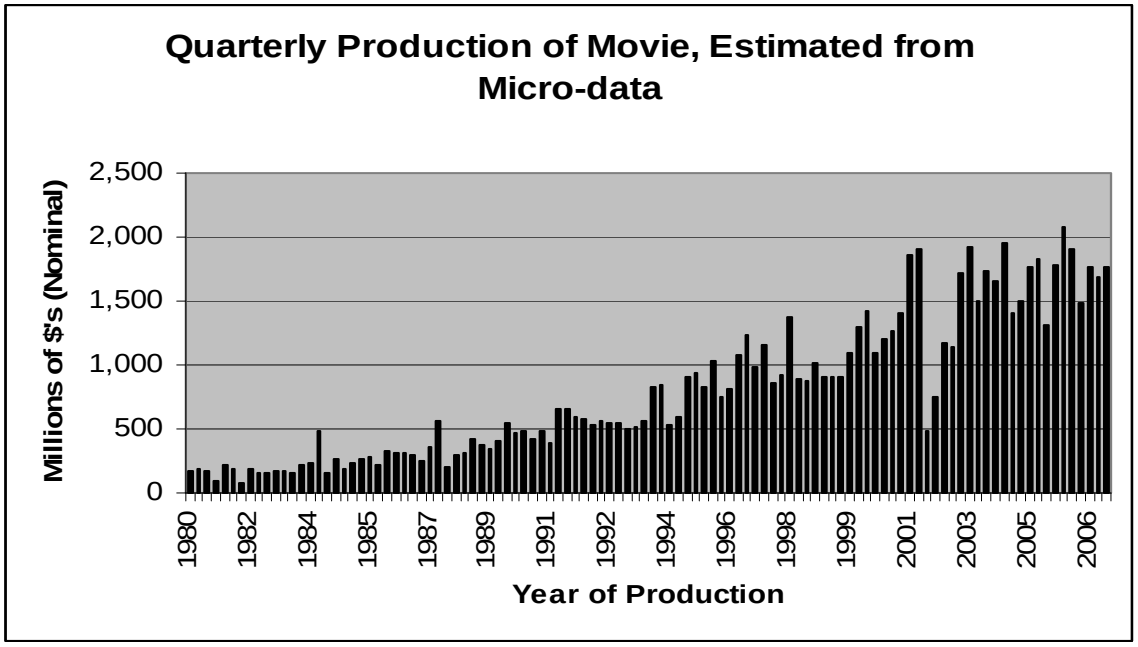
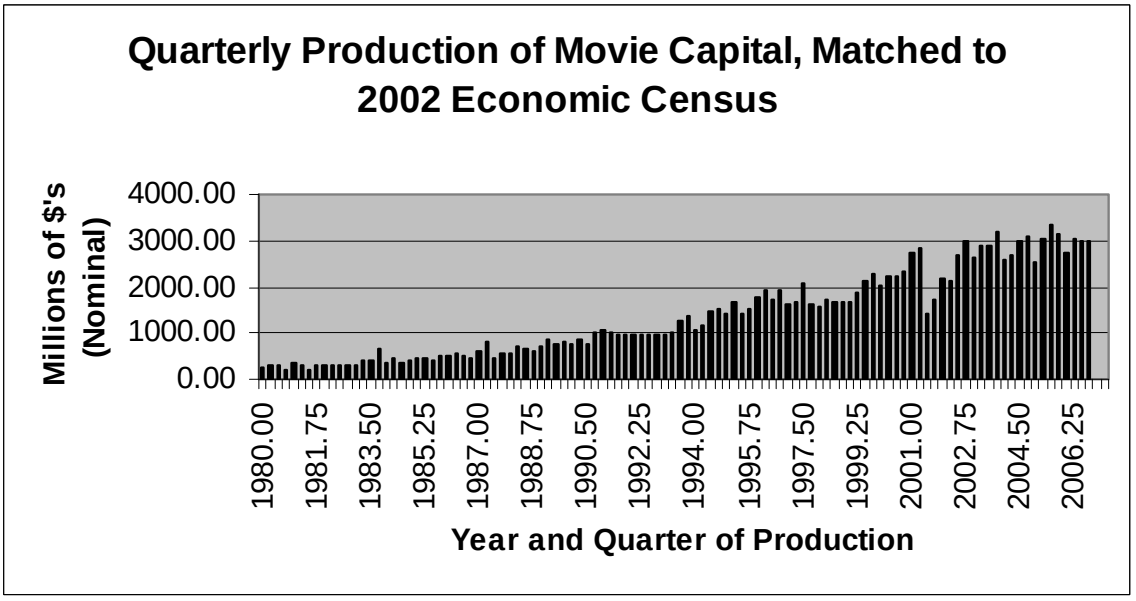


Figure 2.



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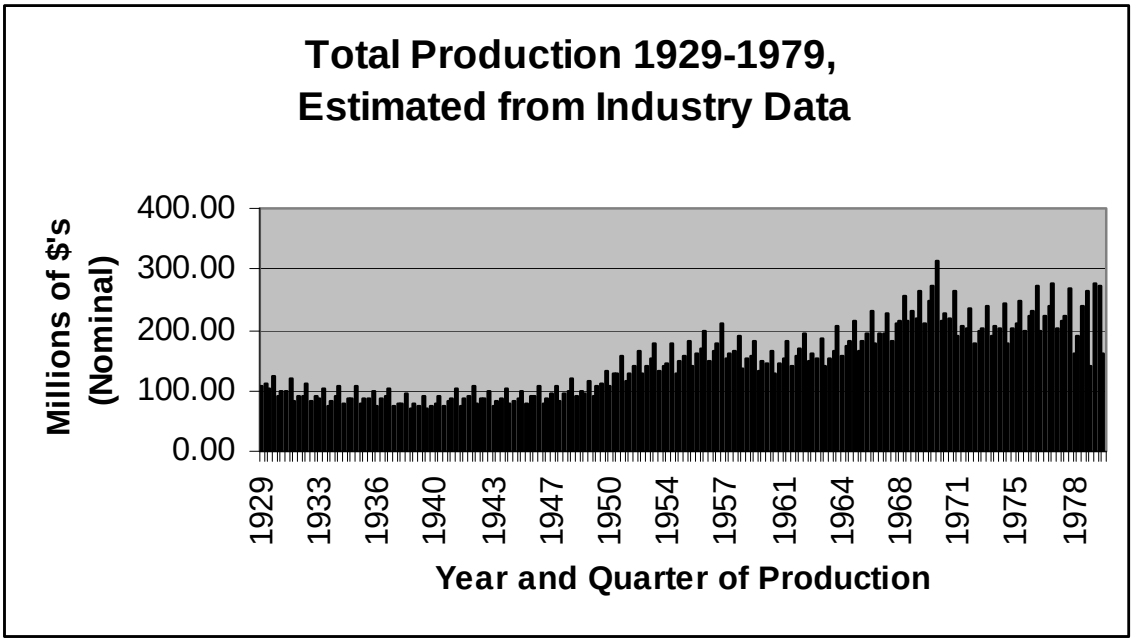

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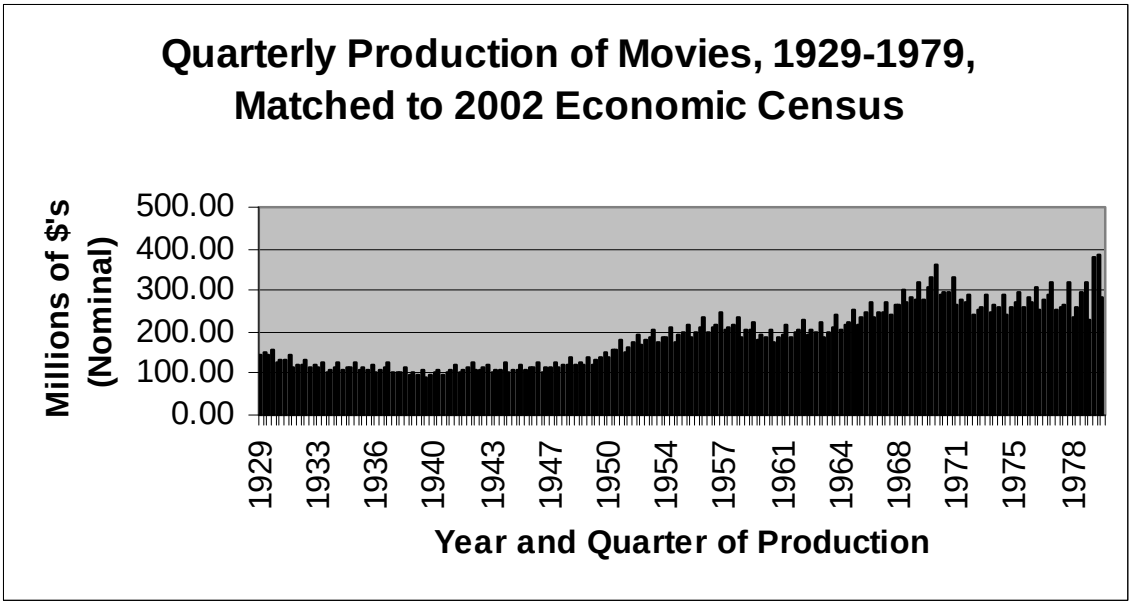
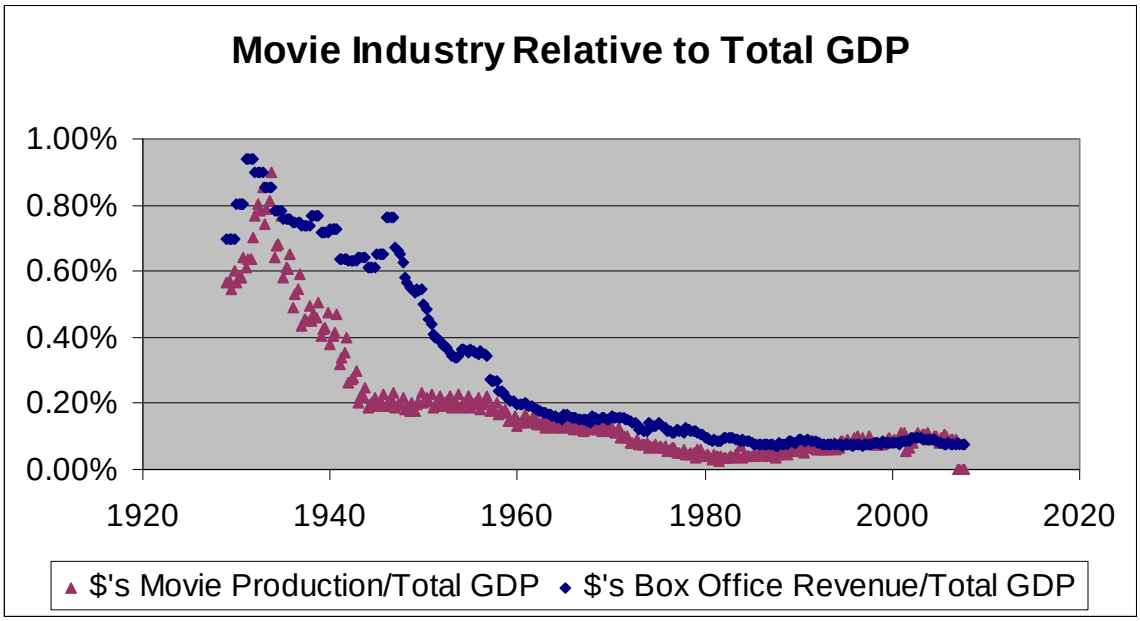


Figure 5



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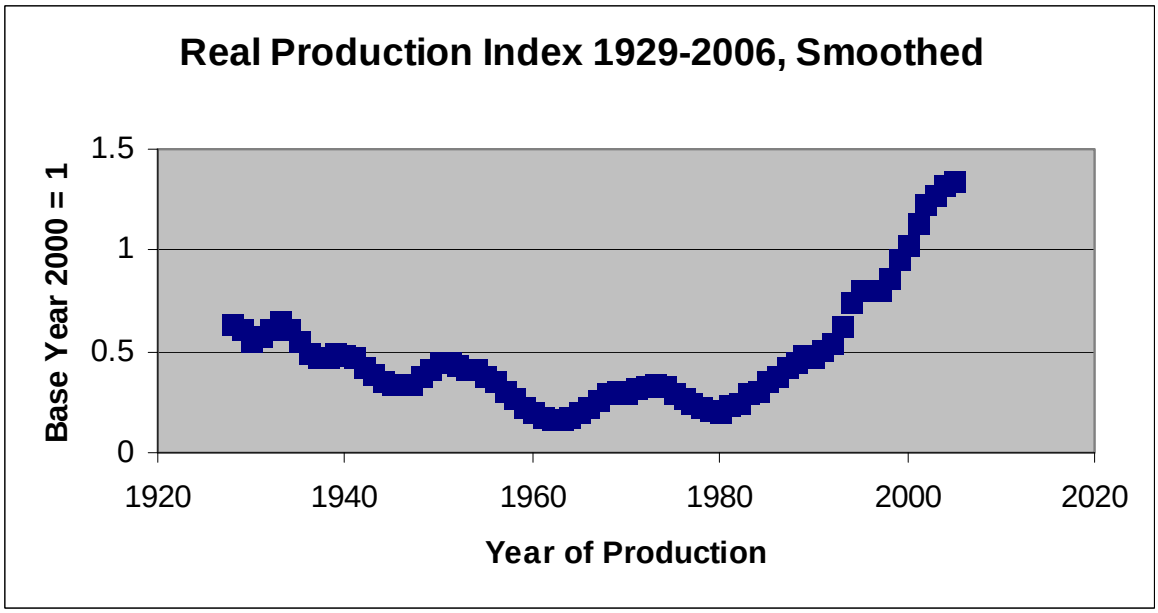

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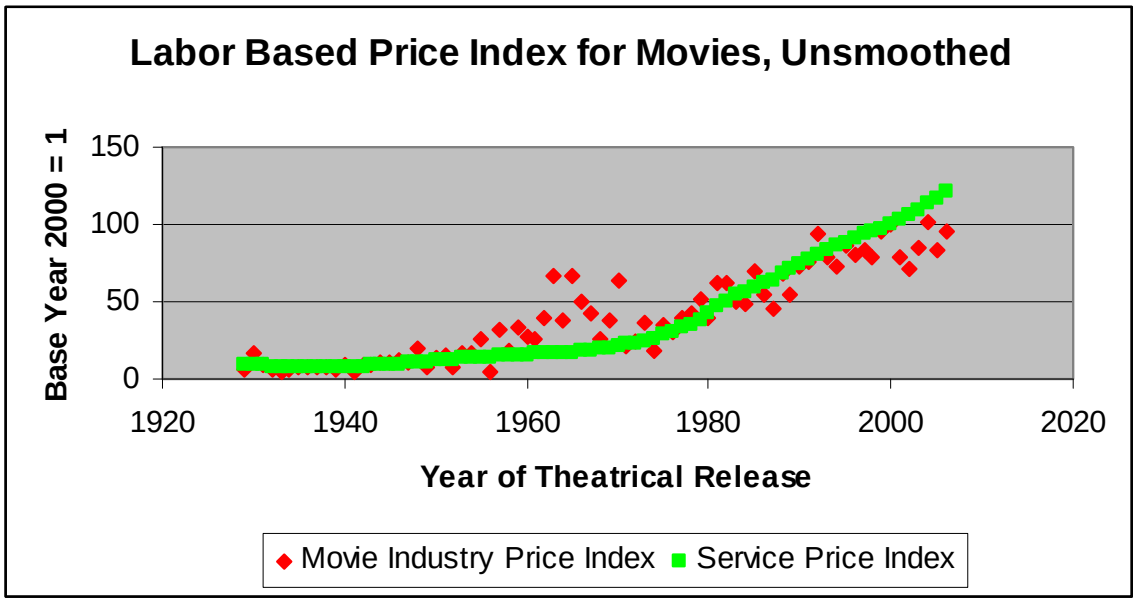

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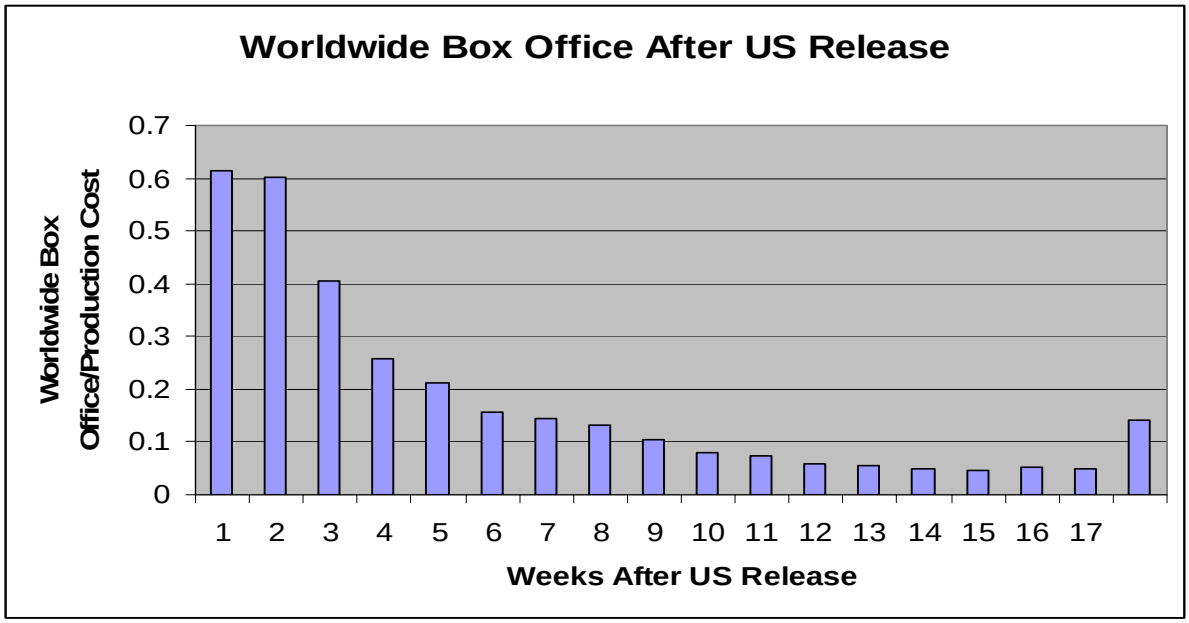


Figure 9

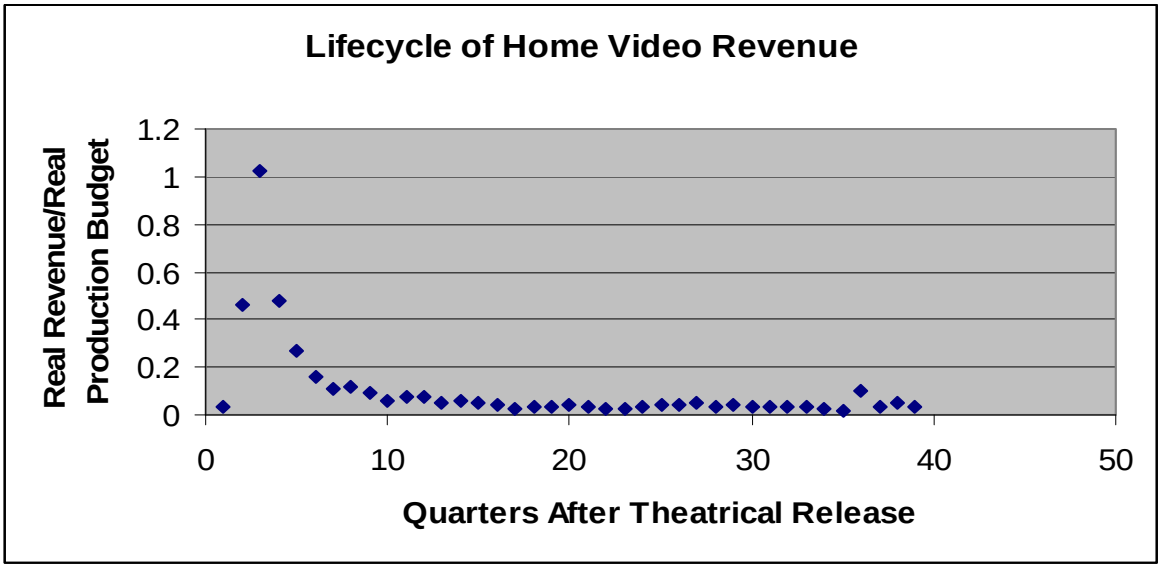
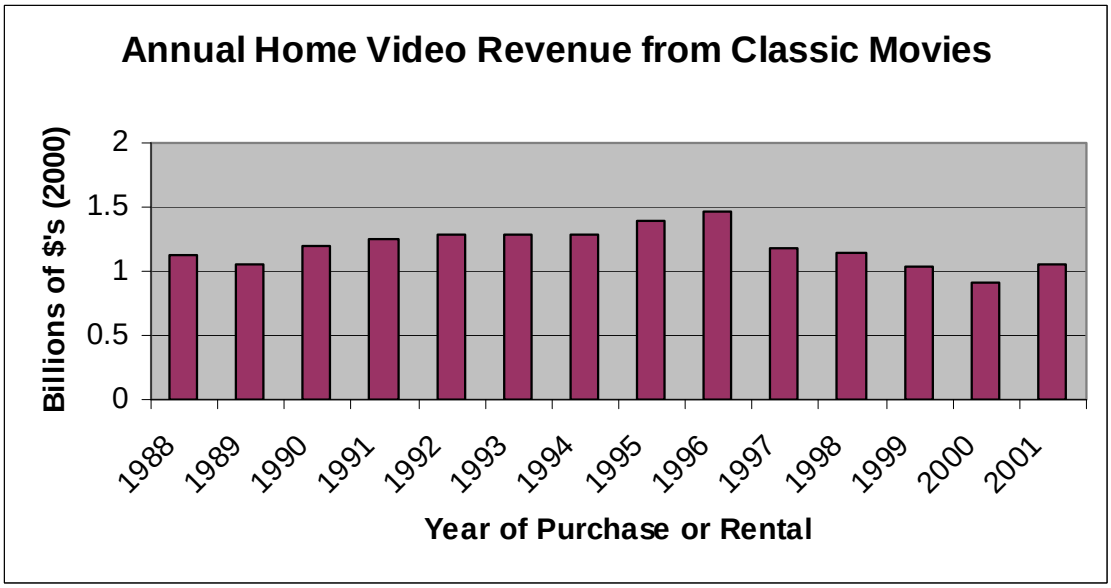


Figure 10



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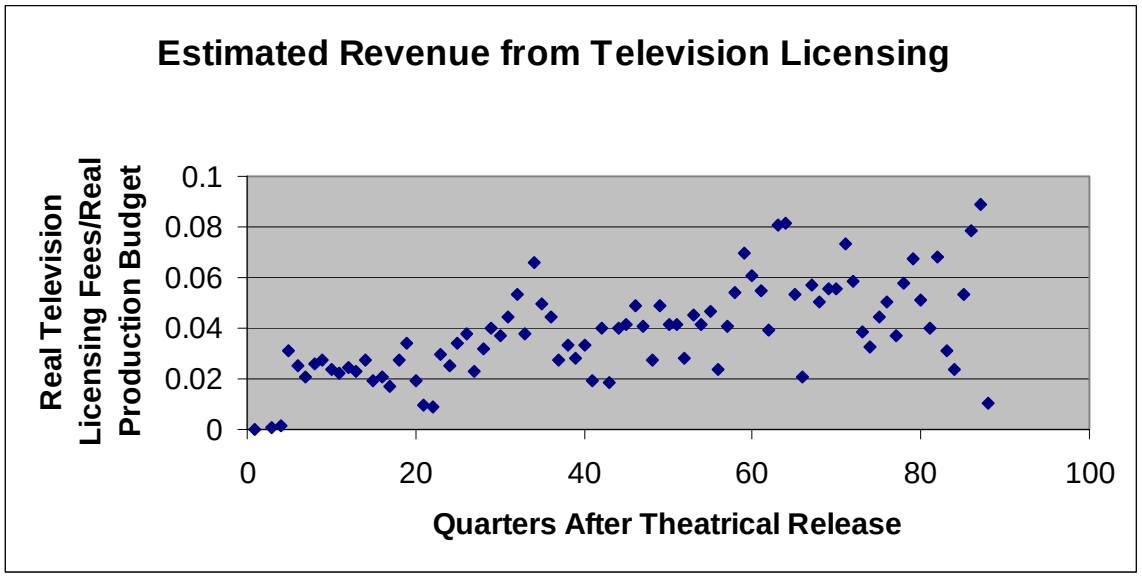

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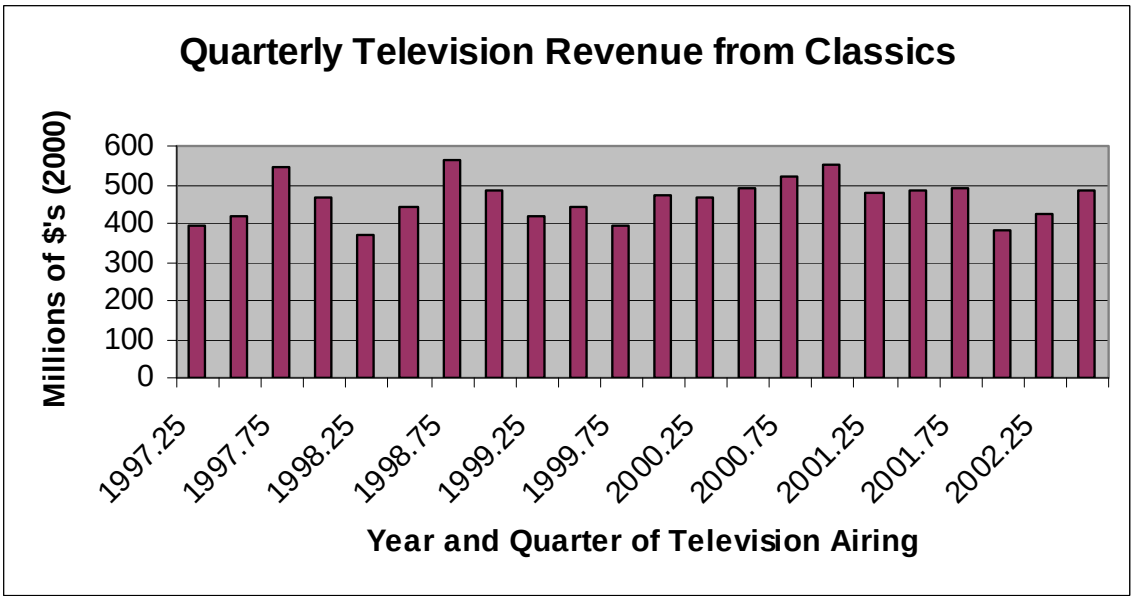

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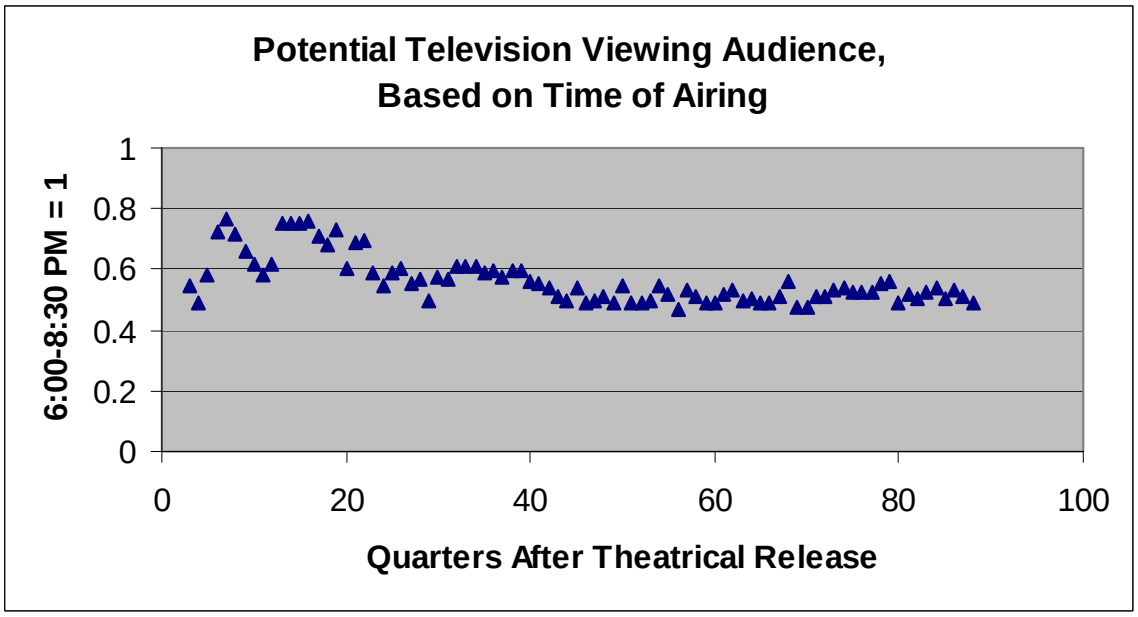

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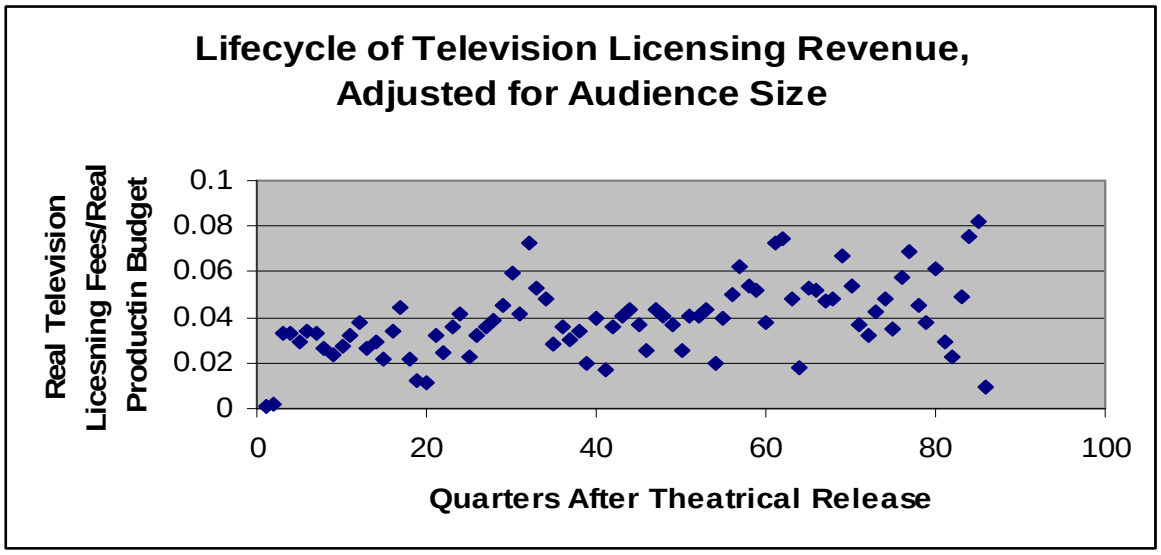

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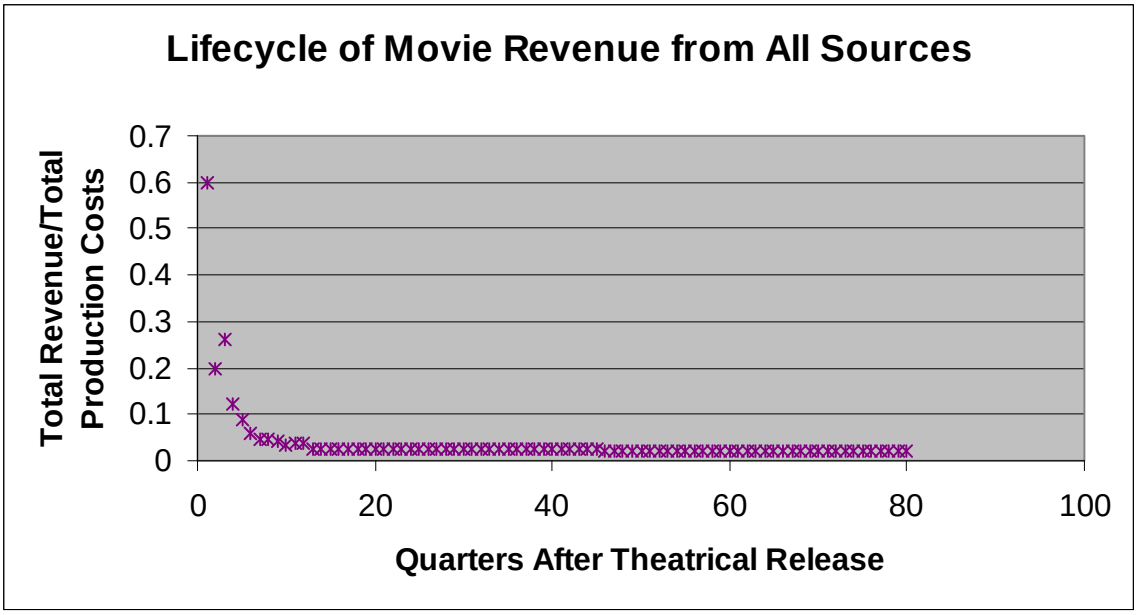

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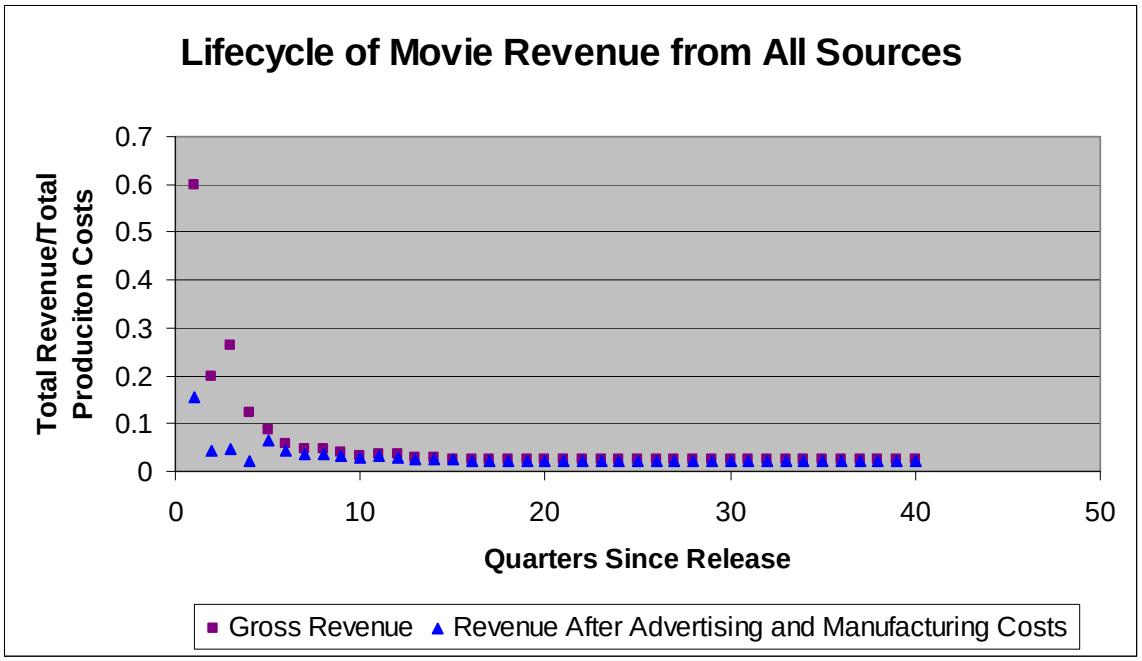

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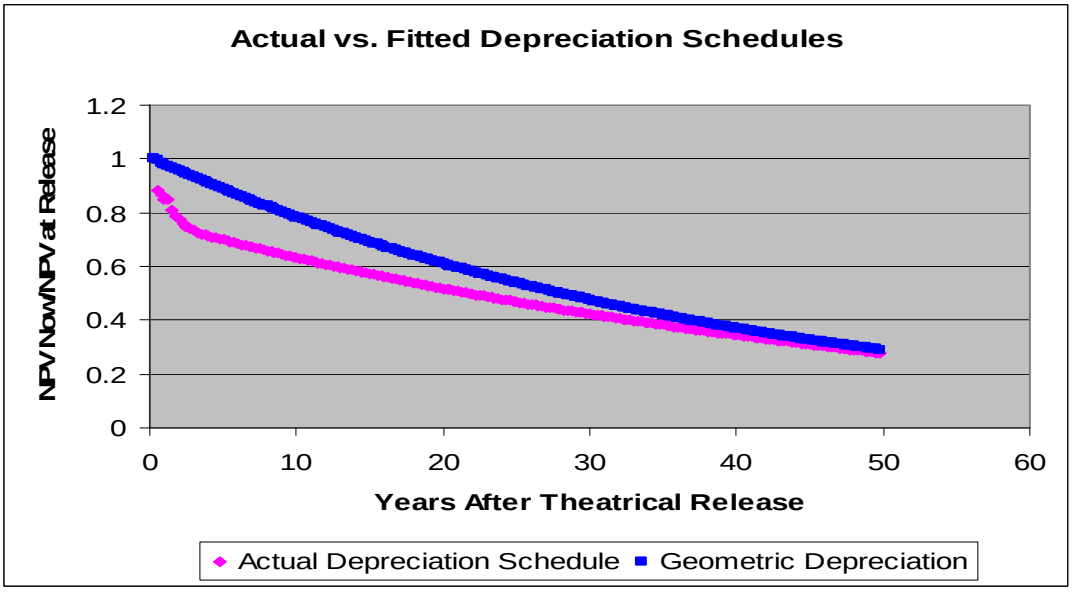

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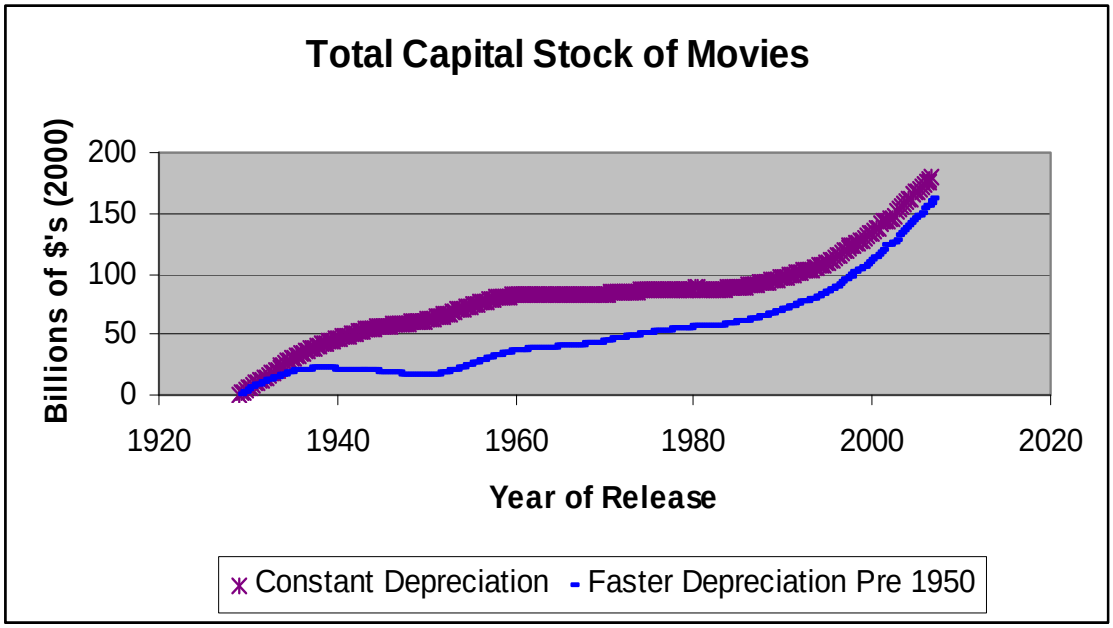

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Appendix 1: Description of Revenue Data

A. Revenue from Theaters Worldwide

My box office revenue data is also taken from the website The-numbers.com. This website provides weekly box office revenue in the United States for all major motion pictures since 1982. It also provides worldwide box office revenue for a smaller sample of movies since 2004. At the time I downloaded the data, the charts for worldwide box office data are available from March of 2004 to December of 2007. The charts for US box office revenue are available from 1982 to 2008.

The-numbers.com draws its box office data from the studio's reports of the total box office revenue for a particular movie. These box office revenues are based on the ticket sales reported by movie theaters to the studios. The reported ticket sales are audited regularly by the studios, and so are believed to be reliable.

B. Revenue from Home Video Sales

My data on home video rentals and purchases is taken from a survey by Alexander and Associates. Alexander and Associates conducted telephone survey of one thousand US consumers a week between 1987 and 2006. Consumers who rented movies were asked the title they had rented and what store they had rented the movie from. Consumers who bought a movie were asked the title they had bought and how much they

had paid for their movie. In total, Alexander and Associates records 18,221 DVD purchases, 27,882 DVD rentals, 157,431 VHS purchases and 637,933 VHS rentals. Alexander and Associates then assigned a unique movie code to every movie title in their dataset. A single theatrical movie sometimes received multiple codes. For example the Star Wars trilogy was re-released in 1997 with improved special effects. The new versions got its own codes.

Consumers could not remember a specific title for 205,137 rentals and 4,483 purchases. The much larger error rate for rentals probably reflects the fact that consumers had already returned the movie, and therefore could not check the title during the survey. These observations were excluded from the dataset. In my empirical analysis, I corrected for the missing data by adjusting the weights so total rental revenue summed to the proper amount. This procedure produces unbiased results if consumers forgot all movie titles at an equal rate.

In addition, consumers might have misreported the title of movies or the surveyer might have misrecorded the title. According to Bob Alexander, consumers are more likely to forget the title of children's movies because they did not watch the movies themselves. Surveyers may also have been more accurate at recording the titles of popular movies. These biases probably lower the percentage of old movies recorded. I do not know if how large the bias might be.

Because the survey dataset is so large, I created a stratified random sample of 2,784 movie codes to study, with an oversampling of popular titles.[24] I then used The-numbers.com and IMDB.com to determine the original source for each movie, the date

[24]The complete dataset, including the sampling rules and probability for each movie is available upon request.

when each movie was released and the production budget for that movie. A small number of home video movies were first released on TV or direct-to-video. I exclude those movies from my analysis. In addition to that sample, I also sampled every theatrical movie produced between 1980 and 2007 with valid data on production budget, as described in section 1. I exclude observations after July of 2002 because the dataset given to me after July of 2002 is incomplete.

In many cases, the reported movie title is ambiguous and could potentially match many movies. For example, the title "101 Dalmations" could refer to a live action movie produced in 1996 or an animated movie produced in 1961.[25] In those cases, I used my best judgment to match the reported title to the most likely movie. A complete dataset of matched titles, release dates and movie codes is available upon request. As a robustness check, I tried alternative matching rules for movies with multiple possible matches. I find that changing the matching rules has little effect on the depreciation rate.

The Economic Census only reports the total industry revenue from the home video market, and so I cannot use it to calculate rental and purchase revenue separately. I used the industry data from the Entertainment Merchants Association's 2007 report to calculate the revenue received from rentals and purchases of each movie. The EMA's report estimates both rentals and purchases for every year from 1997 to 2006. I calculated rentals and purchases for earlier years using a two step process. I first used the home video revenue given in 'The Big Picture' (Epstein 2005) to calculate the total home video revenue earned from 1988 to 1996.[26] I then calculated the revenue for the rental

[25] Alexander and Associates have separate movie codes for each movie, so it is possible to distinguish them in theory. However, it is clear from the data that the surveyors often confused the two.
[26] Epstein (2005) only gives revenue every five years. I assumed a constant growth rate over the five year period. I also adjusted Epstein's numbers so there would be no break in trend between the two series.

market and the purchase market by projecting the rental share in 1997 backwards. The rental share remained roughly constant between 1997 and 1999, so it makes little difference whether I take the rental share as constant between 1988 to 1996 or use the actual growth rate.

In my empirical analysis, I will calculate the total revenue received by a studio from its movie copyrights according to the following assumptions: 1) I assume that studios receive revenue on the same date a consumer buys or rents a movie. Changing this assumption has a large effect on the amount of depreciation in the first few months after theatrical release, but it does not significantly change my estimates of the total capital stock or the average depreciation rate; 2) I assume that studios receive revenue from the rental market in proportion to the total # of rentals and revenue from the sell-through market in proportion to the total # of sales by year. For some movies, Alexander and Associates reported a suggested retail price. My empirical results did not change significantly if I used those suggested retail prices to weight each observation, but the sample size was smaller.[27]; 3)I assumed that every quarter should have equal weight when calculating studio revenue. In other words, I assumed that sales and rentals were constant over the year. The formula to calculate revenue for each movie is as follows:

Rental Revenue for Movie A in Quarter X = Total Rental Revenue in Quarter X*
(# Number of Rentals in Movie A in Quarter X) /(Total # of Rentals in Quarter X)

[27] Suggested retail price does not necessarily match with actual price paid. In the 1980s and early 1990s, studios often sold movies at a very high price point (~$100) to rental stores for the first few months after home video release. They then lowered the price and sold videos to consumers. In 1997, studios created a new system where they sold movies to Blockbuster and other large chains for a small upfront price and a 50% share of rental revenue.
Alexander also asked consumers how much they paid for movies purchases, but that data is not available for most years. Even when it is available, many consumers didn't answer.

Sales Revenue for Movie A in Quarter X = Total Sales Revenue in Quarter X*
(# Number of Sales in Movie A in Quarter X) /(Total # of Sales in Quarter X)

Total Home Video Revenue for movie A in Quarter X = Rental Revenue+ Sales Revenue

C. Tevenue from Television Licensing

My television revenue dataset is taken from a historical listing of television programs by the European company Red Bee Media. This company maintains a listing of television programs shown in the United Kingdom back to 1997, France and Germany back to 2001 and the rest of Europe back to 2003. Movies shown on television are listed in this dataset with the time, date and channel of airing. BEA purchased a subsample of their dataset covering 1,000 popular movies.[28] The subsample lists every single time those 1,000 movies are shown on TV if the television program is included in Red Bee Media's historical listing. I cannot observe any television broadcasts that are not included in Red Bee Media's database, and so my estimated depreciation schedule may be biased.

In my main empirical analysis, I will focus on movies aired in the United Kingdom. I made this choice for three major reasons: 1) The Red Bee Media's underlying dataset goes back the farthest for the United Kingdom; 2) The United States and the United Kingdom share similar tastes in movies. Therefore, television listings in the United Kingdom are a better proxy for US television listings than television listings from continental Europe; 3) In non-English speaking countries, US movies are often

[28]I focused on popular movies to maximize the total number of airings listed. The list of movies searched for and the sampling rules are available upon request.

listed under a variety of titles in the television programs, depending on the individual translator. Red Bee Media often had difficulty matching these listings with the correct title. Therefore, it is likely that the television listing data for the UK is higher quality than in continental Europe.

This database provided by Red Bee Media Services has absolutely no information on the price paid by television stations to the studios for licensing rights. To the best of my knowledge, there are no publicly available datasets that contain price data for individual movies. Both studios and television stations consider licensing prices proprietary data, and do not release any public datasets. In many cases, individual price data simply does not exist at all. Movies are often transferred between companies owned by the same corporate parent. In that case, the reported price might be set to minimize tax liability or payments to actors. Studios also sell blocks of movies to foreign television stations as part of a single transaction (Epstein 2005).

In my empirical analysis, I will impute the price paid by a television station for licensing rights according to the following assumptions: 1) I assume that studios are paid on the same date a television station shows the movie.[29] ; 2) Conditional on year and quarter of broadcast, I assume that studios charge a fixed rate per movie. The only difference between popular movies and unpopular movies is that popular movies are shown more often; 3) Red Bee Media's dataset often lists multiple airings of the same movie on the same date. For example, some popular TV channels rebroadcast their entire lineup on a different channel delayed by one hour. This rebroadcast channel is listed

[29] Studios are allowed to recognize their licensing revenue on the licensing period begins, which may be months before the television station actually airs the movie (AICPA 2000).

separately in Red Bee Media's dataset. In my empirical analysis, I will drop these duplicate observations.

In theory, the license fee for a movie should depend on the total number of potential viewers. For example, a station broadcasting to the London metropolitan area should be charged more for the same movie than a station broadcasting to a remote rural community. In practice, all local versions of a particular TV channel broadcast US movies on the same date and at the same time. Therefore, almost all movies in my dataset are broadcast across the entire UK.

The assumptions provided above allow me to estimate how much revenue movie A received *relative* to movie B in quarter X. However, I cannot compute the absolute dollar amount without knowing the average price paid by networks for the right to use a movie. I calculated the average price paid by networks using a three-step process. I first used the revenue breakdown given by Edward Epstein in 'The Big Picture' on page 20 to determine aggregate quarterly revenue from pay TV and regular TV.[30] I then calculated the total number of times any movie in my sample was shown on television in the United Kingdom for quarter X. If the movies in my sample represented the entire market, then I could calculate the average license fee according to the formula:

Price for pay TV = (Total pay TV Revenue)/(Total # of Movies shown on pay TV)

Price for regular TV = (Total regular TV Revenue)/(Total # of Movies on regular TV)

[30] Epstein (2005) only gives revenue every five years. I assume a constant growth rate over the five year period. I divide yearly revenue by 4 to get seasonal revenue.

In fact, the television listings given by Red Bee Media represent only a fraction of the total market for US movies in the United Kingdom. Furthermore, the share of the market covered by my sample may be changing over time as new movies are released.[31] Because I don't know the total size of the market, I can't calculate the exact market share of movies in my sample. In this paper, I will use the sales share for my sampled movies in the home video market as a proxy for their share in the television market. For example, suppose that my sampled movies represented 50% of all sales in the home video market during 1998. Then I assume that my sampled movies also represent 50% of television licensing. In fact, the movies in my sample represent approximately 35%-40% of all sales in the period 1997 to 2002, with the share of sales decreasing slightly over the time period. I can therefore calculate television licensing revenue with the formula:

$$\text{Pay TV Revenue}_{\text{Movie A}} = (\text{\# of broadcasts for Movie A})*(\text{Total pay TV revenue})*(\text{Market Share of Sampled Movies})/(\text{Total \# of broadcasts for all movies in sample})$$

$$\text{Regular TV Revenue}_{\text{Movie A}} = (\text{\# of broadcasts for Movie A})*(\text{Total regular TV revenue})*(\text{Market Share of Sampled Movies})/(\text{Total \# of broadcasts for all movies in sample})$$

$$\text{Total TV Revenue} = \text{Pay TV Revenue} + \text{Regular TV Revenue}.$$

I then smoothed this revenue stream across five quarters:

$$\text{Smoothed TV Revenue}_X = (\text{TV Revenue}_{X-2} + \text{TV Revenue}_{X-1} + \ldots \text{ TV Revenue}_{X+2})/5$$

[31] If I had sampled movies randomly, then I could easily estimate the exact fraction of the market covered. However, I drew my sample from movies with many votes on IMDB.com and high box office revenues in the United States.

I also experimented with controlling for the number of potential television viewers. I drew my data on TV watching from the 2007 American Time Use Survey. In that survey, individuals were asked to write down what they were doing throughout the course of a particular day. I found that television viewing exhibits a strong time pattern. At 4:00 in the morning, only 0.13% of people are watching television or a movie. This percentage gradually rises throughout the day. By 5:00 in the evening, 2.9% of Americans are watching television. The number of tv viewers then climbs rapidly as people get off work. By 8:30 in the evening, 6.9% of Americans are watching television. After 10:00, television viewership starts to decline rapidly as people go to bed.

I made the following assumptions to calculate the potential viewing audience for each movie: 1)All movies shown are television are exactly 2.5 hours long (including commercials; 2)Viewers watch all parts of a movie that are broadcast during a time they normally watch. In other words, people don't avoid movies that are halfway through when they turn on the television or stay up past their normal bedtime to finish a movie; 3)Viewers only watch television live. In other words, I do not adjust for the possibility of recording a movie and rewatching it at a more convenient time. I then calculated the adjusted revenue for each movie:

$$\text{Adjusted Revenue}_{\text{Movie A}} = \text{Revenue}_{\text{Movie A}} * (\text{Average Potential Audience for Movie A}) / (\text{Average Potential Audience for All Movies})$$