

Theatrical Movies As Capital Assets

By Rachel Soloveichik

Abstract

In 2007, I estimate that studios spent \$20.0 billion producing original theatrical movies. These movies were shown in theaters in 2008 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 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 did not capitalize this category of intangible assets until the July 2013 benchmark revision. In order to change the national accounts, I collected data on movie production from 1915 to 2010. I then calculated how GDP statistics change when theatrical movies are classified as capital assets.

To preview, my empirical results are: 1) Theatrical movies have a useful lifespan of at least 80 years; 2) Over the past decade, nominal movie production has grown slower than the overall economy. As a result, nominal GDP growth falls slightly when theatrical movie production is classified as a capital investment; 3) Thanks to improvements in computer technology; prices for shooting new movies have been constant over the past decade.

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Introduction

The motion picture industry started in the late 1800s when Thomas Edison introduced the Kinetoscope. Over the next decades, movies improved in quality and became a very popular source of entertainment. By 1929, Americans were spending \$720 million per year on movie tickets (Vogel 2004), 0.7% of nominal GDP. The GDP share of movies diminished in the 1950s and 1960s when television became widespread. After 1980, the movie industry made a comeback with the introduction of video cassettes and DVDs. In 2007, studios earned \$39 billion from theatrical movies, 0.27% of nominal GDP.

In 2007, I estimate that studios spent \$20.0 billion producing original theatrical movies. This value includes box office licensing revenue, television licensing revenue, DVD sales, merchandise licensing and any other revenue sources. Because of their long working life, the international guidelines for national accounts recommends that countries classify movie production as an investment activity and movie originals as capital assets. This recommendation was first introduced by the 1993 System of National Accounts (SNA 1993 10.94) and was reiterated in the 2008 System of National Accounts (SNA 2008 10.115).

In the national income and product accounts (NIPAs), this \$20.0 billion of movie production could either be treated as a current expense or it could be treated as an investment. If theatrical movies have a useful life of less than one year, then the production costs for movies should be treated as a current expense. In that case, the final revenue from the sale of movies is all that matters for gross domestic product (GDP), and production costs for movies are an expense in the same way that DVD stamping and movie advertising is an expense. Before the July 2013 benchmark revision, BEA used this method to account for movie production.

In contrast, items with a useful lifespan of more than one year are generally classified as capital assets. If theatrical movies have a long useful life, then the production costs for movies should be treated as a capital investment. In that case, the capital investment in theatrical movies is added to GDP as part of private investment and added to the pre-existing capital stock of movies to get the total capital stock of movies. This capital stock of original movies then returns a flow of value to its owner, and that flow is counted in GDP as part of capital services. GDP counts both the flow of value and the initial investment. As a result, GDP is always higher when a good is changed method 1) to method 2). Finally, the total capital stock of original movies is

depreciated, which is known as consumption of fixed capital. In addition to the well-known GDP, BEA also estimates net domestic production. Net domestic production equals GDP minus consumption of fixed capital. Because net domestic production does not include the cost of maintaining the capital stock, it is generally viewed as a better long-term measure of the total sustainable output of an economy.

In order to calculate the NIPAs with theatrical movies as a capital asset, I estimate real production, prices and capital stock for theatrical movies back to 1929. The most important results are given below.

1) Theatrical movies have a projected lifespan of at least 80 years. Furthermore, the average depreciation rate is only 9.3% per year. The total capital stock of all theatrical movies was worth more than \$150 billion in 2007.

2) Over the past decade, nominal movie production has shrunk from 0.16% of GDP to 0.13% of GDP. This shrinkage occurred during a period that movie production prices rose much slower than overall inflation. Over the same time period, real movie investment grew at 5% per year.

3) The movie industry grew rapidly during the Great Depression. In 1929, theatrical movie investment was \$162 million, 0.15% of GDP. By 1934, movie investment was \$301 million, 0.46% of GDP. Accordingly, the Great Depression looks a little less grim when movies production is counted as an investment activity. After World War 2, movie investment hovered between 0.10% and 0.16% of the overall economy. Accordingly, GDP growth from 1945 to 2010 does not change much when movie production is counted as an investment activity.

My research on capitalizing theatrical movie production is part of a broader initiative by the BEA to improve the treatment of intangible assets in the national income and product accounts. In addition to the movie research, I have papers measuring investment in long-lived television, original music, books and miscellaneous entertainment (Soloveichik 2013a, b, c and d). Other researchers at the BEA have developed a satellite account measuring the annual investment and capital value of R & D (Robbins and Moylan 2007), educational investments (Fraumeni, Reinsdorf, Robinson and Williams 2008) and the role of intangible assets in foreign direct investment (Bridgman 2008).

This paper consists of three 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 estimate the depreciation schedule for theatrical movies and then use that depreciation schedule to calculate capital stocks of theatrical movies from 1929 to 2010.

1. Nominal Production

What Products are Included?

In this paper, I study the production of theatrical movies. The category “theatrical movies” include any movie shown in theaters, even if it earns the majority of its revenue from DVD sales or television licensing. However, this category does not include television movies or direct-to-DVD movies.¹ Those movies are measured in a separate paper “Long-Lived Television Programs as Capital Assets” (Soloveichik 2013a). I also exclude movies distributed on YouTube or other internet broadcasters because those films are very different from theatrical movies. I hope to study long-lived entertainment produced by internet broadcasters in a future paper.

Because this project is focused on the United States national accounts, I restrict my sample to movies produced by US studios. Even if a movie is filmed abroad, it is still included in my analysis if a US corporation or resident originally owned the movie. Some movies are jointly produced by US and non-US studios.² In the absence of any data on the ownership shares, I split those movies proportionally. For example, suppose that a \$100 million movie is jointly produced by a US studio, a French studio and a British studio. I assume that the US studio spent \$33 million producing its share of the movie.

My paper does not calculate imports or exports of movie licensing. In the trade data, BEA treats revenue from US movies shown abroad as an export of services and overseas production of US movies as an import of services. Previous researchers have found that studios

¹ The treatment of direct-to-DVD movies is potentially controversial. They are too small to be in their own category, but they could be placed in either television or theatrical movies. Based on viewership data from Nielsen Media and advertising data from Kantar media, I believe that direct-to-DVD movies are more similar to television programs than they are to theatrical movies. Accordingly, I placed them with long-lived television programs.

² In a few cases, IMDB does not provide production studios. In those cases, I use listed country of production. I drop movies with no information at all.

often misreport the revenue from US movies shown abroad (Hanson and Xiang 2006). It is also possible that studios misreport the value of overseas production of US movies. However, these potential problems have no impact on the estimates in my paper. My paper calculates the **change** to GDP from capitalizing theatrical movies. If imports and exports are misreported, then BEA's estimates of GDP may be incorrect. However, the size of the error 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.

Movie Investment in 2007

The primary dataset for this project is the 2007 Economic Census. According to the Economic Census, theatrical movies earned \$22 billion from domestic licensing, \$6.5 billion from foreign licensing, \$7.1 billion from DVD sales and \$3.0 billion from merchandise licensing.³ Of course, movie studio revenue is not equal to returns on theatrical movie originals. Studios must pay physical sales costs like DVD stamping and marketing costs before they can earn any money from their intangible asset. Based on "The Big Picture" (Epstein 2005a), I estimate that physical sales account for 5% of licensing revenue and 15% of DVD revenue. Based on data from Kantar Media, I estimate that marketing accounts approximately 30% of total revenue. This marketing includes direct advertising costs like airtime and also indirect costs like studio overhead devoted to marketing. After subtracting sales costs, studios earned \$24.5 billion in returns from their theatrical movie assets.

Because my paper is focused on the production of new movies, I would like to measure revenue by the year of release rather than year of sales. In other words, a 2010 re-run of "Cinderella" is attributed to 1950 – not 2010. Of course, I don't know how much movies released in 2007 will actually earn in 2017. Instead, I use data on current market shares for older movies to predict future earnings. This data is described further in section 3. Given my predicted earnings, I calculate the net present value (NPV) of revenues for newly release movies:

$$\text{Investment} = (\text{Sales of New Movies}) * [(\text{NPV of all Sales}) / (\text{Sales in First Year})]$$

³ The Economic Census does not split DVDs and merchandise licensing between television and movies. I use sales data from The-numbers.com to split DVDs. I split merchandise licensing proportionally to other licensing.

In section 3, I calculate that new movies account for 33% of total industry revenue. I also calculate that NPV of future sales is 2.48 times sales in the first year.⁴ Therefore, I calculate that new movie investment is:

$$\text{Investment} = (\text{Revenue after sales costs}) * .33 * 2.48 = 82\% * \$24.5 \text{ billion} = \$20.0 \text{ billion}$$

Movie Investment 1929-2010

I use the Service Annual Survey (SAS) to measure movie investment from 2005 to 2010. I first benchmarked each revenue type reported in the SAS to the 2007 Economic Census. I then applied the adjustments for sales costs, market share for new movies and NPV factor described earlier. Going forward, BEA plans to use revenue data from the SAS to measure movie investment in the national income and product accounts (NIPAs).⁵

Before 2005, I use data on real movie inputs from the website IMDB.com, which is a massive database containing theatrical movies, television programs and videos. Based on my own research, I believe that IMDB contains every major theatrical movie and most minor theatrical movies produced in the US.⁶ For each item in their database, IMDB collects a list of actors and production crew, technical information like run-time and business information like production budgets, etc.

IMDB allows researchers to download the complete raw data files for all movies, television programs, videos and video-games in their database. All of my estimates reported in this paper are based on the complete raw data files. Accordingly, the standard errors for my estimates of real production are relatively small.⁷ I supplement the IMDB data with industry literature giving background on the process of movie production and the non-production costs. Table 1 contains a description of the data used in my analysis and the figures they are used in.

⁴This calculation depends critically on the discount rate. In earlier versions of this research, I used discount rates ranging from 7% real to 10% real. The current numbers in this paper support a discount rate of 8.2% real. The 8.2% discount rate deflates future sales by the PCE deflator, **not** the movie price index. Over the past 20 years, movie prices have grown slower than overall PCE prices. However, I believe investors holding movie originals are concerned with revenues relative to GDP, not revenues relative to the movie industry.

⁵ This approach produces relatively smooth estimates of annual investment. Actual movie filming can be volatile, especially on a quarterly basis. For example, a threatened strike increased filming the first half of 2001. Even though the strike did not materialize, filming still dropped in the second half because studios had already planned their filming to avoid it.

⁶ Alexander and Associates surveys people about home video purchases and rentals. I was able to match most movies mentioned by survey respondents to the IMDB data. Adult movies, exercise movies and music videos were often unmatched.

⁷ However, my estimates are very sensitive to the techniques for imputing budgets to movies with missing data.

I use four separate variables from IMDB to estimate real production budgets: a) the number of actors; b) the number of non-actors (e.g. writers, camera people, make-up artists, etc.); c) the number of locations listed and d) the number of special effects companies. To start out, I restrict the sample to major movies released 2000 to 2009.⁸ In section 2, I will show that inflation was very low over that time period. Therefore, I do not need controls release year. Live action and animated movies are produced very differently, so I estimate two separate production budget equations. The following equations are the precise regression used in Stata.⁹

$$\text{Nominal budget for live action films} = \alpha_{LA} * (\text{number of actors}) + \beta_{LA} * (\text{number of non-actors}) + \gamma_{LA} * (\text{number of locations}) + \delta_{LA} * (\text{number of special effects companies}) + \epsilon_{LA}$$

$$\text{Nominal budget for animated films} = \alpha_{AN} * (\text{number of actors}) + \beta_{AN} * (\text{number of non-actors}) + \epsilon_{AN}$$

For live action films, the coefficients imply that one extra actor costs \$46,000; one extra non-actor costs \$172,000; one extra location costs \$1,118,000 and one extra special effects company costs \$4,488,000. For animated movies, the coefficients imply that one extra actor costs \$485,000 and one extra non-actor costs \$502,000. The higher labor costs for animated movies is consistent with the industry literature. Animated movies are generally produced over several years, and so each computer programmer or animator puts in more time on the movie than a set designer does on a live action movie.¹⁰

In the analysis given earlier, I focus on ‘major’ movies, which I define as the top 100 movies each year. All other movies are considered minor movies, and treated separately. Many of these minor movies have no production budgets listed. If I impute production budgets for minor movies based on the cost of major movies, then minor movies account for approximately

⁸ In order to define major movies, I first ranked all US movies by the number of non-actors (which are the biggest cost factor). I then focus on the top 100 US movies each year. If a film is produced jointly by a US and non-US studio, I count it as half a movie. Results are similar if I use another cut-off.

⁹ I use the no option to suppress the constant term. If the constant term is not suppressed, it is positive and significant for every regression. My time series would be very different if I allowed a constant term. However, I believe that the constant is caused by measurement error and is misleading. The R² is 0.80 for both regressions

¹⁰ Star actors are generally paid much less for animated movies, where they only provide voices. However, there are many fewer extras on animated movies. Furthermore, programmers need to do a lot of support work for each character in animated movie. The net effect may be higher costs per actor in animated movies.

84% of total production in 2007. However, minor movies earn only about 25% of the US box office, 25% of the US video revenue and 35% of US television revenue in my sample.¹¹ Furthermore, relatively few IMDB users rate minor movies. Based on all of these factors, I believe that minor movies have significantly lower budgets than their reported inputs would suggest. I impute real production budgets for minor movies according to the following formula:

$$\text{Real budget} = (\text{Supposed budget from listed inputs}) * .99^{\min(\max(\text{rank}-100,0),400)}$$

In other words, I assume that minor movies have smaller budgets than their inputs would suggest, and the difference grows as you move further down the list. My equation was calibrated to a graph of (number of IMDB votes)/ (Supposed budget). The same general equation works reasonably well for all decades studied, from the 1930's to the 2000's.¹² Therefore, it seems to be a general fact of the movie industry that A-list movies use higher cost inputs than B-list movies. However, I don't have enough data to test whether the true budget for minor movies matches this particular equation.¹³ I also reduced budgets by 50% for short movies and 50% for silent movies (75% for silent shorts). This adjustment has a big impact on production and prices before 1929.

Finally, I calculate nominal production for each year. First, I aggregate the real budget for each movie to get real investment by the entire motion picture industry. Next, I multiply real investment by the price index described in section 2. This approach is a little different than the measurement techniques used for long-lived television, books, music and miscellaneous artwork (Soloveichik 2013a, b, c and d). For all of those entertainment categories, I measured nominal investment first and then use my price index to estimate real investment. These two approaches will both produce similar results if the prices are measured correctly. As a robustness check, I also estimate nominal movie revenue from 1929 to 2010 and calculate investment from that.

¹¹ My samples cover 2000-2009 for box office, 1988-2002 for video and 2003-2008 for television. All of the numbers are approximate. The exact percentages might be different if I only look at 2007.

¹² The equation is also roughly consistent with data on box office, home video and television advertising revenue. However, I do not have enough data to be certain of the precise form.

¹³ Movies that report budgets generally have higher (IMDB votes)/(Supposed budget from listed inputs). This suggests movies with budgets might be higher quality. The bias is biggest for minor movies, which rarely report budgets.

Because of the reporting bias, I ignore reported budget for minor movies. Instead, I only use imputed budget.

Figure 1 compares both estimates of nominal movie production from 1929 to 2010. The most important result is that the estimate based on IMDB data tracks the estimate based on revenue reasonably well over time. I believe that the IMDB data is higher quality than the revenue data. For example, I do not have any data on foreign box office revenue before 1965. Before then, I assume that foreign box office revenue is a fixed percentage of US box office revenue. This fixed percentage might not hold in unusual times like World War 2. Also, the ratio of new investment to revenue may have changed over time. In the rest of the paper, I will use the IMDB data to measure investment, prices and capital stock.

Calculating Quarterly Production

This paper counts movie investment when the movie is first released, **not** when the movie is filmed. I make this choice for two related reasons: 1) It is extremely difficult to measure quarterly filming costs in real times. Accordingly, my quarterly numbers would be too speculative to include in the NIPAs; 2) Conceptually, unreleased movies could be counted in inventories as “work in progress,” similar to the treatment of uncompleted manufactured goods. This paper does not count unreleased movies in inventory. Instead, this paper is focused on how GDP changes when entertainment originals are reclassified as capital assets.

For interested readers, Figure 2 shows estimates of the value of unreleased inventory from 1990 to 2009. There is a clear seasonal pattern to movie inventory. Studios generally film all around the year but release their best films during the summer and right before Christmas. Most data users focus on seasonally adjusted numbers, so the consistent pattern is adjusted out. However, there is also some non-seasonal variation in inventory. Some of this variation can be explained by labor relations. For example, actors threatened a strike that would have started in May of 2001. Studios responded to the threatened strike by increasing production before the strike and stockpiling enough films to last until the spring of 2002. In the end, no strike occurred, but studios still cut back on production in the second half of 2001 so that they could use up their huge stockpile (Graham 2001). Other inventory variation might be related to the financial crisis or just a measurement error.

2. Price Indexes and Real Production

It is difficult to develop a price index for movie originals. Each movie is a unique artistic creation, so I can never compare the cost of producing two identical movies at different times. In this paper, I use labor and non-labor inputs to calculate the real budget for each film in the IMDB dataset. I assume that each actor, each non-actor, each filming location and each special effects company produces the same amount of entertainment capital over time. I then calculate my price index as the ratio of nominal production budgets to real budgets. Therefore, my price index will double if the nominal production budget doubles while inputs are held fixed. This price index assumes zero multifactor productivity growth since 1915¹⁴ and omitted inputs grow at the same rate as inputs tracked. I believe that the technologies like DVD players should be considered improvements in viewing technology – not movie technology. After all, studios often re-release classic movies on DVD.

Price Indexes from IMDB Data

I used the same IMDB data described in section 1. First, I used the regression coefficients described earlier to estimate what the nominal production budget for each movie would be **if** it was filmed between 2000 and 2009. As a robustness check, I also calculated real budgets using major movies filmed 1980-1989, 1960-1969 and 1940-1949. I then dropped the movies which did not report production budgets and calculated a price index for each year:

$$\text{Price in Year X} = \frac{(\text{Nominal Budget}_{\text{Movie 1}} + \dots + \text{Nominal Budget}_{\text{Movie N}})}{(\text{Real Budget}_{\text{Movie 1}} + \dots + \text{Real Budget}_{\text{Movie N}})}$$

Figure 3 gives the price index from 1929 to 2009. The most important result is movie prices have been almost flat from 2000 to 2009. At the same time, the general service sector price rose 32%. I believe that the slow inflation for movies is caused by improvements in computer technology. Digital video-cameras are cheaper and easier to use than film-based

¹⁴Multi-factor productivity could rise if directors learned better production techniques over time. Alternatively, it could fall if early movies used up all the good storylines. For simplicity, I assume that productivity has not changed at all over time. This might overestimate productivity before 1935, when the movie industry was very new.

video-cameras. Once the movie is shot, studios use computers to edit the film, create special effects, etc. The other noteworthy result from Figure 3 is that price trends are similar regardless of which base period I use. For the rest of the paper, I will use movies filmed 2000 to 2009 to calculate price indexes.

Potential Sample Selection Problems

Sample selection may potentially bias the price indexes shown in Figure 3. IMDB does not report production budgets for all movies in the sample. Movies with missing data generally have fewer actors, non-actors, special effects companies and filming locations. Even controlling for the inputs listed, movies with missing data do worse. For every dollar of imputed production spending, movies with missing budget data earn 73% lower box office revenues,¹⁵ 42% less from home video¹⁶ and 13% less from television licensing.¹⁷ There are two ways to interpret this correlation: a) movies with missing data are expensive flops; b) movies with missing data are cheap successes. If a) is true, then my price imputations are correct and the missing data does not bias my results. If b) is true, then my price imputations are flawed and the missing data created biased estimates.

It is possible that missing data creates serious problems with my time series. For example, suppose that movies with missing budgets cost 50% less than otherwise similar movies which did report budgets. Between 1929 and 1989, only 22% of major movies report a budget. Between 1990 and 1999, 54% of major movies report a budget. Between 2000 and 2008, 81% of major movies report a budget. In that case, prices for major movies 1929-1989 are overstated by $(1-22\%)*.5 = 39\%$ before 1990, $(1-53\%)*.5 = 23.5\%$ between 1990 and 1999 and $(1-81\%)*.5 = 10\%$ between 2000 and 2009. In other words, I overestimate historical prices badly and therefore underestimate inflation over time.

I can't fix the sample selection problems. However, the results in Figure 1 suggest that it is not too severe. In Figure 1, I used a price index based on Figure 3 to calculate nominal investment for every year from 1929 to 2010. As a robustness check, I also used nominal

¹⁵ Based on US box office revenue reported by IMDB. Sample restricted to major movies released 2000 to 2009.

¹⁶ Based on survey data for 1987-2002. Sample restricted to major movies released 1990-1999.

¹⁷ Based on airing time (premium & regular cable counted equally) 2003-2008. Sample restricted to major movies released 1990-1999.

revenue data to measure nominal investment. The two techniques give similar results, suggesting that IMDB-based price index is reasonably accurate.

Input Prices for the National Accounts

The price index presented in Figure 3 is conceptually interesting, but it is too volatile to use in the National Accounts. From one year to the next, prices may drop 25% and then go right back. In addition, the IMDB price index requires days of data analysis to calculate. That workload is not feasible for BEA analysts to do each quarter.

In this section, I calibrate an input-based price index to match the IMDB price index shown earlier. This input-based index is a weighted average of a BEA price index, and two BLS price indexes. Because the data is already available, it can be calculated in a few minutes.

a) The main input for movies is live performances to film. These live performances require inputs like scripts, scenery, costumes, actors, etc. Animated movies have different inputs, but they still need writers to create a script, graphic designers to create characters and actors for the voice-overs. For both types of movies, labor costs account for the majority of input costs, but there are also non-labor costs like offices to plan the movie, materials for the scenery and costumes, etc. I have not been able to locate a pre-existing price index that tracks live performance costs in the movie industry. However, BEA does track consumer prices for live entertainment such as theatrical plays, dance performances and music concerts. I assume that performances in the live entertainment industry use similar inputs to live performances in the movie industry – so the prices should move similarly.¹⁸ BEA's live entertainment price index is published in NIPA Table 2.4.4U, line 211. Before 1959, I use the overall PCE deflator as a proxy for live entertainment costs. That price index is published in Table 2.4.4, line 1.

b) The second input for movies is video cameras to record and process the live performances. BLS has produced a producer price index (PPI) for photographic and photocopying equipment. The series ID for that PPI is PCU333316333316.¹⁹ Going forward, I recommend that analysts use that PPI. For historical prices, I use a variety of price indexes.

¹⁸ Ticket prices for popular music concerts have risen much faster than other components of the live entertainment sector. This increase appears to be a response to music piracy (Krueger 2005) and is not caused by an increase in input costs. However, popular music concerts are a relatively small share of the overall live entertainment industry. Therefore, the price index does not change much when I adjust for music concert prices.

¹⁹ BLS briefly produced a specific PPI for video cameras used in the movie industry (PCU33315333157), but that PPI only started in 2007 and was discontinued shortly afterwards.

From 1977 to 2006, I use the BEA deflator for ‘other video equipment’. That price index is given in Table 2.4.4U, line 40. From 1947 to 1976, I use the BLS PPI for ‘audio and video equipment manufacturing’. The series ID for that PPI is PCU334310334310. For 1929 to 1946, I use the BEA deflator for ‘audio, video & information processing equipment and media’. That price index is given in Table 2.4.4, line 14. I then splice all of those time series together to get a price index for movie cameras from 1929 to 2010.

c) The last input for movies is computers to edit the raw footage, add special effects and other digital enhancements. Over the past two decades, studios have benefited from enormous improvements in computer quality. I recommend that analysts use the general PPI for ‘electronic computer manufacturing’. The series ID for that PPI is PCU334111334111. IF BLS ever produces a more specific PPI, then analysts can switch to that.

Of course, computers have not always been used in movie studios. For historical price indexes, I assume that computer usage was negligible before 1990. At that time, animated movies used hand drawn illustrations instead of computers to create their scenes. Computer usage then grew rapidly over 1990s. By 2000, computer costs plateaued at 15% of the nominal budget for live action movies and 30% of the nominal budget for animated movies. Of course, real computer prices have been plummeting since 2000. Therefore, real computer usage has increased from 2000 to 2010. This includes supercomputers used to create special effects, computers used to edit raw footage and other digital enhancements.

None of these price indexes are a perfect proxy for movie input costs. In particular, I am concerned that the price index for live entertainment is too smooth. For a variety of reasons, ticket prices for live theater may be sticky despite economic problems. In contrast, movie actors and other talent may have flexible wages. Most studios hire their workers for an individual movie, so they can quickly adjust wages for new projects. If unemployment is high, studios may be able to assemble a top quality team for less than normal rates. I welcome suggestions to measure historical prices better.

Figure 4 compares the input-based price index with IMDB price index. In the long-run, both input-based price indexes track the IMDB-based price index reasonably well. The input-based price index does a better job of matching IMDB prices when I adjust for unemployment. However, this is mostly important during the Great Depression. In the past few years, the IMDB price index has not dropped despite a large increase in unemployment. Accordingly, the

relationship between unemployment rates and movie costs may no longer hold. In order to be cautious, BEA will use the unadjusted input price index in the national accounts. That price index is used to calculate nominal investment in Figure 1 and nominal inventory in Figure 2.

Hedonic Price Indexes

I experimented with a hedonic price index to measure the cost of producing a movie of constant quality over time. Unfortunately, the only measures of quality available on IMDB are length of the movie, width of film, animated versus live action and color film versus black and white. Most of these quality measures achieve their maximum by 1980. None of them capture expensive items like dramatic special effects and high quality computer animation. In contrast, the input-based quantity index performs reasonably well at measuring those expensive items. I do quality adjust slightly by reducing the budgets for silent films by 50% and the budgets for short films by 50% (75% for silent shorts). This adjustment has a significant impact on initial capital stock in 1929, but little impact on prices after 1935.

Consumption-Based Price Indexes for Movies

Prices paid by consumers for theatrical movies might offer another potential price index for theatrical movies. The BEA produces four separate price indexes that are relevant to movies: a) a price index for movie tickets; b) a price index for purchased DVDs; c) a price index for rented DVDs and d) a price index for cable television. These price indexes are all reported in Table 2.4.4U. The line numbers are 44, 210, 215 and 219.

Figure 5 compares the input price index with BEA's four price indexes. I find that the consumption-based price indexes do not track each other or the input-based price index. Movie ticket prices and cable prices rose significantly faster than input costs. At the same time, DVD rental prices have remained almost constant and DVD purchase prices have fallen dramatically. Given the huge differences between the four indexes, it is important to pick the right consumption-based price index to deflate nominal expenditures. However, there is no easy way to determine which index is the right one to use.

Even if the consumption-based price indexes were consistent, they still might not be useful. All of those price indexes track prices for goods or services disseminating copies of theatrical movies, **not** the underlying theatrical movie originals. For example, the price of movie

tickets might rise because rents go up for the building or wages rise for theater ushers. Based on the industry literature, I estimate that theatrical movie costs account for approximately 25% of a movie theater ticket prices, 50% of DVD prices (purchases & rented) and 15% of cable prices.²⁰ In theory, it is possible to adjust consumer prices to strip out non-artwork costs. However, that process is much more difficult than using input costs.

Furthermore, the consumption-based price indexes are not adjusted for the quality of a theatrical movie. Based on the IMDB data, I believe that real movie quality has risen significantly from 1929 to 2010. In the 1930s, the typical major movie had 15 non-actors to write scripts, design sets, etc. In the 2000s, the typical major movie had 106 non-actors. Modern studios are also much more likely hire special effects companies and shoot scenes outside of the studio lot. Therefore, the average movie ticket in 2010 buys a better experience than the average movie ticket did in 1929.

Real Production 1929-2010

Figure 6 calculates an implicit quantity index by dividing the nominal production spending estimated in Figure 1 with the unadjusted input-price index shown in Figure 4. I find that real movie production grew rapidly from 1929 to 1935. Movie production then stayed flat for the next forty years. After 1975, movie production started growing again. Between 1975 to 2008, movie production grew by 8% per year.

It is interesting to note that the quantity index in Figure 6 does not track with Census data on total employment in the theatrical industry.²¹ The Census data is based on worker's self-reported industry in the 1920, 1930, 1940, 1950, 1960, 1970, 1990 and 2000 population Census and the 2001-2008 American Community Survey. My quantity index shows that real production increased by more than 400% between 1980 and 2008. In the Census data, employment increased by only 10%. The main difference between the two series is how they handle outsourcing. The Census only counts workers in the United States. In contrast, my analysis includes workers around the world as long as a US studio owns the movie. Over the last 30 years, domestic studios 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

²⁰ The 15% share is only for movie originals. Television program originals also contribute to cable costs.

²¹ This includes theatrical plays, movies and some television.

owned by US studios. In addition, the Census's count of workers may miss employees who are not employed directly by the movie studios. For example, Pixar might hire a computer consulting firm to help with animation. In the 1970's, the average movie paid \$6.4 million to actors and non-actors, but only \$0.37 million to special effects companies (2005 dollars).²² In the 2000's, the average movie spent \$24.3 million to actors and non-actors and \$17.5 million to special effects companies. This rapid growth in special effects spending will not show up in movie studio employment.

3. Depreciation Schedules and Capital Stock for Movies

The standard order for a movie release is first movie theaters, then DVD sales and finally television. In this paper, I will use five separate datasets to estimate the rate at which studios receive revenue from their movie originals: 1) US box office data from IMDB.com; 2) a consumer survey of home video purchases and rentals within the United States from Alexander and Associates; 3) A historical dataset from Tribune Media Services listing the dates and stations selected theatrical movies are shown on US broadcast and cable television; 4) A historical dataset from Red Bee Media Services listing the dates and stations selected theatrical movies were shown on European television; 5) Nielsen ratings for a sample of US television airings of theatrical movies.²³ Appendix 1 contains more information on the source of the datasets used, the data cleaning rules and the procedures for estimating quarterly revenue.

In this paper, I define the value of a movie original as the expected present value of future revenues minus future costs. I define the depreciation schedule as the rate at which a movie original declines in value over time.²⁴ There are many possible reasons why a movie original might decrease in value over time. In this paper, I will not attempt to distinguish between exhaustion of the target market, obsolescence of the special effects technology, physical depreciation of the film reel, or any other reason why consumers stop buying an old movie. I

²² Sample covers live action movies in the top 100 each year. Payments are estimated from the regressions used in Section 1 and IMDB's data. I do not know actual payments.

²³ Figures 7-20 are taken from an earlier version of this paper. Since that version, I have slightly changed my price indexes and other factors which could influence the depreciation schedule. The graphs would be very similar if I used the latest price indexes.

²⁴ I discount future revenues at 7% real. The depreciation schedule changes slightly if I use a different discount rate.

will simply estimate the schedule at which studios earn revenue from their movie originals and the costs associated with those revenues.

Revenues from Movie Theaters Worldwide

The first stage of a typical movie's lifecycle is theatrical release. In 2002, studios earned 21% of their revenue from theatrical release. The 2007 Economic Census does not split box office licensing and television licensing, but movie studios probably earned a slightly smaller share from box office in 2007. Since the 1948 Paramount antitrust ruling, studios have not been allowed to own movie theaters and display their films directly. Instead, studios rent copies of 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 smaller shares for later weeks (Vogel 2004). On average, box office licensing equals 40% of movie theater ticket sales.

I found that the typical movie has a very short lifespan in US theaters, as shown in Figure 7. Between 2000 and 2009, the typical movie earned 69% of its box office revenue in the first quarter after theatrical release and 26% in the second quarter. US box office revenue trails off dramatically after that. As a robustness check, I also used data from The-number.com to track worldwide box office revenue. I found very similar results: movie theaters around the world only show new movies.

Home Video Revenue

The next stage in a typical movie's lifecycle is DVD release. According to the 2007 Economic Census, studios earned 22% 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 or rent old movies years after initial release.

Figure 8 shows (estimated real home video revenue)/(real production budget) for new movies by quarters since release. The typical movie is not released to DVD until about six months after theatrical release. Once it is released, it sells DVDs worth more than 100% of its production budget over six months. After the first year, revenue trails off quickly. Total DVD

revenue is 125% of the production budget in the first year, 74% of the production budget in the second year, 24% of the production budget in the third year and 14% of the production budget in the fourth year.

Figure 9 shows (estimated real home video revenue)/(real production budget) for older movies by quarters since release. I find that the revenue decrease slows dramatically once a movie passes the first few years. Between years 4 to 9, revenue drops by about 14% per year. Between years 10 to 14, revenue drops by about 5% per year. After year 15, revenue remains almost constant. All of these numbers are an average. My sample covers the entire universe of movies produced in the US, so there are many movies which do not appear in the dataset at all. Those movies are counted as zeroes when I calculate (real licensing revenue)/(original production budget). Because of random variation, I cannot determine the precise depreciation rate for very old movies, but it is clearly small.²⁵

I also find a very small depreciation rate when I track a fixed sample of pre-1980 movies, as shown in Figure 10. These movies accounted for a little more than 10% of total studio revenue between 1988 and 2002. Because the depreciation rate is so small, I cannot determine the precise number. The point estimate for my depreciation rate changes when I use a different functional form or different price indexes to deflate nominal revenues.

In order to get the best possible estimate of the long-term depreciation rate, I use the complete sample of classic movies. First, I calculated real home video revenue 1988-2002 by year of release. For example, movies released in 1950 earned \$760 million in home video revenue between 1988 and 2002 (2005 dollars). Earlier in this paper, I calculated that studios spent \$1.5 billion (2005 dollars) producing those same movies.

Figure 11 shows the ratio (real home video revenue 1988-2002)/(original production budget) by year of release. Even when I aggregate by year, the data is still very noisy. However, there is a general pattern for older movies to earn less than newer movies. On average, movies released 1929 to 1953 earned home video revenues equal to 25% of their original production budget. Movies released 1954 to 1979 earned home video revenues equal to 39% of their original production budget. Therefore, I calculate that long-term depreciation is 36% over 25

²⁵ Some movies are remade every few years. For example, there are dozens of “Sherlock Holmes” movies or television programs. Alexander and Associates tried to identify the precise movie people watched, but many consumers might have gotten confused and misreported the movie. As a robustness check, I restricted the sample to movies with unique titles. I found that depreciation rates were very similar.

years, or about 2% per year.²⁶ This depreciation rate is sensitive to my estimates of historical production budgets, the price index used to deflate classic movie production budgets and the price index used to deflate contemporary home video revenue.

Television Licensing Revenue based on Airtime

The final stage of typical movie's lifecycle is television licensing. In 2002, studios earned 34% of their revenue from television. Movies are first shown on premium cable about nine months after theatrical release (Vogel 2004). Premium cable channels generally show newer movies, but they occasionally show older movies if the audience is still interested. Movies are first shown on regular cable and foreign television about 24 months after theatrical release (Vogel 2004). Regular cable and foreign television show movies for decades, until the audience loses interest.

Figure 12 shows (estimated real television revenue)/ (real production budget) for new movies by age and television market. I find that US premium cable has two separate windows. Premium cable starts showing movies about six months after theatrical release. It then shows movies frequently for the 18 months. Movies then are withdrawn over the next few years. By the time a movie is four years old, it is almost gone from premium cable. Finally, movies return to premium cable when they are about seven years old. In contrast, regular cable and foreign television are much steadier. Networks first show movies when they are about two years old. After that, they continue showing movies at about the same rate for the next eight years. Just like home video, I track the entire universe of movies produced in the US. Movies which do not appear at all are counted as zeroes.

Figure 12 shows the depreciation rate for older movies is relatively small. However, the time span is too short to estimate a precise depreciation rate. In Figure 13, I track a fixed sample of pre-1995 movies from 2003 to 2008. Once again, I find that the depreciation rate for older movies is relatively small, but I cannot get a precise depreciation rate. In order to get a better depreciation rate, I use the complete sample of classic movies. I use the exact same techniques described earlier for Figure 11.

²⁶ According to current copyright law, movies lose protection after 95 years. In theory, I could adjust the depreciation schedule accordingly. In practice, movies that are old are already heavily depreciated. Furthermore, the industry has lobbied several times to extend their copyrights and may do so again.

Figure 14 shows the ratio (Estimated Television Revenue)/(Real Investment) by year of release for US television. Very few movies released before 1980 are shown on premium cable. Based on that data, I calculate that premium cable revenues decrease by 10% per year after the first few years. In contrast, regular cable often shows older movies. I calculate that regular cable revenues decrease by about 5% per year. I do not have good annual data for foreign TV, but the market share for classics is fairly large.²⁷ In my analysis, I will assume that foreign TV depreciates at the same rate as regular cable. Just like home video sales, these depreciation estimates are sensitive to my estimates of historical production budgets, the price index used to deflate classic movie production budgets and the price index used to deflate contemporary television revenue.

Television Licensing Revenue based on Viewership

I do not know how much television networks paid for television licensing. Based on the 2007 Economic Census and Nielsen data, I estimate that premium cable channels earn approximately \$0.28 per viewer-hour and regular cable channels earned \$0.15 per viewer hour. Therefore, it is likely that premium cable channels pay a higher licensing fee per viewer. However, I do not have any data on actual prices charged for individual movies or genres. In most cases, television licensing payments are negotiated privately and the prices are kept secret.

As a substitute for data on license fees, BEA has purchased a special dataset of cable ratings from Nielsen. Cable networks receive a monthly fee per household, so they should prefer movies that draw more households. Therefore, it seems reasonable to use viewership per hour as a proxy for licensing fees per hour.²⁸ The Nielsen dataset reports the domestic rating for every television program shown on ten randomly selected days between 2003 and 2008. I do not have any ratings data for foreign television. I used the Nielsen dataset to impute television revenue for Figures 12-14.

Figure 15 shows the average rating by age for premium cable and regular cable. The ratings data is very noisy, so I cannot draw a smooth curve. But there does not appear to be any trend for older movies to get lower ratings. Even if total viewership was fixed, it is possible that

²⁷ BEA purchased a dataset that gave all airing for a sample of 1,000 movies. In order to get the most data, I picked a sample of popular movies. It would be extremely difficult to translate that sample into a representative sample.

²⁸ This assumes that the non-licensing costs are identical for old and new movies. The main non-licensing cost is likely to be advertising by the network. I analyzed a dataset from Kantar Media that gives advertising by networks for theatrical movies. I found that advertising is approximately proportional to viewership.

classic movie viewers could be less profitable for other reasons. In order to test that hypothesis, BEA purchased ratings data by demographics. I found little relationship between movie age and viewer demographics. If anything, classic movies attracted slightly more prime-aged men than recent movies.²⁹ Therefore, it seems unlikely that classic movies earn less per viewer minute than recent movies. Because all movies earn about the same amount per viewer minute, studios probably charge similar licensing fees per viewer. If not, then a cable network could switch to cheaper movies and reduce its costs without reducing the number of subscribers.³⁰

Lifecycle for Sequel Rights

In this paper, I only value individual movies. This is consistent with the SNA's final handbook (SNA 2008 5.2.2 "Criteria for inclusion"). In theory, one might also capitalize sequel rights for theatrical movies as well. For example, the 'Star Wars' franchise is legally protected. Nobody can make a new 'Star Wars' movie without permission from its current owner. Holding the production budget fixed, sequels receive 25% higher box office revenue than original movies.³¹ Furthermore, box office revenue accounts for 21% of total movie revenue. Therefore, one might calculate that sequel rights account for $25\% \times 21\% = 5\%$ of a movie's value.

As a robustness check, I measured the lifespan for sequel rights. I found that sequels are the most common within five years of the original movie. After that, the sequel rate trails off slowly. This lifecycle is very similar to the lifecycle for other revenue sources such as home video and television. If I capitalized sequel rights, then I would split the value of each original movie into two separate assets: the movie itself and potential sequel rights. However, these two assets are both produced using the same inputs and have similar lifespans. Therefore, the aggregate capital stock would not change if sequel rights were capitalized separately from individual movies. By the same token, aggregate production and real production would remain almost unchanged.

²⁹ Advertisers pay much higher rates for men 18-49, so ad-supported networks often target their shows to that group. On the other hand, cable distributors charge identical monthly subscription fees for all demographic groups.

³⁰ It is possible that cable stations receive other benefits from showing new movies. For example, viewers might value an hour spent watching new releases higher than an hour spent watching classic movies. In that case, licensing fees per viewer-hour might be higher for new movies.

³¹ Sequels also earn slightly lower home video and television revenues and spend less on advertising. None of those differences are statistically significant. All figures for major movies only. Box office data is for 2000-2008.

Advertising Costs for Theatrical Movies

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 2005b). 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. In order to track advertising spending, BEA purchased a subscription to 'Adspender' by Kantar Media Services. This dataset tracks advertising by product across the US. I then adjusted the Kantar data for non-US advertising. In total, I estimate that studios spend about 45 cents on advertising airtime for every dollar they spend on filming.

Figure 16 shows advertising spending by quarters since release. In the first quarter after theatrical release, studios spend 30% of their filming investment on advertising. In the next three quarters, studios spend another 14%. After the first year, studios spend almost nothing on advertising. On average, studios spend more money advertising their new films than they earn from theatrical release. At first glance, it would seem that studios could raise profits by skipping the theatrical release entirely. In fact, advertising new movies almost certainly raises demand for DVDs in six months when the movie is released to the home video market. It is also possible that advertising new movies raises demand for television showings in ten years. BEA's general practice is to treat advertising as a current expense. Therefore, I will deduct advertising revenue from revenue in that quarter. Because of this choice, the value of movie originals peaks in the third quarter, after advertising is completed.

Manufacturing Costs

Before a movie can be shown in theaters, movie studios must print thousands of reels and distribute them across the world. I estimate that printing and distribution costs are approximately 10% of box licensing office revenue.³² All of these costs occur right before theatrical release.

Movie studios also need to stamp, pack and ship DVDs around the world. In "The Big Picture", Epstein reports that studios spend about \$4-\$5 for each individual DVD on

³² This estimate is significantly lower than the \$1.3 billion for the six major studios reported in a recent article (Alimurung 2012). If that article is correct, then movie depreciation rates are slightly lower and movie investment in 2007 was slightly lower. In the future, studios may switch to digital distribution and save printing costs. However, digital distribution requires other costs like new projectors.

manufacturing and sales. These manufacturing costs and sales expenses represent around 33% of the wholesale price for DVDs. For simplicity, I will assume that studios stamp DVDs and ship them in the same quarter they're sold. Epstein also reports that it only costs \$30,000-\$50,000 for a studio to prepare the master DVD file from a pre-existing film reel,³³ less than 0.1% of filming costs. This upfront cost is small enough to ignore.

Movie studios spend almost nothing on manufacturing for television licensing. In “The Big Picture”, Epstein estimates that it costs only around \$150,000 for a studio to prepare a pre-existing film for television release. And the television network pays all of the advertising and customer service costs itself. I will assume that 99% of the revenue from television licensing represents a return on the investment filming a movie.

Overhead Costs and Profit-Sharing

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 a 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.³⁴ This is similar to the tech industry, where workers are often paid with stock options. The investment activity is the same regardless of when the workers are paid or how the payment is structured. I will not subtract these payments from studio revenue.

Final Depreciation Schedule

Earlier in this paper, I calculated separate depreciation schedules for box office revenue, home video revenue, television licensing revenue and advertising. In order to combine these rates into a single depreciation schedule, I need to weight each revenue source properly. I will benchmark all my revenue data to the 2007 Economic Census.

³³ 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.

³⁴ 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.

According to the 2007 Economic Census, theatrical movies earned \$22 billion from domestic licensing, \$6.5 billion from foreign licensing, \$7.1 billion from DVD sales and \$3.0 billion from merchandise licensing and other revenue. In order to calculate depreciation, I need to split the licensing revenue by category. Based on the industry literature and other datasets, I estimate that studios earned \$6.4 billion from box office licensing, \$8.7 billion for DVD sales and DVD rental licensing³⁵, \$1.2 billion from pay-per-view licensing, \$0.03 billion from broadcast television licensing, \$9.1 billion from US premium cable licensing, \$5.3 billion from US regular cable licensing and \$4.6 billion from foreign television licensing. Figures 7 through 16 give the quarterly revenue schedule for each individual movie product. I weighted those quarterly revenue schedules by the share for each individual product and then subtracted the costs described above. I have no data on merchandising revenue or “all other operating revenue”. However, most merchandising occurs early in a film’s lifecycle. For example, McDonalds might run a Happy Meals tie-in for an upcoming kids’ movie. I will assume that merchandising revenue tracks box office licensing.

The revenue in Figures 7-15 are not consistent with the filming budgets reported by IMDB. For every \$1 in filming costs, I calculate that studios earn \$4.15 in future revenues and pay \$1.53 in non-filming costs. Based on that result alone, it might seem that film making is an extraordinarily profitable investment. However, movie studios spend a lot of money on administration and other overhead costs. For example, producers often read hundreds of scripts before they pick a few to film. In a competitive market, total investment will be equal to total revenue minus total sales costs on average. I assume that studio management spent \$1.61 on overhead for every \$1 they spent filming. Those studio overhead costs are part of the original investment just like film and costumes.³⁶

Figure 17 shows the present value of this net revenue stream for every year after theatrical release. I cannot match the depreciation schedule perfectly with any simple curve.

³⁵ Larger video rental companies generally do not buy their DVDs outright. Instead, they pay a small upfront fee for the DVD and then share their rental revenue going forward (Mortimer 2006)

³⁶Depreciation rates are very sensitive to how studio overhead is allocated. When calculating depreciation, I allocate all overhead to filming and count it in the original investment. If I allocate overhead equally between filming and advertising, then theatrical movies **appreciate** early in life and peak in value at 140% of initial investment. On the other hand, theatrical movie depreciate much faster if I allocate overhead to long-term television licensing.

In section 1, I allocated some overhead to advertising. This allocation determines the precise nominal investment in movie originals – but it does not influence depreciation rates directly.

The depreciation schedule shown in Figure 17 uses earlier revenue numbers, so the weights are not precisely the same as reported in the paper. This has minimal impact on depreciation rates.

However, I can match the aggregate depreciation rate with a simple geometric curve that drops by 9.3% per year. In the national accounts, BEA will use that simple depreciation rate to calculate capital stock and consumption of fixed capital.

Figure 18 shows my estimate of the aggregate real value of movie originals for every quarter from 1929 to 2010. These capital stock estimates are derived from the real investment statistics shown in Figure 6 and the depreciation schedule shown in Figure 17 (after costs).³⁷ The most important result from Figure 18 is that geometric depreciation rates produce an aggregate capital stock number very similar to aggregate capital stock number calculated with complex depreciation schedules. Furthermore, the simple geometric depreciation rate is much easier to incorporate into the national accounts.

It might seem that the 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 customers for American movies are nowhere near any hypothetical saturation point. Between 1988 and 2002, real production spending for new movies increased from \$4 billion to \$9 billion per year (2005 dollars). Over that same time period, Alexander and Associates report that home video rentals and sales of pre-1980 movies remained steady at around \$1 billion per year (2005 dollars). Based on that evidence alone, it does not seem that new movies are strong substitutes for classic movies. In a separate paper, I study books as capital assets (Soloveichik 2013c). In that paper, I find that real book production has remained flat since 1965. Over the same time period, the adult population increased 50%. Per-capita sales of newspapers and magazines have also fallen significantly. Perhaps Americans are substituting from printed media to electronic media?

The pre-1950 capital stock estimates shown in Figure 18 are very speculative. In 2007, virtually all movies shown in movie theaters are new. Before 1950, movie theaters were the only way to watch movies. Accordingly, I might conclude that theatrical movies had a very short lifespan in 1940. On the other hand, movies then were kept in theaters much longer than they are now. Furthermore, the entire movie industry was extremely new. So, there was no stock of older movies to watch even if theater audiences had been willing to watch classic movies. As a

³⁷ I use IMDB data on real production to calculate initial capital stock in 1929. The first motion pictures were produced before 1900, but those movies were mostly novelties. I start the theatrical movie industry in 1915.

robustness test, I also experimented with depreciation rates of 20% from 1915 to 1950. This reduces the capital stock before 1950 significantly – but it has little effect on modern capital stocks. The NIPAs will use a constant 9.3% depreciation rate from 1915 to 2010.

Comparing My Depreciation Schedule to Other Estimates

To the best of my knowledge, no previous researchers have estimated the depreciation rate of movie originals from empirical data. Most European countries currently include movie originals in their national accounts, but I have not been able to locate any 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 originals. One country used a service life of three years for movie originals 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 used data from IMDB.com to identify which films were in each transaction. I also used the number of IMDB votes for each film to identify the popularity for each film by year of release. For example, ‘Star Wars’ got 45% of all votes cast in 1977.³⁸ This procedure measures the realized market value of each film library **not** the original investment cost. Unexpected hits are worth much more than their original investment cost and flops are worth much less.

Results from my imputation are shown in Table 3. Using a complex depreciation schedule for movies, I found that actual sale prices are 77% of predicted sale prices. However, the sale prices are extremely variable. Most sale prices are well below the predicted price. On the other hand, George Lucas sold the Star Wars series to Disney for \$4 billion.³⁹ Even

³⁸Because Star Wars was so popular, 1977 received more total votes. I smooth votes over five years.

³⁹This deal was not a clean purchase of the Star Wars franchise. On the one hand, Disney did not purchase full Star Wars rights. 20th Century Fox owns rights to “A New Hope” and has a home-video distribution contract for the other films until 2020. On the other hand, Lucasfilms owned studio buildings and other non-film assets. Furthermore, Lucasfilms had some rights to the Indiana Jones franchise, though most are held by Paramount. For simplicity, I assume that the subtractions and additions cancel out.

accounting for the incredible popularity of the original Star Wars movies, I still only predict a sale price of \$1.4 billion.

At first glance, the low sale prices for film libraries indicate theatrical movies depreciate quickly. In fact, new film libraries and older film libraries both sell below predicted prices. The Warner film library is a striking example of that problem. It was first sold in 1957 for \$30 million (\$176 million in 2005 dollars). It was then resold in 1982 for \$75 million (\$134 million in 2005 dollars). These two sales suggest a depreciation rate of 1.1% per year – even slower than the decrease predicted by my complex depreciation schedule.⁴⁰

Distressed prices are one possible explanation for the low sale prices observed in Table 3. When valuing future revenues, I used a discount rate based on long-term stock market returns. However, studios selling film libraries are often near bankruptcy. Because of their financial difficulties, they could discount the future more heavily than normal. The discount rate is likely to be especially high when the overall movie industry is in financial distress. Predicted prices would match actual film prices much better if I use a higher discount rate when valuing libraries.

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 retain 41% 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 retain about 24% 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.

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

⁴⁰ However, the two prices may not be a fair comparison. The theatrical movie industry faced heavy competition from broadcast television in the 1960's, but then benefited in the 1980's from home video and cable television. Executives in 1957 and 1982 might have anticipated industry conditions in the near future when pricing libraries.

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, I believe that IRS underestimates the value of old movies.

Conclusion

In this paper, I constructed estimates of investment, prices, depreciation and capital stocks of theatric movies. This change helps bring the NIPAs in line with SNA 2008, which recommended that entertainment originals be treated as capital assets.

My paper has three novel findings:

1) Theatrical movies have a projected lifespan of at least 80 years. Furthermore, the average depreciation rate is only 9.3% per year. The total capital stock of all theatrical movies was worth more than \$150 billion in 2007.

2) Over the past decade, nominal movie production has shrunk from 0.16% of GDP to 0.13% of GDP. This shrinkage occurred because movie production prices rose much slower than overall inflation. Over the same time period, real movie investment grew at 5% per year.

3) The movie industry grew rapidly during the Great Depression. In 1929, theatrical movie investment was \$162 million, 0.15% of GDP. By 1934, movie investment was \$301 million, 0.46% of GDP. Accordingly, the Great Depression looks a little less grim when movies production is counted as an investment activity. After World War 2, movie investment hovered between 0.10% and 0.16% of the overall economy. Accordingly, GDP growth from 1945 to 2010 does not change much when movie production is counted as an investment activity.

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

Dataset	Description of Dataset	Used to Create
2004-2008 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
2007 Economic Census	The Economic Census is conducted every 5 years by the Census Department. It surveys businesses in the United States.	Depreciation Schedules
IMDB.com	This website provides a list of all 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, Price Indexes & Theatrical Revenue
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
Tribune Media Services	This is a dataset of American movies shown on US television. 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
Nielsen Ratings Service	This is a dataset giving ratings for movies shown on cable television on specific dates.	Television Licensing Revenue Schedule & Depreciation Schedule
Kantar Media Services	This dataset gives advertising spending by product and week	Advertising Spending Schedule & Depreciation Schedule

Table 2: Summary Information on IMDB's Dataset

Year of Theatrical Release	# of Movies in Dataset	Mean Production Budget		Movies Are Weighted by Imputed Budget (Real)			
		Real	Nominal	US Share	Animated Share	Production Budget is Reported	Filming Dates are Reported
1915-1919	16,241	\$78,901	\$2,379	100%	1%	7%	11%
1920-1924	8,364	\$171,215	\$11,825	100%	1%	11%	19%
1925-1929	8,045	\$261,028	\$28,904	100%	0%	17%	24%
1930-1934	5,647	\$873,968	\$54,621	100%	1%	20%	45%
1935-1939	5,269	\$1,447,859	\$119,948	100%	1%	20%	63%
1940-1944	4,635	\$1,632,372	\$158,537	100%	4%	15%	58%
1945-1949	3,973	\$1,736,799	\$331,357	100%	2%	15%	32%
1950-1954	3,479	\$2,009,989	\$316,340	98%	2%	15%	29%
1955-1959	2,522	\$2,613,806	\$509,978	97%	2%	24%	30%
1960-1964	1,974	\$3,002,279	\$808,716	92%	6%	26%	27%
1965-1969	2,908	\$2,327,214	\$757,950	91%	5%	26%	23%
1970-1974	3,454	\$2,231,566	\$550,816	94%	4%	29%	19%
1975-1979	3,178	\$2,764,303	\$979,013	93%	4%	29%	21%
1980-1984	3,306	\$3,632,503	\$1,989,642	91%	4%	40%	29%
1985-1989	5,265	\$3,059,997	\$2,022,303	92%	6%	40%	47%
1990-1994	5,145	\$4,059,582	\$3,032,759	91%	5%	43%	67%
1995-1999	7,925	\$3,881,170	\$3,448,581	91%	4%	71%	70%
2000	2,166	\$3,126,695	\$3,069,053	85%	8%	82%	73%
2001	2,516	\$3,231,662	\$2,741,741	83%	7%	83%	73%
2002	2,974	\$2,689,779	\$2,622,687	84%	4%	83%	71%
2003	3,389	\$2,407,303	\$2,363,935	85%	5%	79%	77%
2004	4,369	\$2,086,676	\$2,067,339	82%	7%	80%	84%
2005	5,711	\$1,615,704	\$1,530,026	82%	4%	81%	88%
2006	6,336	\$1,586,295	\$1,427,005	81%	9%	74%	83%
2007	7,046	\$1,354,639	\$1,336,287	87%	9%	74%	83%
2008	9,424	\$1,041,791	\$955,788	81%	8%	82%	78%
2009	13,853	\$572,580	\$673,458	88%	10%	76%	70%

Table 3: Selected Film Library Sales

Year	Description of Deal	Complex Depreciation Schedule	9.3% Geometric Rate	Actual Sale Price in Current \$'s
2012	George Lucas sold the Star Wars films to Disney	\$1.42 billion	\$908 million	\$4.05 billion
2010	Disney sold the Miramax film library to Filmyard Holdings	\$2.18 billion	\$2.05 billion	\$0.663 billion
2006	Dreamworks sold a controlling interest in the DreamWorks live-action library to Soros Strategic Partners and Dune Entertainment II	\$1.97 billion	\$2.13 billion	\$0.9 billion
2003	Lions Gate acquired Artisan. In addition to its own movies, Artisan also owned the home video rights for Republic Pictures, Vestron and Carolco.	\$569 million	\$506 million	\$210 million
1997	MGM acquired Orion/Samuel Goldwyn studios	\$1.24 billion	\$1.09	\$573 million
1993	Turner Broadcasting acquired New Line studio	\$462 million	\$506	\$500 million
1985	MGM/UA Entertainment sold their film library and studio property to Turner Broadcasting. Turner then sold back everything but the library.	\$1.24 billion	\$650 million	Net price of \$1.02 billion
1982	Filmways sold the library they'd bought from American International Pictures	\$117 million	\$92 million	\$26 million
1982	Proposed Sale of pre-1948 Warner library	\$410 million	\$75 million	approximately \$75 million
1979	American International Pictures sold their entire library to Filmways	\$122 million	\$110 million	\$25 million
1958	Paramount sold their pre-1948 library to MCA	\$204 million	\$103 million	\$50 million
1957	Warner Brothers sold their pre-1948 library to United Artists	\$349 million	\$262 million	\$30 million

Library descriptions are taken from 'Entertainment Industry Economics' (Vogel 2004) and media reports. I exclude sales with non-movie assets such as studios, real estate or television episodes. It is possible that studios do not own their movies fully. For example, directors might be promised a share of future profits.

Figure 1: Nominal Movie Investment

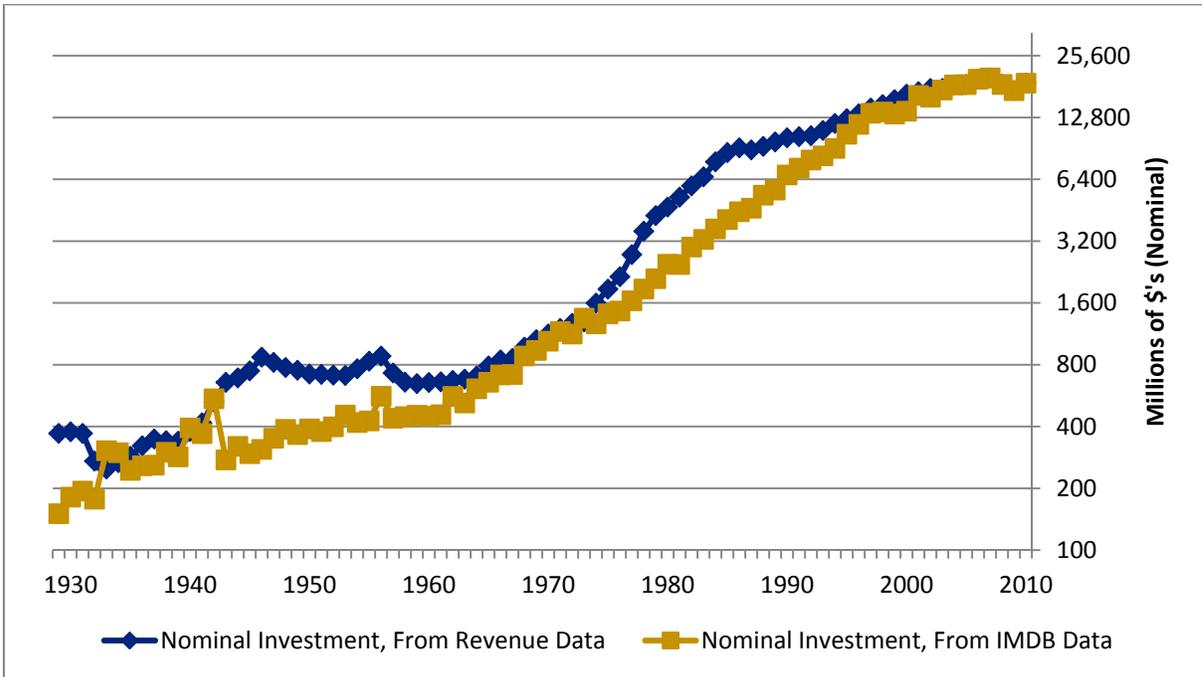


Figure 2: Unreleased Movie Inventory

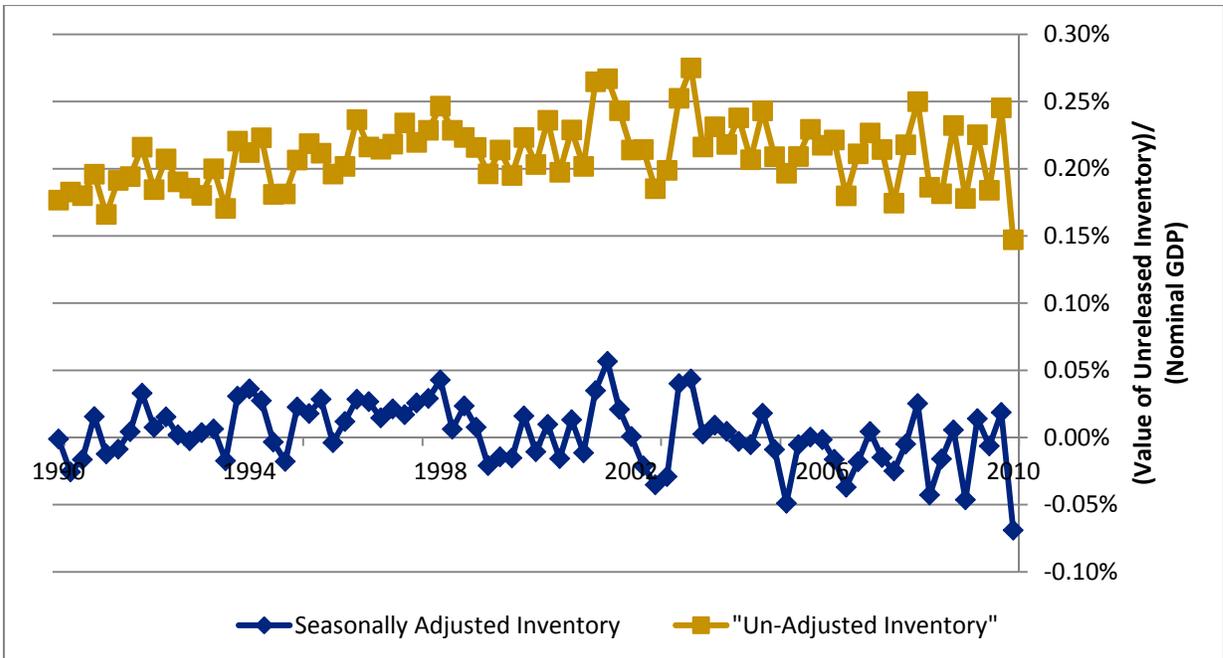


Figure 3: Prices Based on IMDB Data

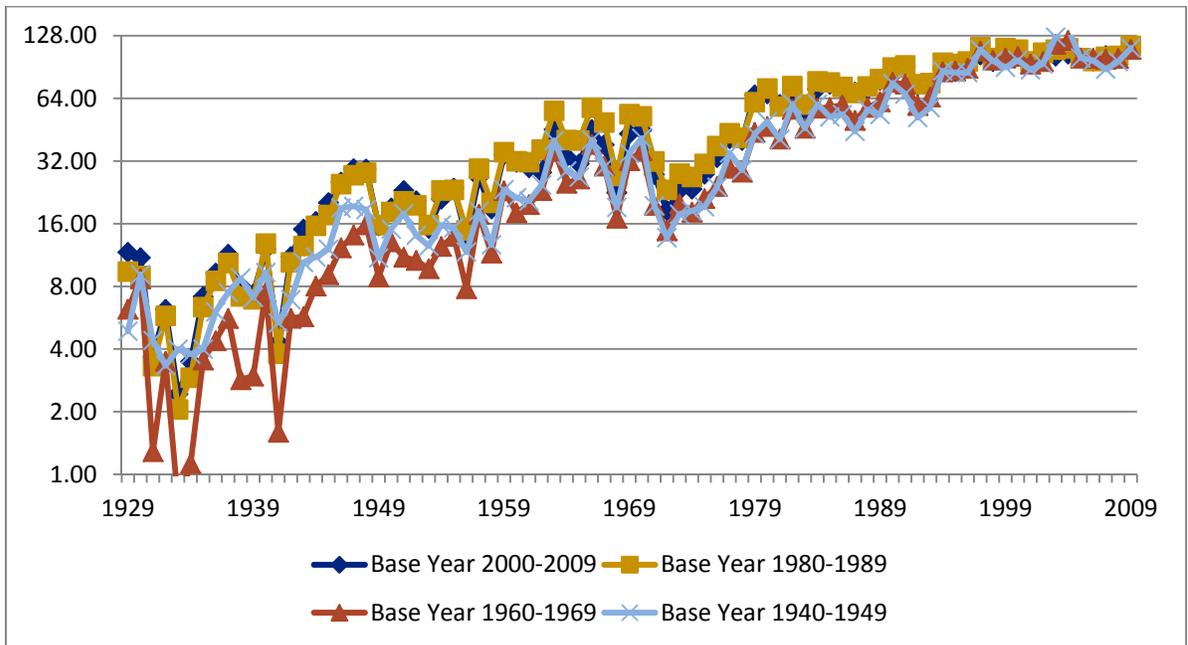


Figure 4: Input-Based Price Indexes

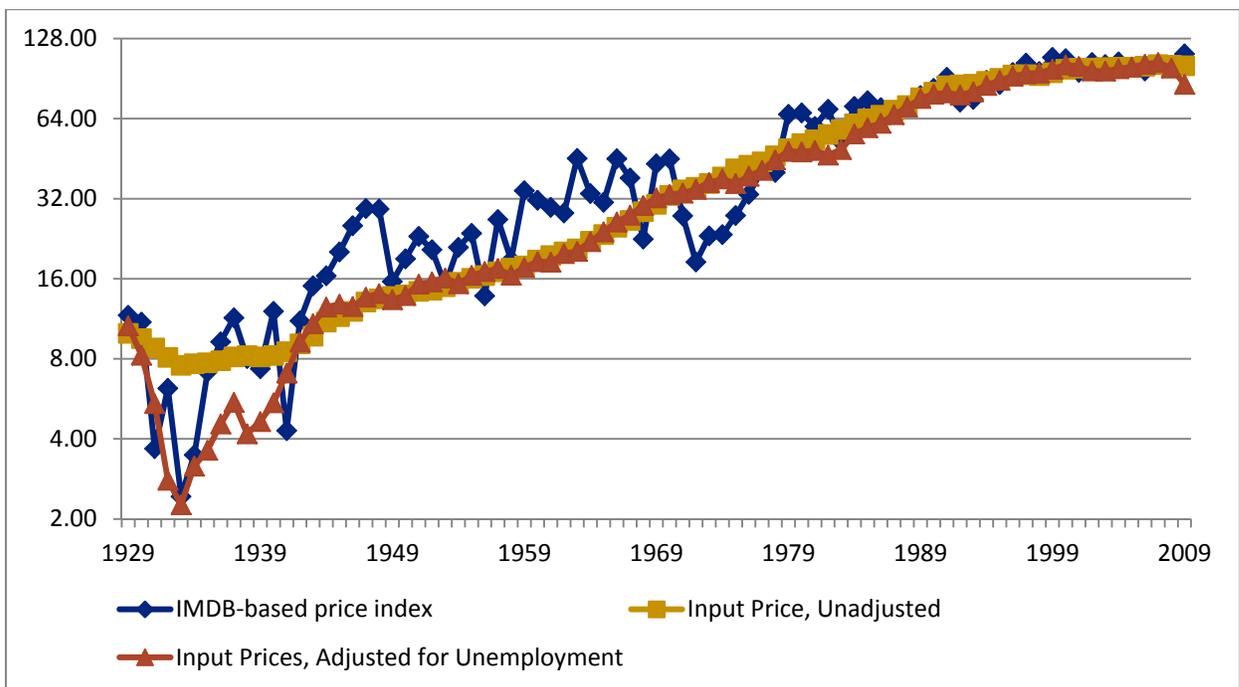


Figure 5: Consumer Prices for Movies

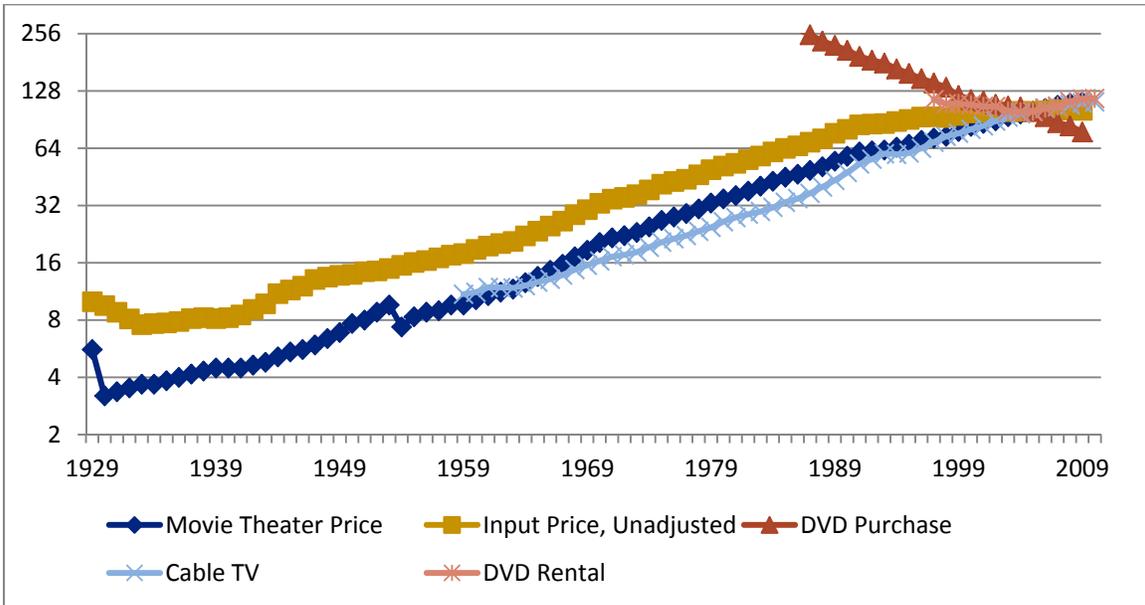


Figure 6: Real Movie Investment

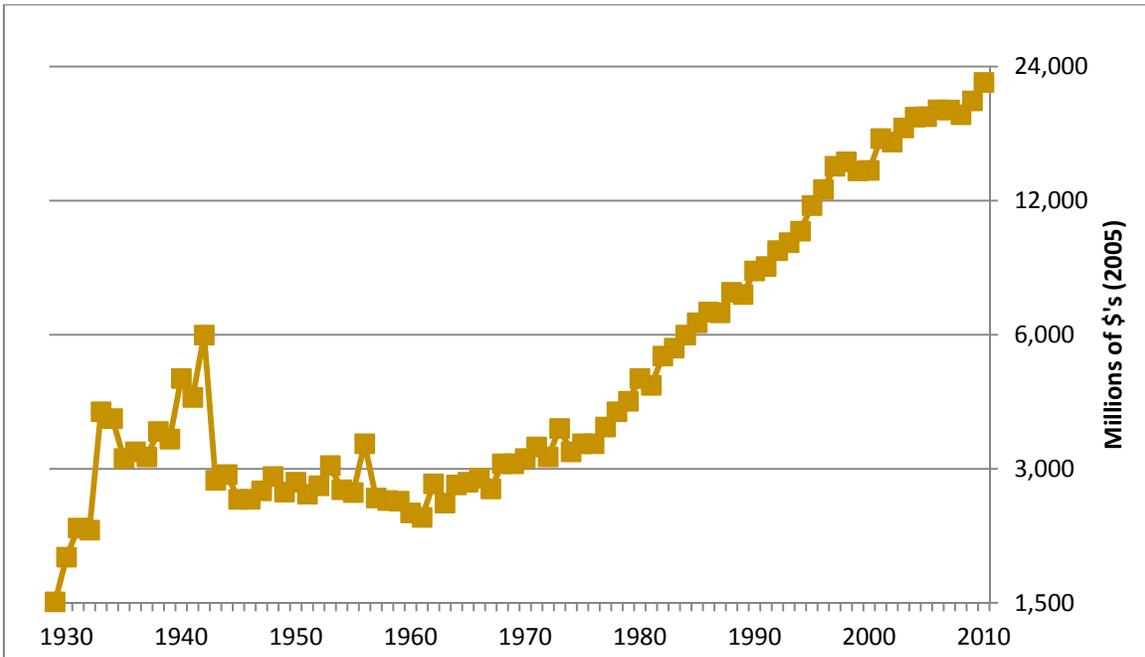


Figure 7: Box Office Revenue by Quarter

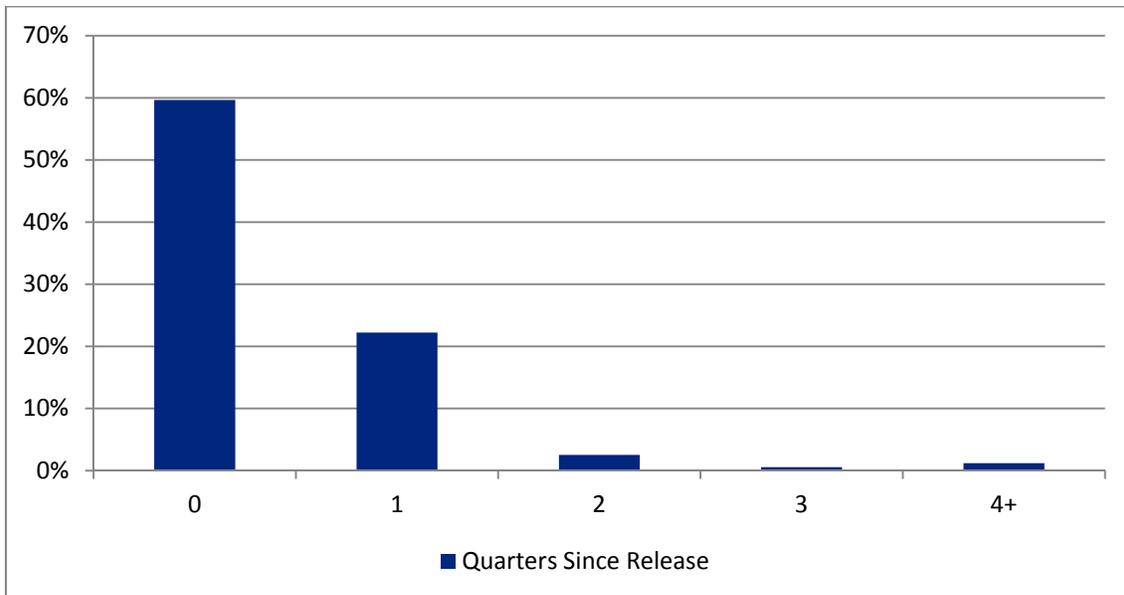


Figure 8: DVD Revenue for New Movies

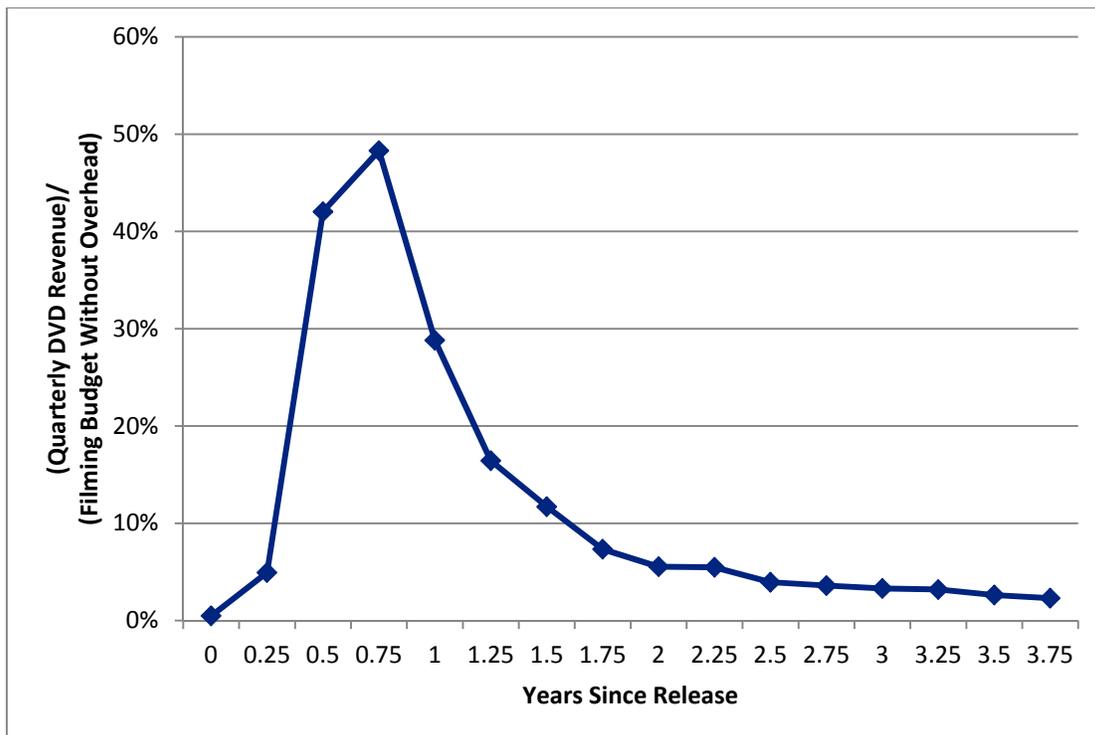


Figure 9: DVD Revenue for Older Movies

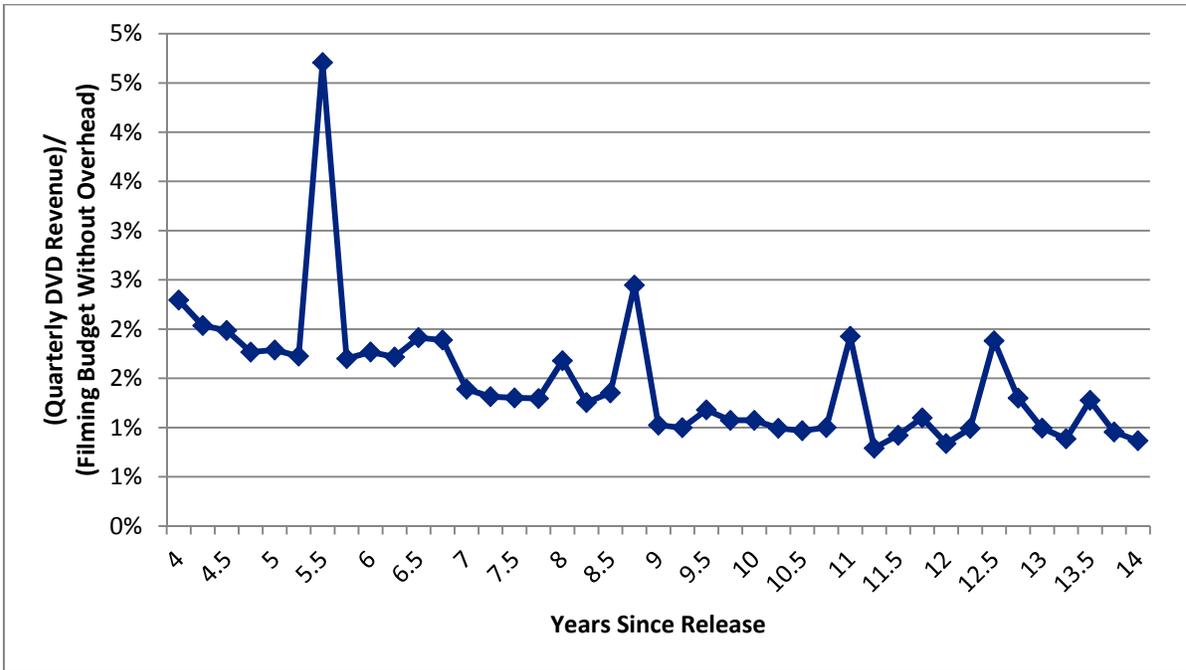


Figure 10: Quarterly Revenue for Pre-1980 Movies

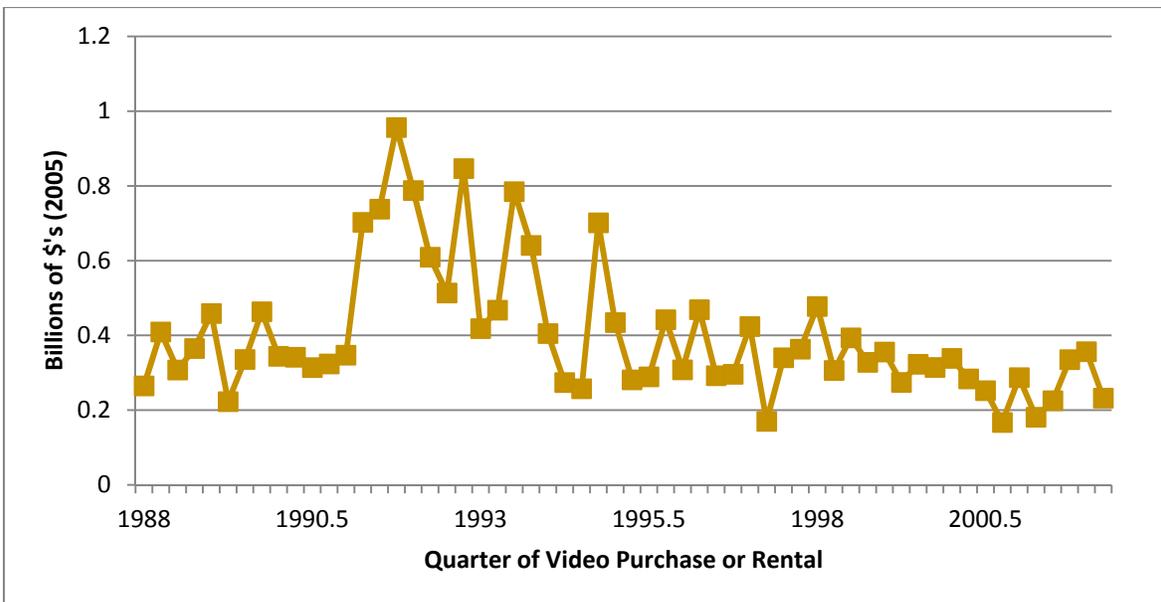


Figure 11: Relative DVD Revenue 1988-2002

Each Release Year is One Observation

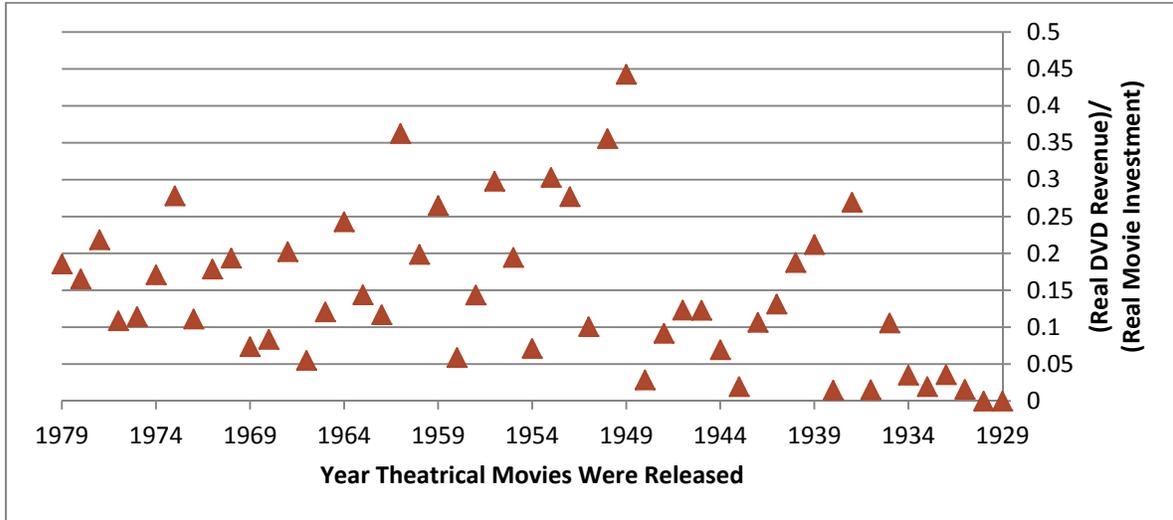


Figure 12: Estimated Television Revenue

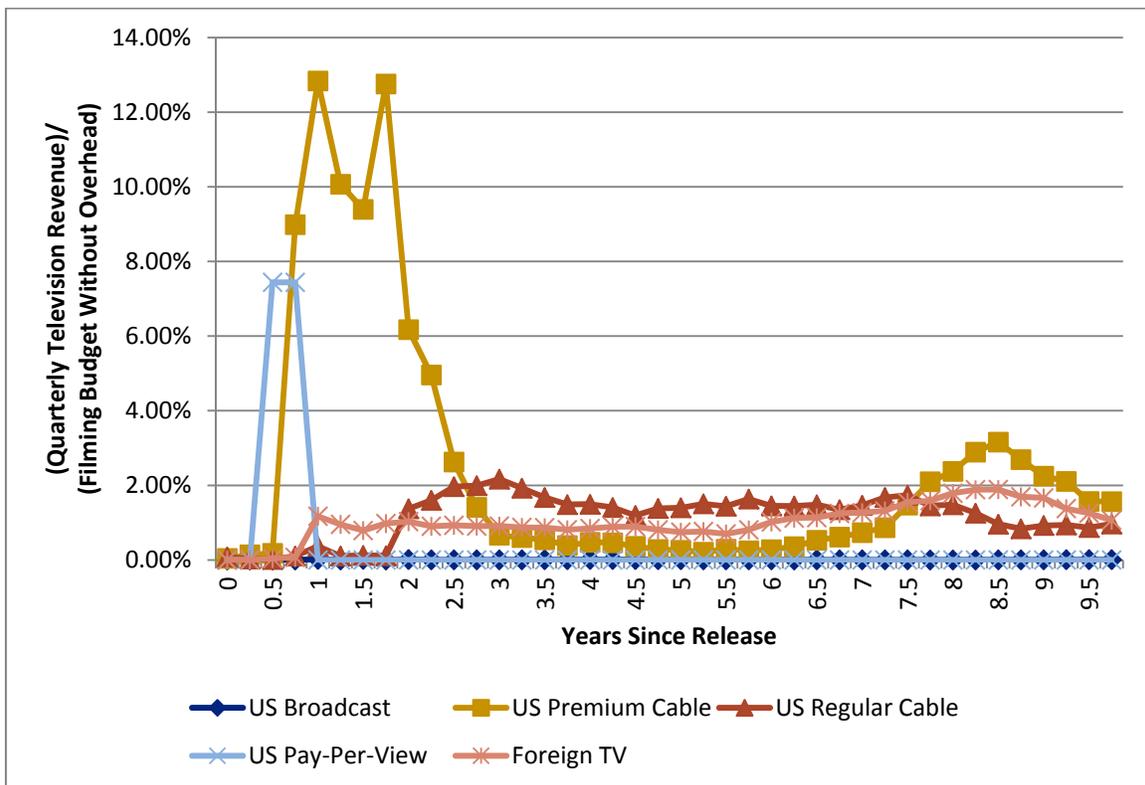


Figure 13: Quarterly Revenue for Pre-1995 Movies

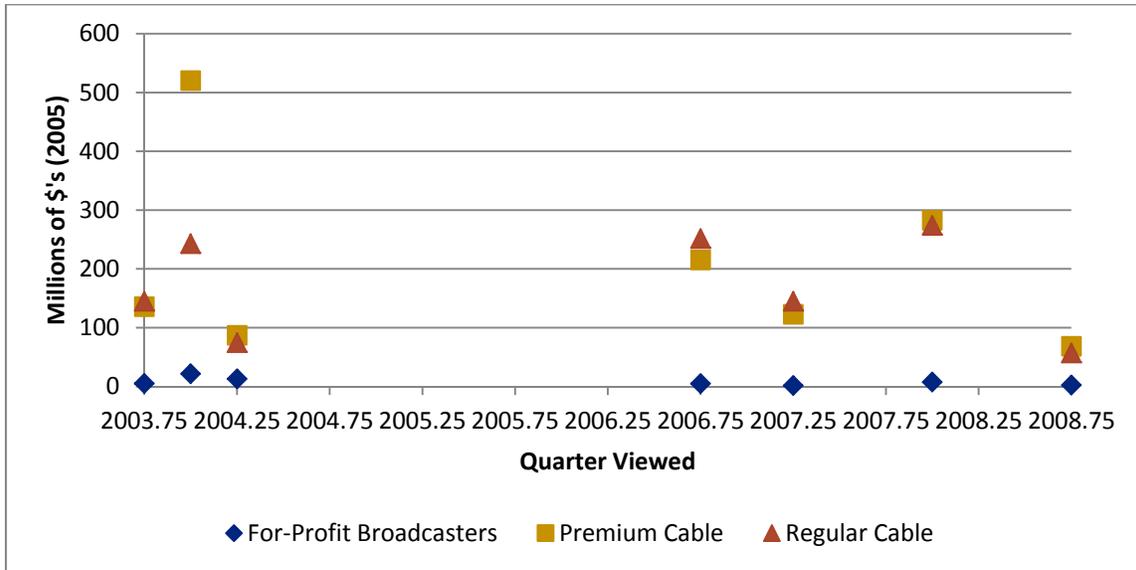


Figure 14: Relative TV Revenue in Sample
Each Release Year is One Observation

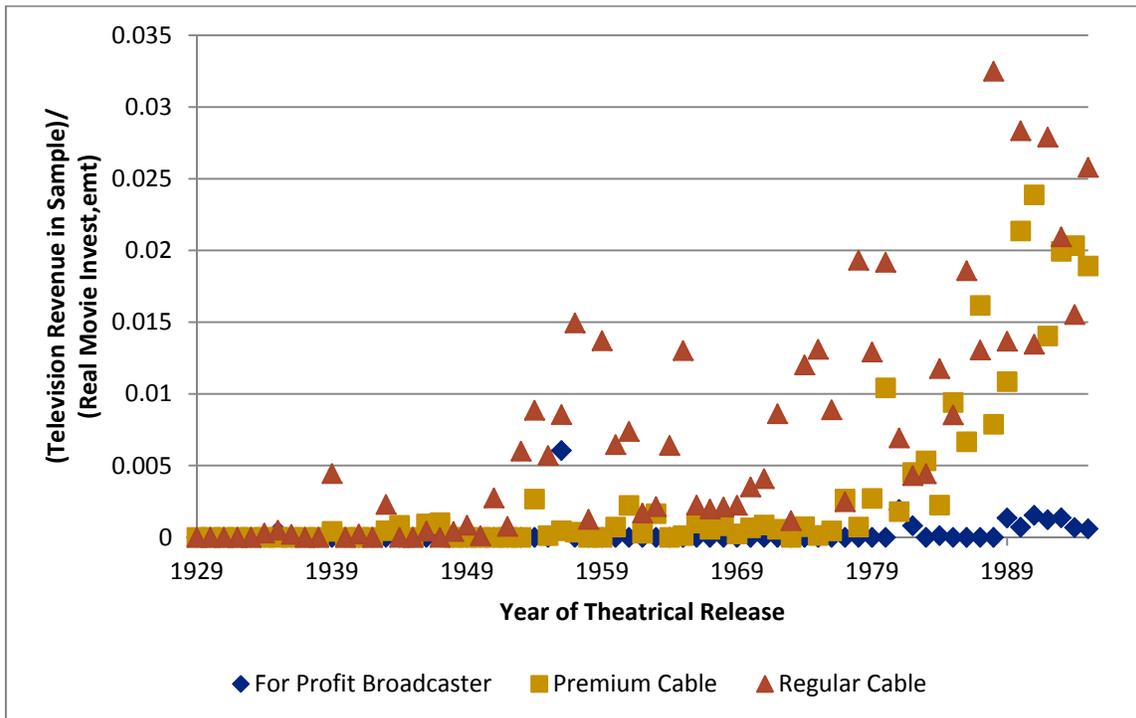


Figure 15: Nielsen Ratings Over Time

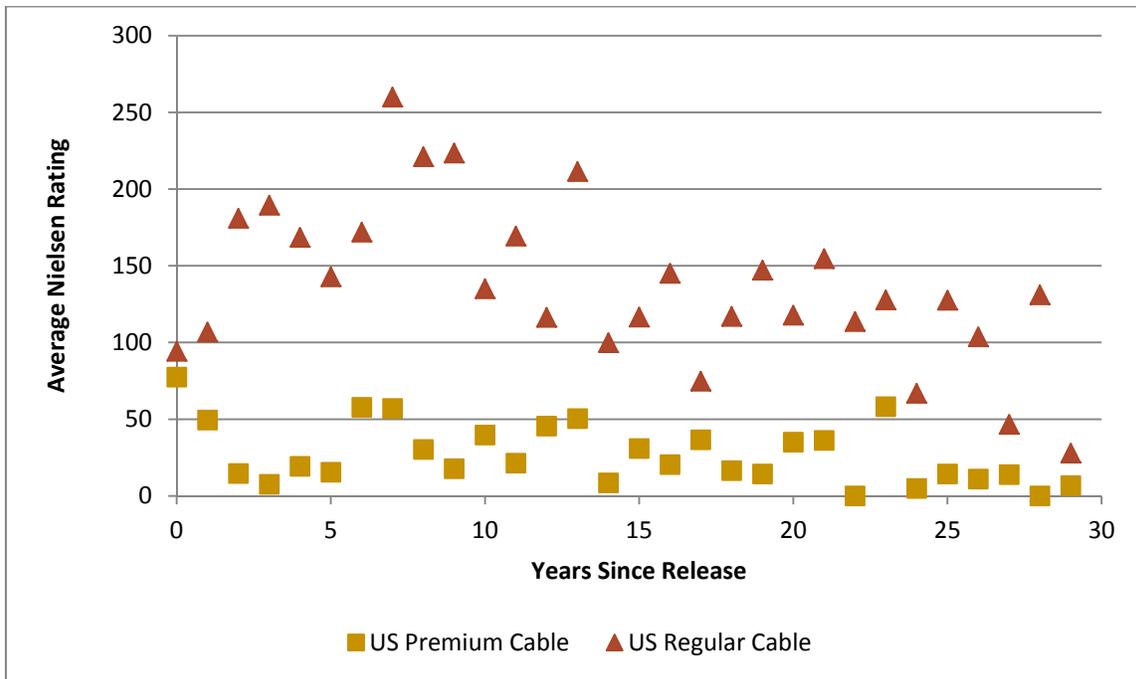


Figure 16: Marketing Over Time

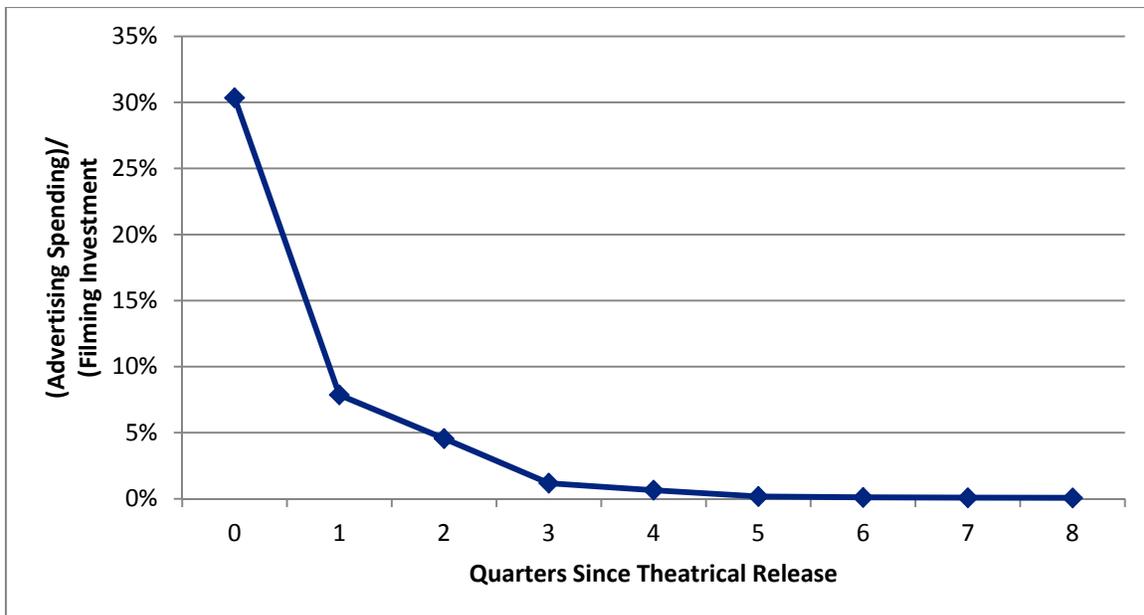


Figure 17: Combined Depreciation Schedule

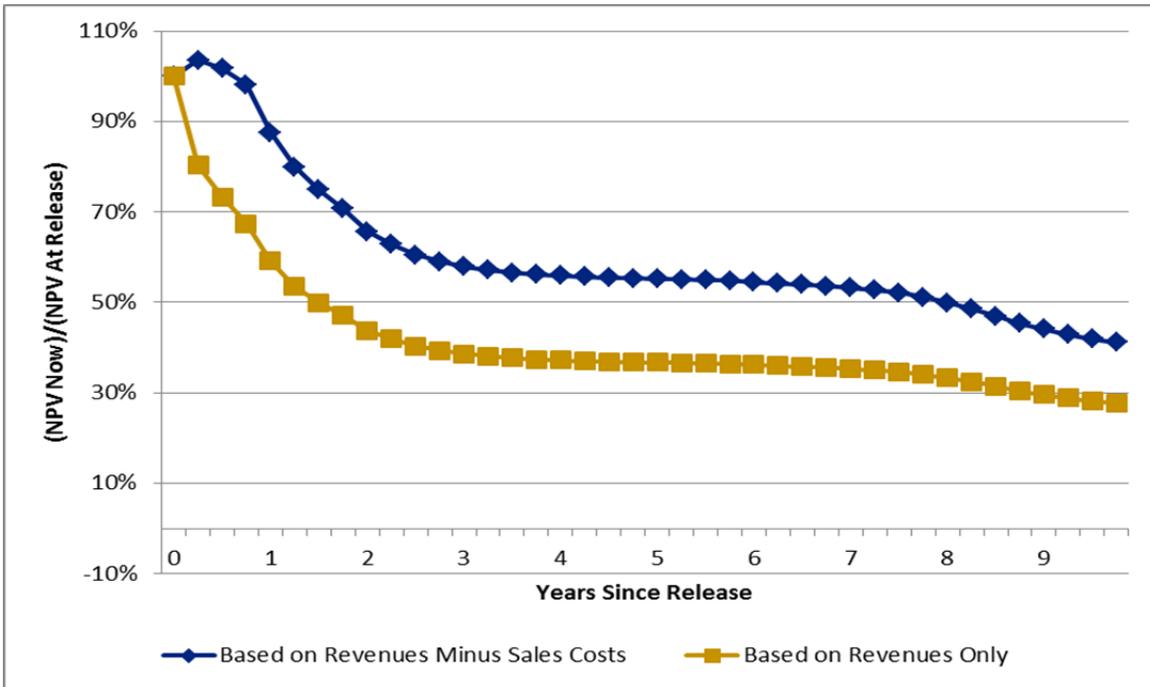
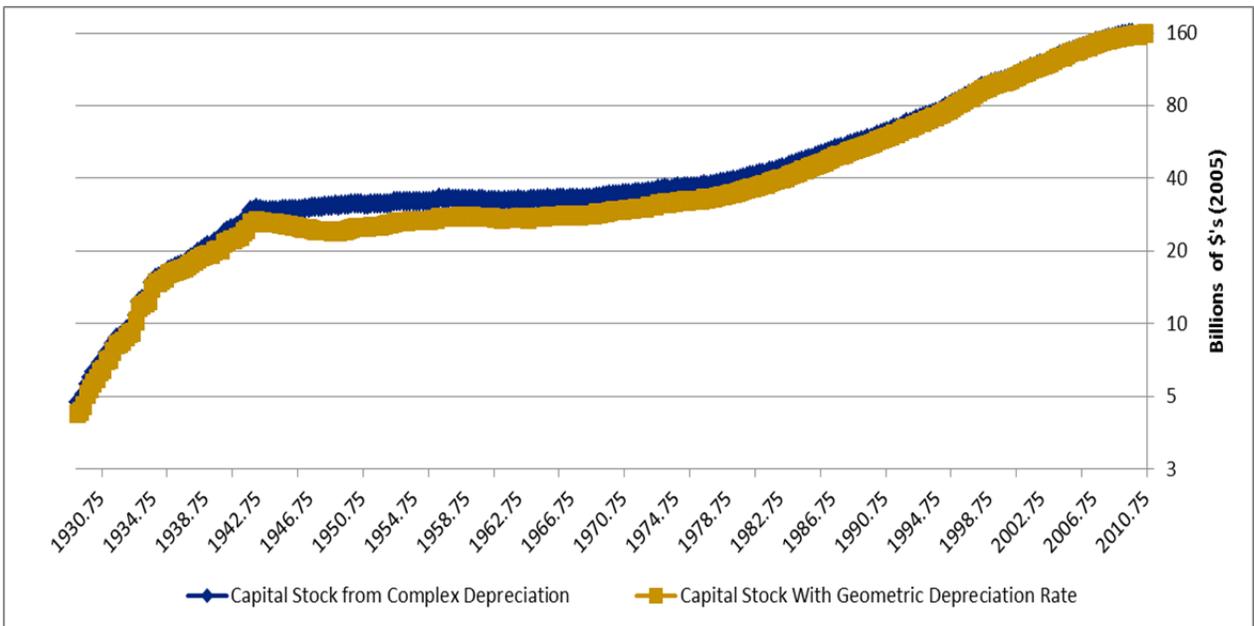


Figure 18: Aggregate Capital Stock



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Appendix 1: Description of Revenue Data

A. Revenue from Theaters Worldwide

My box office revenue data is also taken from IMDB.com. IMDB provides weekly US box office for selected movies. After 2000, most major movies have data. 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.

Because the survey dataset is so large, I created a stratified random sample movie codes to study, with an oversampling of popular titles. I then used The-numbers.com and IMDB.com to determine the original source for each movie, the date when each movie was released and the production budget for that movie. I exclude movies that were first released direct-to-video or on television. Those movies will be studied in the television paper. In some cases, consumers could not remember a specific title or misreported the

title. I matched titles to IMDB.com as best as I could, and dropped the ones I couldn't match.

In the first step, I assume that revenue is proportional to the number of rentals or purchases for each movie. For example, suppose that Alexander and Associates tracks 10,000 rentals in 1997 and total rental revenue was \$5 billion. I assume that each rental corresponds to \$500,000 in revenue. My data on consumer rentals and consumer sales is taken from the Entertainment Merchants Association 2007 report.

In the second step, I adjust revenue for price changes. Alexander and Associates asked consumers how much they paid for the movie. In many cases, this data is missing. They did not ask rental prices. For every movie & quarter, I calculated relative price = (Average Movie Price)/(Average Price for All Movies). I found that movies in the first year cost about 15% more than older movies. I increase the revenues for movies in the first year by 15% for both purchases and rentals.

In my empirical analysis, I will calculate the total revenue received by a studio from its movie originals 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 number of rentals and revenue from the sell-through market in proportion to the total number of sales by year. I then increased revenues in the first year by 15% to account for the higher prices right after release; 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:

C. Revenue from Television Licensing

My dataset on television airing dates was purchased from the company Tribune Media Services (TMS). That company maintains a listing of television programs shown in the United States back to the 1980's. Unlike Nielsen's ratings data, TMS records not

only the name of a show, but also the precise episode aired. TMS is used by actors to monitor payment of residuals, IMDB to show when individual episodes will air and other industry players.

BEA purchased a subsample of TMS's data. BEA supplied TMS with ten randomly selected days between 2003 and 2008. TMS then gave BEA schedule information for those days, the day before and the day after. I then looked up the title on IMDB for every single one of the programs on TMS's schedule.

My data on Nielsen ratings was purchased from Nielsen Television Ratings Services. Nielsen provided all cable ratings data for ten randomly selected days between 2003 and 2008. I then matched Nielsen's cable rating data with TMS's schedules to get the precise title for each movie shown on cable TV. BEA also purchased some ratings data for local broadcast television. However, US broadcast television shows very few theatrical movies. As a result, the revenue from broadcast networks is too small to study.

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.⁴¹; 2) I assume that the payment for licensing is proportional to the number of viewers; 3) I assume that premium cable channels pay a higher licensing fee than regular cable channels. 3) Conditional on the number of potential viewers and the channel, I assume that studios charge a fixed rate per movie-hour. Results were similar if I assume a fixed rate per prime-aged viewer. The only difference between popular movies and unpopular movies is that popular movies are shown more often.

In a previous paper, I used a dataset from Red Bee Media. That dataset tracked a sample of 1,000 theatrical movies shown on British television from 1997 onward. The results were qualitatively similar, but I did not observe a spike in revenues in the first few years after release. It is possible that British television is less likely to show new movies on premium cable.

⁴¹ 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).