Copyright-Protected Assets in the National Accounts

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In 2007, we estimate that US businesses and governments invested $278 billion in software and US artists produced $54 billion worth of long-lived entertainment originals. These copyrighted materials will yield useful services for years to come. Because of their long working life, the international guidelines for national accounts, System of National Accounts 2008, recommends that countries classify production of software and long-lived entertainment originals as an investment activity and then depreciate the copyrighted assets over time. At the current time, BEA capitalizes software in the national accounts, but does not capitalize entertainment originals. This paper presents data on nominal investment, prices and capital stocks of software and long-lived entertainment originals from 1929 to 2009. We then show how capitalizing software and entertainment influence GDP statistics. For reference, we also include estimates of short-lived entertainment from 1929 to 2009.

To preview, our empirical results are:

1) In 2007, software investment accounted for 2% of nominal GDP. In 1959, software investment was close to 0. Accordingly, average GDP growth increases when software is classified as a capital asset.

2) Entertainment investment accounts for approximately 0.3% of nominal GDP. This share has remained relatively steady from 1929 to 2009. Accordingly, average GDP growth rates do not increase much when entertainment originals are classified as a capital asset.

3) Software has a lifespan of 3-5 years and entertainment has a lifespan of 15-50 years. In 2007, the private capital stock of software was $486 billion and the capital stock of entertainment originals was $353 billion.

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Introduction

Intellectual property products (IPP) are expected to play an increasingly important role in both BEA's national income and product accounts (NIPAs) and the related fixed assets accounts (FAAs). IPPs cover a variety of products, including research and development, computer software, mineral exploration, and entertainment originals. Some of these products are currently recognized as fixed investment (a.k.a. capital formation) in the NIPAs and the FAAs, while others are candidates to be included in the near future. Many of these products are also protected by copyright law. These copyrighted IPPs comprise software and long-lived entertainment such as books and movies.

Because software is already recognized as an asset in the national accounts, there are already considerable written materials describing the methods and source data used to prepare these estimates (Parker and Grimm 2000). Therefore, we have devoted significantly more discussion in this paper to issues surrounding the development of capital measures for entertainment originals, which are still in the research phase. BEA may recognize long-lived entertainment as fixed investment in the future.

The intellectual property measured in this paper does not always coincide with products that are protected by copyright. For example, the federal government does not copyright produced by its employees. Nevertheless, we count software produced by federal employees as a capital asset in the NIPAs. In addition, BEA only counts long-lived items as capital assets in the NIPAs. In this paper, we discuss short-lived entertainment products like newspaper articles briefly. However, the estimates given for production and prices of short-lived entertainment products are for research purposes only. BEA does not plan to change the treatment of short-lived entertainment products in the NIPAs.

The value of copyrighted works is greater than the value of copyright protection alone because programmers and artists could still earn some money if copyright protection were completely abolished. Programming companies often develop open-source software as a loss leader and then sell service

contracts to maintain and customize the software. Musicians sometimes distribute their songs free to build a fan base and then sell concert tickets to cash in. Furthermore, copyright law is not the only barrier to reproducing software or entertainment. For example, printing newspapers and distributing them takes time. It would be extremely difficult for a start-up company to scan in a rival paper, print it up and deliver it in time for morning rush hour. This paper measures the revenue and capital value of copyrighted software and entertainment from 1929 to 2009. We do not estimate how much revenue would be lost if copyrighting was abolished or changed.

The main section of this paper is divided into two parts. In part 1, we discuss why the treatment of intellectual property matters for the national income and product accounts (NIPAs). In part 2, we describe BEA's data on nominal investment, prices and capital stock. We then discuss the general trends from 1929 to 2009. In Appendix A, we discuss the estimation procedures for each category of IPP in detail. Finally we provide background on capital stock calculations in Appendix B.

Section 1: Changes in the National Income and Product Accounts When Intellectual Property Products Are Classified as Capital Assets

In 2007, we estimate that US companies and governments invested $278 billion in software and US artists produced $54 billion worth of long-lived entertainment originals.[2] The cost of producing these $332 billion worth of copyrighted material could be treated as either a current expense (expensing) or a capital investment (capitalizing). If production of entertainment originals is treated as a current

[2] The estimates for entertainment originals presented in this paper are preliminary and may differ from the values that will ultimately be recorded in the NIPAs.

expense, then they play a limited role in the calculation of GDP.[3] Under expensing, production costs are treated the same way as advertising costs, manufacturing costs and shipping costs. If these costs are paid from one business to another they are considered intermediate expenses and are not counted in GDP or capital stock. BEA uses the method described above for entertainment originals.

On the other hand, under the capitalizing method, software and entertainment production costs are treated as private investment and added to the pre-existing capital stock of copyrighted material to get the total capital stock of copyrighted assets. This capital stock then returns a flow of services to its owner. That flow of services is then used by its owner to produce consumer goods or services such as DVDs. GDP does not explicitly count the flow of services from software and entertainment, but it does count consumer spending, investment and government services.[4] Therefore, the flow of services is implicitly counted in GDP along with the initial investment.

Finally, depreciation (which is known as consumption of fixed capital or CFC) is deducted to calculate the new capital stock of copyrighted material. In addition to the well known GDP, BEA also estimates net domestic product (NDP); NDP = GDP – CFC. Because NDP reflects a charge for the cost of using capital, it is generally viewed as a better long-term measure of the total sustainable consumption made possible by an economy. The international guidelines for national accounts, the System of National Accounts 2008 (SNA 2008), recommend that countries use this method. In this paper, we calculate GDP, capital stocks and CFC for the United States when production of copyrighted material is treated as an investment activity. BEA uses the method described above for software.

[3] While entertainment originals are not counted as investment in GDP final expenditures, they do appear to a limited extent in some of the values affecting GDP. Exports and imports of services include royalties for entertainment originals received from or paid to the rest of the world. For sectors where output is generally not sold to markets (government and nonprofit institutions serving households), the value of output is based on expenses and thus includes the cost of producing entertainment originals, which is counted as part of consumption

[4] An exception is that in cases where GDP includes production that is not sold on the market, such as for government or nonprofit institutions, then expenses are used as a measure of output. Depreciation is included as one of those expenses and can be thought of as a partial measure of the services of capital

Switching from expensing to capitalizing may change short-term estimates of GDP growth significantly. Suppose that all movie actors go on strike for a single quarter. When entertainment production is treated as a current expense, GDP doesn't drop until **sales or rentals to households** of theatrical movies drop a year later. On the other hand, the strike reduces GDP immediately if production is treated as an investment.

Reclassifying production costs from current expenses to capital expenditures has important ramifications beyond raising measured GDP and capital stock. For example, the Bureau of Labor Statistics' multi-factor productivity statistics, which measure the value-added output per combined unit of labor and capital input, are also affected by expanding the asset-boundary.[5] Most of the production of entertainment originals is concentrated in a handful of industries, so redefining the scope of capital inputs could result in a notable revision to multifactor productivity for these industries.

Balance sheets, published jointly by BEA and Federal Reserve Board as part of the integrated macroeconomic accounts, are also affected by recognizing expenditures to produce IPPs as capital expenditures. Consolidated balance sheets are presented by sector (households and nonprofit institutions, noncorporate nonfinancial business, corporate nonfinancial business, financial business, federal government, and state and local government) for both financial and nonfinancial assets. In addition, balance sheets for nonfinancial assets are presented by broad type of asset and are published as part of the NIPAs in Table 5.9.[6] Naturally, expanding the asset-boundary would raise the value on the nonfinancial balance sheet, with no corresponding increase on the financial side. These balance sheet positions and changes are useful for analytical purposes and are necessary in order to compute statistical indicators, such as "Tobin's Q" and sector/industry rates of return.[7]

[5] For more information, see BLS Handbook of Methods.
[6] For more information on balance sheets for nonfinancial assets, see Wasshausen (2011).
[7] Tobin's Q is the ratio of financial market valuation of corporate assets to the current-cost value of the assets presented in the balance sheet. For more information on rates of return and Tobin's Q, see Hodge and Corea (2010).

Section 2: Nominal Investment, Prices and Capital Stock of Intellectual Property Products

In order to measure investment and capital stock of copyrighted material, we need time series data on nominal investment and price indexes from 1929 to 2009.[8] We also need a depreciation schedule for capital stock in each category. We can then calculate real investment and real capital stock for Year t:

$$\text{Real Investment}_t = \text{Nominal Investment}_t / \text{Price Index}_t$$

$$\text{Real Capital Stock}_t = \text{Real Capital Stock}_{t-1} - \text{Depreciation}_t + \text{Real Investment}_t$$

In the remainder of section 2, we will give information on nominal investment, price indexes and depreciation schedules for software and long-lived entertainment originals. Short-lived entertainment products are not a candidate for capitalization, so we did not study that category closely. However, we include preliminary information on nominal production and prices for researchers who might be interested in that area.

We only include software and entertainment originals produced by the market sector in GDP. Amateur programmers and artists often develop software for their own pleasure and distribute it for free.[9] For example, a chef may start a blog to share her cooking adventures with the world. In many cases, the amateur work is high quality and provides enormous pleasure to the users. However, the national income and product accounts are focused on market production. The international guidelines for national accounts, System of National Accounts 2008 recommends that countries restrict GDP to

[8] The time series for software starts in 1959. Before then, software investment was close to 0. For entertainment originals, we estimate real production before 1929 to get capital stock in 1929.

[9] The line between market and non-market production is often very thin. For example, a journalism student may start a blog to share their worldview and then get hired to write the same blog for a newspaper. In addition, many software companies distribute a basic product for free and then sell service contracts.

market activity and a few specific types of household production. The covered household production in the System of National Accounts (SNA) does not include amateur blogs or garage bands. Therefore, we do not consider amateur software and entertainment production as investment. Researchers who are interested in aggregate production of software or entertainment will need to adjust the BEA's published numbers to include non-market production.

The line between software and entertainment can be fuzzy. For example, video games are counted in software – but they include storylines, graphics and music like a theatrical movie. In this paper, we classify all IPP products originally included in BEA's software accounts as software and put theatrical movies, television programs, books, music and miscellaneous entertainment in the entertainment category. This classification method accounts for entertainment products with the least disruption to BEA's pre-existing time series on software production. If we had decided to switch products from software to entertainment, then nominal investment in entertainment originals would rise and nominal investment in software would fall by the exact same amount.[10] Therefore, aggregate nominal investment in copyrighted IPPs and GDP would not change. However, we use different price indexes and depreciation schedules for software and entertainment. Accordingly, real investment, capital stock and consumption of fixed capital might change if a product was switched.[11]

2a. Nominal Investment

Nominal Investment in Software

According to the Economic Census of 2007, U.S. software developers sold $127 billion worth of prepackaged software and $98 billion worth of custom software in 2007. Not all of this revenue represents fixed investment. Some software was exported, some was purchased by consumers, and

[10] In practice, we use different methods to estimate production spending for software and entertainment products. The methods might produce slightly different results when a category is switched.

[11] In theory, we could adjust price indexes and depreciation schedules for software when a category are switched from software to entertainment. If done right, that adjustment might keep real investment and capital stock fixed.

some was consumed by business as an intermediate input in producing other goods (e.g. software embedded in PCs). Using the commodity-flow technique, BEA estimates that fixed investment in prepackaged and custom software was $83 billion and $93 billion, respectively. In addition, businesses and governments spent $102 billion developing own-account software, which is software developed in house for the developers' own use.[12]

Figure 1 shows fixed investment in software, by type, as a share of GDP from 1959 to 2009. The figures reflect fixed investment by business, federal and state and local governments, but business fixed investment accounts for about 80% of the total. Not surprisingly, the share of fixed investment in software relative to GDP has grown steadily since 1959, the first year in which the software estimates begin. All three types of software show a notable run-up from about 1997 to 2000, which presumably reflects (at least in part) the replacement of software that was not "Y2K compliant." The average annual growth rate from 1996 to 2000 was about 19 percent for all three types of software, compared to about four percent from 2000 to 2009. Figure 2 illustrates that software investment is sometimes incongruent with fixed investment in other information processing equipment, such as computers and communication equipment. In many years, fixed investment in computers and communication equipment falls while purchases of software increase, suggesting that businesses may choose to upgrade/replace software in lieu of purchasing new, and potentially costlier, hardware.

Nominal Investment in Entertainment Originals

According to the Economic Census of 2007, total revenue from sales and license fees for entertainment was $322 billion. Much of this revenue is non-artwork costs like printing books, stamping DVDs and advertising new releases. We subtract these non-artwork costs from revenue to calculate the

[12]This estimate includes the development of software originals that are reproduced and licensed as prepackaged software. More information on own-account software is provided in the appendix.

value of entertainment originals. In 2007, we estimate that artists spent $150 billion producing new entertainment originals

The $150 billion in entertainment production can be split into $54 billion of long-lived entertainment originals and $96 billion of short-lived entertainment products. Long-lived entertainment originals include theatrical movies, some television programs, books, music and miscellaneous entertainment. These entertainment categories will be capitalized in the NIPAs. Short-lived entertainment products include some television programs, radio programs, Internet broadcasting, magazines and newspapers. These entertainment categories have a useful lifespan of less than one year, and so they are not candidates for capitalization in the NIPAs. However, we include data on those categories for reference.

Figure 3 shows the GDP share of investment in long-lived entertainment originals by category from 1929 to 2009. The most striking thing about Figure 3 is how entertainment categories have changed over time. Most of these changes are driven by technology change. For example, theatrical movies were the largest entertainment category before 1950. After 1950, television quickly became a formidable competitor for theatrical movies. As a result, theatrical movies shrank to only 0.05% of GDP in the early 1970's. Later in the 1970's, VCRs allowed Americans to watch movies at home whenever they chose, increasing the demand for theatrical movies. In response to the increased demand, studios increased filming quality. As a result, investment in theatrical movie originals grew to 0.12% of GDP by 2009.

Although not a candidate for capitalization, short-lived entertainment is still interesting to researchers studying copyrights. Figure 4 shows the production costs for short-lived entertainment relative to GDP from 1929 to 2009. Like long-lived entertainment originals, the categories for short-lived entertainment have changed in relative importance over time. Over the past decade, Internet broadcasting and publishing has been skyrocketing. Short-lived television has also grown, but not nearly

as fast. Conversely, the GDP share for newspapers and magazines has been dropping steadily since 1990. However, radio has been able to adapt over time. Before 1950, radio soap operas and game shows were common. Those programs demanded a lot of focus from their listeners. After 1950, radio shifted to music programs and talk shows. Those programs entertain drivers while they focus on the road.

Despite the shifting GDP shares for individual categories, overall expenditures have been stable relative to GDP. New production of long-lived entertainment originals has hovered around 0.3% of GDP and revenue from pre-existing capital stock of long-lived entertainment has hovered around 0.5% of GDP. In addition, revenue from short-lived entertainment has hovered around 0.6% of GDP. These numbers suggest that demand for entertainment is roughly proportional to income.

The entertainment totals in Figures 3 and 4 are not precisely comparable to the software totals because the estimates in those figures only track entertainment originals. Unlike software, entertainment copies are generally not considered a capital asset.[13] Most prepackaged software is derived from own-account software held by the software developer. Therefore, programs like Microsoft Office are accounted for in two separate forms: a) as an original, which is developed by Microsoft in-house and derives its value from making copies and b) the copies, which are assets purchased by other businesses and derive their value from their use in producing other goods and services.

In addition, Figures 3 and 4 only track entertainment originals used to produce copies for the general public. Entertainment sold to the general public includes products for households like DVDs, products for private businesses like in-store background music and products for governments like textbooks. We include educational products like textbooks as well as leisure products like movies. However, it does not include products designed for a single customer, regardless of whether the

[13] Many entertainment copies have a short useful lifespan, so they are definitely not considered capital assets. For example, a broadcast television program disappears as soon as it's over. Other entertainments copies like books are DVDs are long-lived enough to be consumer durables.

customer is a household, private business or government. For example, a cookbook developed in-house by McDonalds and distributed to its franchises would not be counted even though a similar cookbook sold in stores would be counted. Similarly, a cookbook commissioned by McDonalds from a food research company would not be counted.[14] The focus on public entertainment is mostly driven by data limitations. We have not been able to locate data on in-house entertainment reliable enough to include in the national accounts.[15] We do not know what percentage of software originals are designed for the general public. Therefore, we cannot estimate how much investment in software would be if it was treated in the same way as entertainment originals.

2b. Price Indexes

Naturally, constructing quality adjusted price indexes for copyrighted IPP materials presents some challenges. Each software program, movie, song or book is a unique creation, thereby making it very difficult to price consistent products from period to period. Furthermore, it is extremely difficult to measure the quality of a software program or entertainment. Therefore, we use input costs to create price indexes. Each category of software and entertainment product uses different inputs, so we calculate the price index differently. Appendix A gives detailed information by category.

Our price indexes for software and entertainment only track legal purchases.[16] Open-source software, garage band songs, fan-fiction and blogs are generally distributed for free and earn no profits for their creators. Therefore, the implied wage for the programmers or artists is virtually zero. In addition, consumers often pirate software or entertainment. The consumer price for pirated software is

[14] Many products designed for a single purchaser are customized and therefore not useful to the general public. Accordingly, copyright law may be irrelevant for those software and entertainment products.
[15] The international guidelines for national accounts, SNA 2008, does not exclude non-public entertainment, but their discussion is completely focused on public products like movies, television programs, books and music.
[16] Television and radio broadcasters charge consumers nothing and make money from selling advertising space. BEA counts that advertising revenue when deriving the value of entertainment using the net present value approach.

virtually zero. Over the last decade, the Internet has made it much easier to distribute open-source software and pirate legal software. Accordingly, a price index tracking legal purchases probably overestimates inflation for the typical creator or consumer. However, these activities are not considered market activity by BEA and therefore not counted in the GDP statistics.[17] Accordingly, prices for non-market software or entertainment do not influence our price indexes.

Price Indexes for Software

Figure 5 shows the price of software by category from 1959 to 2009. The prices are shown on a logarithmic scale because prepackaged software has dropped too fast to be shown linearly. Price indexes for prepackaged software fall sharply through the late 1990's and then exhibit more modest rates of decline through 2009. The overall declines in prices of prepackaged software appear to reflect economies of scale. The more modest rates of decline in the latter period likely reflect the incorporation of a producer price index (PPI) for software applications, which was available beginning with 1998. Prices for custom and own-account software, which are essentially identical, have increased modestly over the entire period, with some variations driven primarily by fluctuations in wage rates of programmers and software engineers. These prices are primarily driven by employee compensation costs and the costs of intermediate products consumed. It is assumed that there are no economies of scale and little chance for improvements from learning curves because each own-account and custom computer program tends to be a one-shot effort. Pure input-cost based price indexes assume no changes in productivity, which seems unreasonable given the explosion of technological advances observed in the production of software. Therefore, we combined the prepackaged software price index, which does account for changes in productivity with an input-cost based price index to obtain our custom and own-account price indexes.

[17] SNA 2008 recommends that countries count some black market activity like illegal drug distribution in GDP. However, theft is a redistribution of assets – not new production. Accordingly, it does not affect GDP directly.

Price Indexes for Entertainment

Figures 6 and 7 show the prices of entertainment by category from 1929 to 2009. The most interesting thing from Figures 6 and 7 is steady prices for television programs, movies, Internet publishing and music over the past decade. At the same time, prices for newspapers, magazines, books and miscellaneous entertainment have risen steadily. The difference is caused by computers. Television studios and movie studios use super-computers heavily to edit their raw footage and add special effects. Internet publishers and musicians often use home computers to record their entertainment original and edit it. The price decreases for computers cancel out the wage increases for artists, so final entertainment prices are relatively steady in those industries. In contrast, newspapers, magazines, books and miscellaneous entertainment use much less digital technology to produce or sell their products.[18] As a result, consumer prices for those entertainment categories track wages.

2c. Depreciation Schedules and Current-Cost Net Capital Stock

The SNA defines entertainment originals as entertainment with a useful lifespan of more than one year (SNA 2008). This includes theatrical movies, some television programs, books, music and miscellaneous entertainment. We have estimated depreciation schedules for these entertainment categories and then calculated capital stocks of entertainment originals. The market value of already created radio shows, newspaper articles or magazine articles might not be precisely zero, but they are not long-lived enough to be considered capital assets.

[18] This paper only tracks prices up to 2009. In the past few years, e-books have been growing rapidly. This might change pricing in the book publishing industry dramatically. Going further back, computers did reduce product costs for books, magazines and newspapers in the 1970s and 1980's.

Depreciation Schedules and Capital Stock for Software

Figure 8 shows the depreciation schedule for software by category. Prepackaged software is assumed to depreciate very quickly, with an estimated service life of three years and a declining balance rate equal to 1.65.[19] Custom and own-account software are assumed to depreciate quickly as well--albeit, a little slower than prepackaged software--with estimated service lives of five years and a declining balance rate of 1.65. The service lives are based on some indirect quantitative estimates of the relationships between computer expenditures and software expenditures, anecdotal evidence (including an informal survey of business use of software previously conducted by BEA), and tax-law-based lives of software.[20]

Figure 9 shows the net stock of software relative to GDP from 1959 to 2009. Growth in the combined stock of software has steadily outpaced GDP growth. By 2009, net stock of software is estimated to be almost $530 billion, or 3.7 percent of GDP.

Depreciation Schedules and Capital Stock for Long-Lived Entertainment Originals

Figure 10 shows the depreciation schedule for theatrical movies, long-lived television programs, books and music.[21] Data on viewership for television broadcasts and DVD sales show that theatrical movies and television programs have a relatively long lifespan. In contrast, books and music earn most of their money in the first five years. The main reason for the different lifespans is consumer storage. Theatrical movies and television shows get most of their money from television licensing, which is not durable for consumers. Accordingly, the studios get paid each time a classic movie or television episode is replayed. In contrast, books and music get most of their money from selling a durable product. Once

[19] The declining balance rate gives the speed at which an asset depreciates over its lifetime. A declining balance of 1.65 and a lifespan of 3 years is similar to a geometric depreciation rate of 1.65/3 = 55% per year.
[20] For more information on the methodology underlying BEA's software estimates, see Parker and Grimm (2000).
[21] Each miscellaneous art category has its own lifespan. We omit the individual schedules to keep the graph simple.

they've bought a book, consumers can re-read it without paying more money to the publisher.[22] In this paper, we only measure the capital stock of entertainment originals. Therefore, we count the reprint rights owned by publishing houses – but not the physical books owned by libraries and consumers.

The depreciation schedules in Figure 10 are based on revenue **net** of sales costs. Studios, musicians and authors typically spend a great deal of money advertising their new releases. BEA's general practice is to treat advertising as a current expense. Because advertising is a current expense, we deduct all advertising costs from revenue for that particular year. As a result, first year profits are much lower than first year revenue. In fact, theatrical movies actually have negative profits in the first quarter and therefore gain value early in their lifespan. Another researcher might consider advertising a long-lived investment in brand awareness. That researcher would find higher depreciation rates in the first year after release.[23]

Figure 11 shows the capital stock of entertainment originals relative to GDP from 1929 to 2009. On average, long-lived entertainment originals are worth 2% of GDP. However, the GDP share for capital is not constant over time. At first glance, this seems contrary to the fixed GDP share for entertainment production seen in Figure 4. However, the differences can be explained by changing entertainment categories. Television programs and movies have a much longer lifespan than books or music. Therefore, the capital value of pre-existing entertainment is larger when television programs and theatrical movies are more important and smaller when books or music is more important.

[22]In theory, consumers could make television broadcasts durable by taping a program. In practice, very few consumers use their DVRs for long-term storage. As a result, viewership for old movies decreases much slower than purchases of old CDs or books.

[23] However, the capital value of entertainment originals + capitalized advertising would be identical to our capital values for entertainment originals alone.

Conclusion

This paper described BEA's recent work on software and entertainment originals. BEA currently treats software production as an investment activity in the national income and product accounts and is currently planning to reclassify production of long-lived entertainment originals as an investment activity. These two changes significantly increase investment in the GDP accounts; in 2007 software investment was $277.8 billion and nominal investment for long-lived entertainment is estimated to be $54.6 billion.

While recognizing software as a capital asset doesn't have a notable impact on GDP growth rates, it does have an increasingly notable impact on private fixed investment growth rates and related measures. For example, recognizing software as investment adds about 0.4 percentage point to private fixed investment's average annual growth rate from 1959 to 2009; in more recent periods, 1997-2009, it adds 0.7 percentage points. Capitalizing entertainment originals will not have a significant impact on GDP growth either and its impact on private fixed investment is a bit less notable. Investment in long-lived entertainment has hovered around 0.3% of GDP from 1929 to 2009 and has virtually no impact on GDP growth rates. The steady GDP shares suggest that Americans spend a fixed share of their income on entertainment.

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Appendix A: Background Information on Methodology for Estimating Each Category of Copyrighted IPP

Category 1: Prepackaged Software

Nominal Investment

Prepackaged software is sold or licensed in standardized form. It typically requires little or no modification for use and includes both systems software and applications software. Most producers of prepackaged software are classified in NAICS 51121 (software publishers) or NAICS 334611 (software reproducing).

Nominal investment in prepackaged software is calculated using the commodity-flow technique, which begins with estimates of the domestic output or domestic sales (valued in producers' prices). Then, estimates of the domestic supply of that commodity—the amount that is available for domestic consumption—is prepared by adding imports and subtracting exports. Finally, the domestic supply of the commodity is allocated among domestic purchasers (intermediate consumption, households, business investment, and government) and valued at to purchasers' prices.

Table 1 presents the commodity-flow estimates for 2007 for prepackaged software. Sources of data for the commodity flow components vary over time – here we focus on data used to estimate 2007.[24] Domestic output is based on receipts for prepackaged software applications published by the Census Bureau in the Service Annual Survey. Exports and imports of prepackaged software reflect exports and imports of goods and services (including royalties and license fees) published in BEA's

[24] For more information on prepackaged software and source data for historical estimates, see Parker and Grimm (2000).

International Transactions Accounts. Estimates for intermediate consumption include business purchases of software that are embedded in other equipment and/or software, and are primarily derived from information available from annual reports filed with the SEC by publically held software-producing companies. Finally, trade, taxes, transportation margins, and allocations of household and government purchases of prepackaged software are estimated using a variety of Census data, including class of customer, retail sales, and the Census of Government.

Table 1. Nominal Investment: Prepackaged Software, 2007

		[Billions of dollars]
	Domestic output (receipts)	126.9
plus	Imports	10.4
less	Exports	30.8
equals	Domestic supply	106.4
less	Household purchases	13.5
less	Government purchases	7.8
less	Intermediate Inputs (software included in other products)	21.9
plus	Trade, taxes and transportation margins	6.7
equals	Private fixed investment *	69.9

* These estimates do not necessarily equal published NIPA estimates due to statistical revisions in the source data that have not yet been incorporated in the NIPAs.

Price Index: Different methodologies are used to estimate the price index for prepackaged software in different time periods based primarily on availability of source data. Beginning with 1998, a Bureau of Labor Statistics (BLS) producer price index (PPI) for software applications is used to estimate the prepackaged software price index. For years 1994-97, BEA calculated its own matched-model price index for selected types of prepackaged software, including spreadsheets, databases, and word processors is used. For years 1985-93, a BEA hedonic price index for business applications software is combined with a matched-model price index. Prior to 1985, the price is extrapolated backward using the BEA price index for computers and peripheral equipment.[25]

[25] For more information on BEA's prepackaged software price index, see Grimm and Parker (2000).

Depreciation Schedule: Prepackaged software is assumed to depreciate very quickly, with an estimated service life of three years and a declining balance rate equal to 1.65. The resultant depreciation rate is 0.55 (declining balance rate divided by the service life). The service life is based on some indirect quantitative estimates of the relationships between computer expenditures and software expenditures, anecdotal evidence (including an informal survey of business use of software previously conducted by BEA) about how long software is used before it is replaced and tax-law-based lives of software. The declining balance rate is the default rate for equipment.

Category 2: Custom Software

Nominal Investment: Custom software is software tailored to the specifications of a business enterprise or government unit. It may include new computer programs as well as programs incorporating preexisting or standardized modules. Expenditures for custom software include those for the development (analysis, design, and programming) of software tailored to the business enterprise's or government unit's specifications. The expenditures include payments to free-lance computer software writers and to consulting organizations and individuals, who are not employees, who perform programming and systems analysis to support the development of software. It also includes expenditures on tailored software that is modified by providers of software or computerized equipment. The majority of producers of custom software are classified in NAICS 541511 (custom computer programming services).

Nominal investment is calculated using the commodity-flow technique (see section on prepackaged software for more information). Table 2 presents the commodity-flow estimates for 2007 for custom software. Sources of data for the commodity flow components vary over time – here we focus on data

used to estimate 2007.[26] Domestic output is based on receipts for custom software applications published by the Census Bureau in the Service Annual Survey. Exports and imports of custom software services are estimated from BEA's International Transactions Accounts' "other private services." Estimates for intermediate consumption include business purchases of custom software that are embedded in other equipment and/or software. There is no source data for these estimates and they are derived from the estimates of intermediate consumption of prepackaged software. Finally, trade, taxes, transportation margins, and allocations of government purchases (there are no household purchases) of custom software are estimated using a variety of Census data, including class of customer, and the Census of Government.

Table 2. Nominal Investment: Custom Software, 2007

		[Billions of dollars]
	Domestic output (receipts)	97.7
plus	Imports	7.0
less	Exports	3.4
equals	Domestic supply	101.3
less	Household purchases	0.0
less	Government purchases	15.6
less	Intermediate inputs (software included in other products)	6.9
plus	Trade, taxes and transportation margins	0.3
equals	Private fixed investment *	79.1

* These estimates do not necessarily equal published NIPA estimates due to statistical revisions in the source data that have not yet been incorporated in the NIPAs.

Price Index: The price index for custom software reflects a weighted average of an input-cost index (75%) and the prepackaged software price index (25%). The input-cost index consists of compensation rates for: computer programmers, systems analysts, and software engineers; combined with the intermediate inputs associated with producing software. Compensation rates are derived primarily from BLS occupational employment statistics (OES). The intermediate inputs component is a weighted

[26] For more information on prepackaged software and source data for historical estimates, see Parker and Grimm (2000).

average of BEA price indexes and PPIs for materials, electricity, communications, rent, maintenance and repair, depreciation, and administrative expenses. The input-cost index does not account for changes productivity, which seems unreasonable given the explosion of technological advances available to programmers and engineers for producing software. The prepackaged software price index does account for changes in productivity as it is a market-based price index. Furthermore, custom software consists of a mixture of new programming and existing programs or program modules, including prepackaged software, that are incorporated into final custom software applications. Therefore, the prepackaged software price index is combined with an input-cost based price index in order derive the price index for custom software.

Depreciation Schedule: Custom software is assumed to depreciate quickly, with an estimated service life of five years and a declining balance rate equal to 1.65. The resultant depreciation rate is 0.33 (declining balance rate divided by the service life). The service life is based on some indirect quantitative estimates of the relationships between computer expenditures and software expenditures, anecdotal evidence (including an informal survey of business use of software previously conducted by BEA) about how long software is used before it is replaced and tax-law-based lives of software. The declining balance rate is the default rate for equipment.

Category 3: Own-Account Software

Nominal Investment: Own-account software consists of in-house expenditures for new or significantly-enhanced software created by business enterprises or government units for their own use, including the development of software originals that are reproduced and licensed as prepackaged software. Because there are no market transactions for own-account software, nominal investment is

estimated by summing the costs of production, which include employee compensation–both wage and nonwage–and the costs of intermediate inputs.

Table 3 illustrates the computation of nominal investment for own-account software. Sources and methods used to calculate own-account software vary a bit over time – here we focus on source data and methods used to estimate 2007.[27] Using the BLS' occupational employment statistics, wages are derived by multiplying the number of programmers, software engineers and systems analysts in selected industries times the wage rate in those industries. Wages are reduced by subtracting the portion of wages of programmers, analysts, and engineers employed by the "computer systems design and related services industry" that represents the production of custom software for sale; sales of the custom software produced by this industry are already included in the PFI estimates of custom software. Total operating expenses are derived by multiplying wages by a consolidated "blow-up" factor of 2.02. This blow-up factor consists of two components: the first converts wages to compensation by accounting for nonwage compensation; the second converts compensation to total operating expenses by accounting for input costs. The estimates of nonwage compensation are based on relationships between wage and nonwage compensation derived from NIPA data by industry. The estimates of input costs are based on relationships between intermediate inputs and compensation that are derived primarily from the Census Bureau's economic census. Finally, total operating expenses are reduced by a factor of 0.5 to account for the fact that only part of programmers, analysts, and engineers' time is spent developing own-account software. Data on the proportion of time spent by programmers and systems analysts on the development of new software are based on a private study, reported by Barry Boehm, of the share of software development and maintenance costs in 487 business organizations.[28]

[27] For more information on own-account software and source data used for historical estimates, see Parker and Grimm (2000).

[28] Barry W. Boehm, Software Engineering Economics (Englewood Cliffs, NJ: Prentice-Hall, 1981): 533-35, 548-50.

Table 3. Nominal Investment: Own-Account Software, 2007					
[Billions of dollars]					
Occupation	**Wages**	**x 2.02**	**= Operating expenses**	**x 0.5**	**= Investment**
Computer programmers	17,459		35,267		17,633
Computer software engineers, applications	27,113		54,769		27,384
Computer software engineers, systems software	22,368		45,184		22,592
Computer systems analysts	24,299		49,084		24,542
Sum	**91,239**		**184,303**		**92,152**

Price Index: (Identical to the custom software price index.)

Depreciation Schedule: (Identical to the custom software depreciation schedule.)

Category 4: Theatrical Movies

Nominal Investment: The main dataset used in this paper is the Economic Census. According to the 2007 Economic Census, US movie studios earned $20 billion from domestic licensing rights, $6 billion from foreign licensing rights, $8 billion from selling DVDs and $3 billion from merchandise licensing. These categories don't correspond to individual products, but the 2002 Economic Census is much clearer. We use the 2002 numbers to calculate revenue by product in 2007. We estimate that movie studios earned $6.4 billion from licensing films to movie theaters, $2.3 billion from licensing films to video rental companies[29], $6.2 billion from DVD sales, $20.2 billion from television licensing and $3.0 billion from licensed merchandise (ex. Disney Princess napkins). These revenue numbers count exports of US movies abroad and exclude imports of foreign movies to US consumers. In total, theatrical movies earned $37.2 billion in 2007.

Movie studios have substantial non-artwork costs. BEA purchased a subscription to Kantar's 'Adspender' dataset to measure advertising. According to 'Adspender', movie studios spent $3.6 billion on advertising time in the US in 2007. We then estimated spending on foreign advertising and studio

[29] Studios typically sell the DVD to large chains for a small upfront price and a share of rental profits. This contract allows studios to price discriminate better (Mortimer 2007).

costs for producing the ad campaign.[30] In total, we estimate that marketing expenditures were $9.2 billion in 2007. In addition, printing film reels typically costs 10% of box office licensing, stamping DVDs cost 15% of DVD revenue and TV studio administration costs 1% of television licensing (Epstein 2005). We were not able to find any data on the physical costs for licensed merchandise. We will assume that physical costs are 4% of merchandising revenue. After subtracting these costs, movie studios received $26.9 billion in capital services from their films.

Movie studios have a significant capital stock of pre-existing movies. Even if new investment fell to zero, they would still earn significant licensing revenue for decades to come. The relationship between new investment and revenue depends on the individual movie product. Movie theaters almost always show new movies, but regular cable networks often show old movies. Based on box office data from the-numbers.com, we estimate that studios spend 95 cents on new investment for every dollar in box office net revenue (revenue after non-movie costs like advertising & sales). Based on survey data from Alexander and Associates, we estimate that studios spend 79 cents on new investment for every dollar of DVD net revenue. Finally, we use television viewership data from Nielsen to estimate that studios spend 59 cents on new investment for every dollar of television licensing revenue. We could not locate any dataset on merchandise licensing. We will assume that studios spent the weighted average amount, 72 cents, on new investment for every dollar of merchandise licensing revenue. These ratios are based on 2007 industry structure, and may not apply if the movie industry changes dramatically. We might choose to re-estimate the ratios in a future benchmark revision. But it would be too difficult to estimate them every year. Table 4 shows a simplified version of the calculations for 2007.

Table 4: Movie Investment from the 2007 Economic Census

	Licensing fees from movie theatres	6.4
	Licensing fees from DVD rental companies	2.3
	Licensing fees from television	20.2
	DVD Sales	6.2
	Licensing fees from merchandising	3
equals	Theatrical movies revenue	38.3
less	Advertising and overhead costs	9.2
less	Printing film reel costs (10% of theatre revenue)	0.6
less	TV administration costs (1% of TV revenue)	0.2
less	DVD stamping costs (15% DVD sales)	1.3
Less	Merchandise licensing costs (4% of merchandising)	0.1
equals	Adjusted film revenue	26.9
times	Ratio to convert revenue to production cost	70%
equals	Nominal Investment	18.7

[30] This includes actor time for promotional events, filming costs for ads and general studio overhead.

The calculations in Table 4 can be used to estimate annual movie investment going forward from 2007. For those estimates, we use the Service Annual Survey and benchmark it to the 2007 Economic Census. We use data from IMDB.com to calculate historical movie investment from 1915 to 2006. IMDB.com is a massive website that contains information on virtually all US movies since 1900. The complete data on IMDB.com is available for download by researchers. Among their other datasets, IMDB.com reports the filming dates and budgets for most major movies back to 1900.[31] Based on that data, we calculate real filming budgets for every year from 1915 to 2007. We then inflate the reals by the price index developed in the next section. More details on the IMDB data are given in: 'Theatrical Movies as a Capital Asset' (Soloveichik 2010).

Price Index: We use an input-based price index for theatrical movies. This input-based index is a weighted average of a BEA price index, and two BLS price indexes. We then adjust those inputs prices with BLS's estimate of multi-factor productivity (MFP) in the private non-farm business sector.

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. We 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. We will assume that performances in the live entertainment industry use similar inputs to live performances in the movie industry – so the prices should move similarly.[32] BEA's live entertainment price index is published in NIPA Table 2.4.4U, line 211. Before 1959, a broader price index is used that covers live entertainment, museums and sporting events. That price index is published in Table 2.4.4, line 77.

b) The second input for movies is video cameras to record and process the live performances. BLS has produced a PPI for video cameras used in the movie industry since 2007. The series ID for that

[31] Coverage is better after 1995, but historical data is also available. We impute missing movies.
[32] 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 We adjust for music concert prices.

PPI is PCU3333153333157. Going forward, we suggest that analysts use that PPI. For historical prices, we use a variety of price indexes. From 1977 to 2006, we use the BEA deflator for 'other video equipment'. That price index is given in Table 2.4.4U, line 40. From 1947 to 1976, we use the BLS PPI for 'audio and video equipment manufacturing'. The series ID for that PPI is PCU334310334310. For 1929 to 1946, we use the BEA deflator for 'audio, video & information processing equipment and media". That price index is given in Table 2.4.4, line 14. We then splice all of those time series together to get a price index for movie cameras from 1929 to 2009.

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. We suggest 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, we 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 budget for live action movies and 30% of the budget for animated movies. Of course, real computer prices have been plummeting since 2000. Therefore, real computer usage has increased from 2000 to 2010.[33] This includes supercomputers used to create special effects, computers used to edit raw footage and other digital enhancements.

d)Finally, we adjust all of those input prices for productivity growth in the movie industry. It is virtually impossible to measure the quality of a theatrical movie. Consumers' viewing experiences have definitely been improving with DVDs, plasma TV's and surround sound. But we believe that those quality improvements should be attributed to the electronics industry, not the movie industry. After all, studios often re-release old classics on DVDs. But there is no way to compare the artistic merit of 'Snow White and the Seven Dwarves' with 'Toy Story'.

We will assume that multi-factor productivity (MFP) in the movie industry grew at the same rate as MFP in the overall economy. In particular, we use the MFP for the private non-farm business sector. The BLS series ID for that time series is MPU491007. That time series runs from 1987 to 2010. The average growth rate for MFP is 1%. From 1929 to 1986, we don't have annual data on MFP growth. We

[33] These statistics are picked to match the IMDB price index described later. We do not have cost shares for movie studios. We assume that live performances have a larger cost share when computers are not used.

will assume that MFP grows at the average rate, 1%, for each year from 1929 to 1986.[34] We have also explored using labor productivity for research and development (R&D) to adjustment the input prices. Like entertainment, R&D is a creative industry with skilled workers as the main input. However, the MFP adjustment is much easier to implement. For now, we will use that in our movie price index.

BEA's price index for live entertainment is based on consumer prices. Therefore, it already incorporates MFP growth in the live entertainment industry. We would double-count technology progress if we used the full MFP factor to adjust input prices. Instead, we will adjust input prices by the weight for computers and video cameras. Both inputs are priced using the PPI, so MFP growth is not included implicitly. Table 5 shows prices for 1930, 1950, 1970, 1990 and 2005 to 2009:

Table 5: Movie Investment Prices from 2005 to 2009

	1930	1950	1970	1990	2005	2006	2007	2008	2009
BEA Price Index for Live Entertainment	5	7	20	58	100	104	108	110	112
BLS PPI for movie cameras	-	-	-	-	-	-	100	101	102
BLS PPI for 'other audio and video equipment'	-	-	-	110	132	132	132	132	132
BLS PPI for computers	-	-	-	1032	92	83	71	61	54
Movie Camera Price Index	119	113	82	84	100	100	100	101	102
Computer Price Index	-	-	-	1117	100	90	77	66	59
Weight for Movie Camera Prices	15%	15%	15%	15%	15%	15%	15%	15%	15%
Weight for Computers	0%	0%	0%	0%	15%	15%	15%	15%	15%
Price index for Inputs	10	14	33	81	100	101	102	101	100
Multi-factor Productivity	47	57	70	83	100	100	101	100	100
Weight for MFP	15%	15%	15%	15%	30%	30%	30%	30%	30%
Price Index for Completed Movies	11	15	35	83	100	101	101	101	100

The paper 'Theatrical Movies as a Capital Asset' (Soloveichik 2010) calculates a price index for inputs to theatrical movies a different way. In that paper, we used data from IMDB.com to measure the # of actors, # of non-actors, # of filming locations and # of special effects companies for every movie in IMDB's dataset.[35] IMDB also gives the nominal filming budget for a selected sample of movies. Based

[34] This probably underestimates MFP growth in the 1930's. The technology of theatrical movies was mostly invented by 1929. But it probably took a few years for directors to figure out how to shoot movies properly. In the paper "Theatrical Movies as a Capital Asset", we measured modern viewership for movies by year of release. We found that very few movies shot before 1935 are watched now. At the same time, many movies from the late 1930's are still being watched (Snow White, Wizard of Oz and Gone with the Wind). The low viewership cannot be explained by measurable inputs like number of actors or sound quality. This suggests that artistic quality needed time to develop.

[35] IMDB's data may miss some inputs. Major movies are more likely to be complete.

on the IMDB data, we calculated a price index for inputs to the movie industry. Over time, the price index from IMDB matches closely with the price index for inputs developed earlier. However, the price index from IMDB is extremely labor intensive to calculate. Furthermore, is very volatile from year to year. Therefore, we suggest the input-based index in the national accounts.

Depreciation Schedule: We use a simple geometric rate of 4.1% per year for modern movies. In an earlier paper, we calculated a very complex depreciation schedule. That complex depreciation schedule looks very different when it is graphed against a simple geometric rate of 4.1% per year. However, the simple and complex depreciation schedules produce very similar estimates of capital stock and consumption of fixed capital (CFC) in the national income and product accounts (NIPAs). Accordingly, we use the simple rate in this paper.

The changing technology for selling theatrical movies is a problem for our depreciation rates. In the 1930's, movie theaters were the only way to sell movies. The typical movie stayed in theaters for a couple of months and then disappeared. Movie studios could re-release old films, but those old films were a small share of revenue. Nowadays, movies also disappear quickly from theaters. But they live forever on DVD and cable television. Accordingly, the depreciation rate for theatrical movies is much lower now than it was in the 1930s. In our capital stock calculations, we assume that theatrical movies depreciated at 9.3% per year from 1929 to 1950. During the 1950's, the depreciation rate gradually decreases and settles at 4.1% per year in 1960.

Category 5: Television Programs

Nominal Investment for Long-Lived Programs: We are still working on this entertainment category. The numbers reported for 2007 investment are well researched and unlikely to change much in the final accounts. However, we are still in the process of analyzing the data needed to measure historical investment, price indexes and depreciation rates. Our estimates of current capital stock and may change significantly in the final accounts.

The main dataset used in this paper is the 2007 Economic Census. Unlike movies, television investment occurs in a number of industries. US television studios earned $8.1 billion from domestic television licensing, $2.5 billion from foreign television licensing, $2.1 billion from selling DVDs and $1.1 billion from licensed merchandise. Television broadcasters earned $32.1 billion from selling advertising

space, $0.4 billion from licensing their program and $1.8 billion from public funding and licensing. Finally, cable networks earned $21.9 billion from selling advertising space, $15.5 billion from licensing their programs to cable distributors and $1.8 billion from licensing their programs to broadcasters. The 2007 Economic Census does not break out export revenues for networks, but we estimate that for-profit broadcasters earned $0.8 billion from licensing their long-lived shows abroad and cable networks earned $2.1 billion from foreign licensing.[36] In total, US television stations and studios earned $90.2 billion in 2007. These revenue numbers count exports of US shows abroad and exclude imports of foreign shows.

Not all of the $90.2 billion in revenue comes from the new production of long-lived television programs. Many television stations license pre-existing shows from US television studios or foreign television stations. These licensed shows have already been counted when they were produced by television studios or they are out of scope because they are foreign. In order to avoid double-counting, we subtract estimated licensing payments to get the revenue for new television only. In addition, many television programs are short-lived. SNA 2008 recommends that only entertainment with a service life of more than one year should be treated as a capital asset. Dramas and sit-coms are frequently re-run more than one year after first release, so they qualify as an asset by this definition. In contrast, news programs, sporting events, game shows and soap operas are rarely re-run. Accordingly, those programs are too short-lived to be counted as a capital asset.[37] Finally, cable networks often show theatrical movies. The licensing revenue for those theatrical movies has already been counted in the movie industry.

In order to estimate the US production of long-lived television programming, BEA purchased a special dataset from Kantar Media. The Kantar data gives advertising revenue by program name, program genre and market type for every quarter from 1995 to 2010. The Kantar dataset does not track premium cable and public television because those market types do not have advertising. We purchased schedule information from Tribune Media Services and used that information to calculate the share of revenue attributable to long-lived US television programs for those channels.

Based on the Kantar data, we estimate that television networks earned $5.7 billion in revenue from foreign television shows and $7.0 billion in revenue from theatrical movies shown on television. We also estimate that long-lived US television programs account for approximately 50% of the

[36] We do not have good data on imports or exports of short-lived programming. However,US sports and news probably have a much smaller exports than long-lived programming.

[37] Even though individual episodes are short-lived, the game show format or soap opera storyline lasts a long time. Therefore, one might count the format as a capital asset. Sequel rights are not capitalized in this research.

remaining revenue. This revenue share has remained roughly constant from 1995 to 2010. We do not yet data have on genres before 1995. BEA purchased Nielsen viewership data back to the 1950's, but we have not yet had a chance to analyze it.

Like theatrical movies, television producers have non-artwork costs. Broadcast television stations must maintain their broadcasting facilities and sell ad space to businesses. Cable networks sell ad space and negotiate licensing fees with cable distributors. However, television stations spend very little cash on advertising. Instead, they use their own airtime to promote new shows.[38] Therefore, the television industry has much lower non-artwork costs than the movie industry. We are still researching the television industry, so we do not have a precise figure for non-artwork costs. For now, we assume that television studios spend 15% of DVD revenue and 4% of merchandise licensing revenue on physical sales costs. We also assume that television networks spend 25% of their revenue on physical costs like antennas and other non-television costs.

Television studios have a significant capital stock of pre-existing dramas, sitcoms and documentaries. Even if studios ceased new investment entirely, the pre-existing capital stock would still provide revenue for decades to come. Using data from IMDB.com, we estimate that studios spend 79 cents on new investment for every dollar in revenue they earn from licensing. This figure might change if the television industry has a strike or other disruption, but it likely to be relatively stable otherwise.

Table 6 shows a simplified version of the calculations for 2007. This table is designed to show the general ideas discussed here.

[38] When we calculate depreciation schedules, we adjust for the value of within-network promos. New shows typically get much more promo time than older shows, so upfront profits are much lower after adjustment.

Table 6: Television Investment from the 2007 Economic Census

NAICS 5121	Domestic licensing fees earned by US television studios	8.1
NAICS 5121	Foreign licensing fees earned by US television studios	2.5
NAICS 5121	DVD sales	2.1
NAICS 5121	Licensing fees from merchandising	1.1
NAICS 5151	Broadcast advertising	32.1
NAICS 5151	Licensing fees for broadcast programs	0.4
NAICS 5151	Estimated export revenue for long-lived broadcast programs	0.8
NAICS 5151	Donations and public funding for non-profit broadcast television	1.8
NAICS 5152	Cable Advertising	21.9
NAICS 5152	Licensing fees for cable programs to cable distributors	15.5
NAICS 5152	Licensing fees for cable programs to broadcast networks	1.8
NAICS 5152	Estimated export revenue for long-lived cable programs	2.1
equals	Total television revenue	90.2
less	Physical production like DVD stamping and administrative costs	18.2
less	Adjustment to remove licensing fees for US television already counted in another part of the television industry	10.3
less	Adjustment to remove licensing payments for imported television	5.5
less	Adjustment to remove cable movie revenue	5.8
equals	Adjusted TV program revenue	50.4
times	Ratio of short-lived US television to adjusted television revenue	52%
equals	Nominal production spending on short-lived programs	26.8
equals	Imputed licensing revenue from long-lived programs	23.6
Times	Ratio to convert long-lived revenue to long-lived production	79%
Equals	Nominal investment in long-lived television programs	18.6

Price Indexes: We suggest an input-based price index for television similar to the price index for theatrical movies. Like movies, the three main inputs for television programs are live entertainment services and photographic equipment. However, the weights assigned to each input are a little different. We assume that fiction television programs like sitcoms, dramas and television movies have fewer special effects, and therefore need less computers than theatrical movies. The price weights in our input mix are 78.5% live entertainment costs, 7.5% computers and 15% movie cameras. We also assume that non-fiction programs like documentaries or cooking shows spend less on labor services and more on movie cameras and computers. For example, many nature programs have no scripts or paid actors. Instead, they film animals for thousands of hours and the splice scenes together and add a voice-over to get a coherent plot. The precise weights in our input mix are 55% live entertainment, 15% computers and 30% movie cameras. We use Kantar genre, Nielsen viewership genre and other datasets to estimate the market share for fiction and non-fiction for every year from 1949 to 2010. Based on those assumptions, we calculate a weight for movie cameras and computers:

$$\text{Computer Weight in Year t} = 0.075*(\text{Fiction Market Share}_t)+0.15*(\text{Non-fiction Market Share}_t)$$

Movie Camera Weight in Year t = 0.15*(Fiction Market Share$_t$)+0.30*(Non-fiction Market Share$_t$)

Like theatrical movies, we use the multi-factor productivity (MFP) for the private non-farm business as a proxy for MFP growth in the television industry. Once again, we assume that live entertainment costs already include MFP growth, so we only adjust partially for MFP growth. Table 7 shows the various price indexes used and the overall television price index 2005-2009:

Table 7: Price Indexes for Long-Lived Television Investment 1930-2009

	1950	1970	1990	2005	2006	2007	2008	2009
BEA Price Index for Live Entertainment	7	19	58	100	104	108	110	112
BLS PPI for movie cameras	-	-	-	-	-	100	101	102
BLS PPI for 'other audio and video equipment'	-	-	110	132	132	132	132	132
BLS PPI for computers	-	-	1032	92	83	71	61	54
Movie Camera Price Index	130	103	151	100	96	92	90	90
Computer Price Index	1117	1117	1117	100	90	77	66	59
Non-Fiction Share	6%	6%	7%	14%	15%	17%	19%	18%
Weight for Movie Camera Prices	16%	16%	16%	17%	17%	18%	18%	18%
Weight for Computers	0%	0%	0%	9%	9%	9%	9%	9%
Price index for Inputs	13	31	79	100	101	102	102	102
Multi-factor Productivity	57	70	83	100	100	101	100	100
Weight for MFP	16%	16%	16%	26%	26%	26%	27%	27%
Price Index for Television	14	32	81	100	101	102	102	102

The index shown in Table 7 is preliminary and may change significantly in the final accounts.

Depreciation Schedules: We are still in the process of calculating the depreciation schedule for television. Based on our work so far, we estimate a depreciation rate of 9.3% per year on television. We will use that rate until we complete our research.

Category 3: Books

Nominal Investment: Authors typically keep legal ownership of their copyrighted books, so it might seem that we should only count author royalties when valuing books. In practice, publishers provide expensive inputs like editing, formatting and cover art. In return, publishers get long-term distribution contracts with a fixed royalty rate. If a book is successful, the publishers make large profits from the

distribution contract. From an economic standpoint, these long-term contracts give partial ownership of the book to the publishers. Therefore, we believe that BEA should count both publisher profits and author royalties when valuing books.

The main dataset used in this paper is the 2007 Economic Census. In 2007, US publishers earned $26.1 billion from book sales. The Economic Census does not break down that revenue by category, but the Service Annual Survey (SAS) does. Based on the 2007 SAS, publishers sold $23.8 billion of printed books, $1.1 billion of digital books and $1.2 billion of audio books. In addition, US magazine publishers earned $41.8 billion from the sale of magazines. We estimate that 1.4% of that magazine revenue was for books licensed to magazines for serial publication. Therefore, total revenue for books was $26.7 billion in 2007.[39] We have not been able to find reliable data on foreign book sales by US authors or US book sales by foreign authors. For simplicity, we will assume that imports and exports cancel out.

Authors and publishers have significant non-artwork costs. The American Association of Publishers (AAP) generously shared their survey data with BEA. Based on their survey data, we calculate that marketing accounts for 19% of publisher revenue and printing accounts for 45% of revenue. This survey data focuses on printed books, so it does not apply to digital books and audio books. Our initial research was conducted in 2009 and focused on sales data up to 2007. At that time, audio books and digital books were a relatively small share of the book industry. Because they were so small, we did not study them in detail.

Digital book sales have been growing rapidly over the past few years. By now, Amazon sells more digital books than paper books. Therefore, BEA might choose to measure writing costs and marketing costs for digital books in more detail later on. This decision depends on the market share for digital books and the time available for research. For now, we assume that audio books have the same stamping costs as music CD's and digital books have the same downloading costs as music downloads.[40] This works out to CD stamping costs of 20% for audio books and 2% for digital books (versus printing costs of 45%).[41] We will also assume that these ratios have been constant from 1929 to 2009. Going forward, BEA can choose to keep these physical cost estimates or update them with new data.

[39] We believe that this $26.7 billion in revenue is **net** revenue, i.e. sales after returns, discounts and allowances. However, the actual questionnaire is very confusing and some publishers may have reported **gross** revenue. If that is the case, then we are overestimate total output for the book industry and total entertainment revenue. We are currently investigating further. This may also change revenue numbers for other copyrighted products.
[40] We count recording costs such as author reading time & sound effects in book investment.
[41] We assume audio books have a wholesale price of $10 and digital books have a wholesale price of $9.

Publishers and authors have a significant capital stock of pre-existing book manuscripts. Based on sales data from Nielsen Bookscan, We estimate that publishers and authors spend 58 cents writing new books for every dollar in net book revenue (revenue after non-music costs like advertising & sales). In the past two years, new book sales and classic book sales have dropped by approximately the same margin. Therefore, the ratio of new investment to revenue is roughly constant over the business cycle.

Table 8 shows a simplified version of the calculations for 2007. This table is designed to show the general ideas discussed here.

Table 8: Book Investment from the 2007 Economic Census and 2007 SAS

	Domestic sales of printed books (including imported books)	23.8
	Domestic sales of audio books (including imported books)	1.2
	Domestic sales of digital books (including imported books)	1.1
	Domestic sales of books licensed to magazines	0.6
less	Imported books (20% of domestic book sales)	5.3
plus	Exported books (assumed to equal imports)	5.3
equals	Sales of domestically produced books	26.7
less	Marketing costs (19% of revenue)	5.1
less	Printing costs (42% of revenue)	10.9
equals	Adjusted book revenue	10.4
times	Ratio to convert revenue to production cost	58%
equals	Nominal Investment	6.0

Going forward, digital books may present serious measurement problems. Amazon has recently started a program where authors can sell digital books directly to consumers. In addition, some authors have started posting book chapters on their websites and charging readers per chapter. These unconventional books are part of the market sector, so they should be counted in GDP along with traditional books. However, the SAS might not be able to track books sold outside the traditional publishing industry. If unconventional books grow to a large share of the market, BEA might need to use alternative data sources to measure them.

Price Indexes: We suggest the BLS's producer price index (PPI) for book publishers. That price index is available on the BLS's website with a series ID PCU51113-51113. That PPI started in 1984. Before then, we use BEA's consumer price index for recreational books (Table 2.4.4, line 17) and consumer price index for educational books (Table 2.4.4, line 22). Unlike movies and television, this price index is not based on input costs. Therefore,we do not need to adjust for multi-factor productivity growth.

It is important to note that the BLS PPI for book publishers has risen much faster than the consumer price index for books. We believe that the difference is driven by improvements in the retail sector over the past few decades. Thirty years ago, most books were sold by small book stores. Nowadays, most books are sold by chain book stores or online. Those channels have lower average prices.[42] Going forward, we might need to revise our price index to account for digital books properly. However, that is a project for the next comprehensive revision.

Depreciation Schedules: We use a geometric rate of 17.3% per year. Like theatrical movies, books have a very complex depreciation rate. But the complex depreciation rate yields similar estimates of capital stock and consumption of fixed capital than a geometric rate of 17.3% per year. For simplicity, we will use a geometric rate in our calculations.

Category 4: Music

Nominal Investment: Like books, musicians typically keep legal ownership of their copyrights but sign long-term distribution contracts for their CD's. We will count both musician royalties and recording studio profits when valuing CD sales.

The main dataset used in this paper is the 2007 Economic Census. In 2007, US recording studios earned $8.4 billion from CD's, legal downloads and other music sales; US rights organizations collected $2.3 billion from royalties[43]; US musical groups earned $2.9 billion from live concerts[44]; and US publishers earned $0.3 billion from printed sheet music. US musical groups frequently perform abroad and non-US groups perform in the US – so the ticket sales are adjusted for imports and exports already. However, CD sales, royalties and printed sheet music are not adjusted. Based on Billboard charts for the US and IFPI charts for Europe, we calculate that US musicians earned $9.2 billion from CD sales worldwide, $2.2 billion from royalties worldwide and $0.4 billion from printed music worldwide. In total, US musicians and recording studios earned $14.6 billion in 2007.

[42] The mismatch between the two price indexes suggests that BEA's price indexes might not be a reliable proxy for historical PPI's. As a robustness check, we also experimented using Census of Manufacturers data to calculate a wholesale price index. We found that matched reasonably well, but the Census of Manufacturers was more volatile.
[43] We do not count royalties paid by television or movie studios to use a song in their new shows. The value of those songs has already been counted in the movie industry. Conversely, we count movie soundtracks sold on CD or played on the radio in music.
[44] This only includes popular music concerts. We count symphony orchestra in live theater.

We use industry datasets to estimate annual music revenue. The Recording Industry Association of America (RIAA) provides CD sales back to the 1970's. The Service Annual Survey gives printed music sales for certain years. We use annual reports from the two major music licensing organizations, ASCAP and BMI, to estimate music royalties back to the 1980's. We use data from Pollstar.com to track live music concerts back to the 1980's. Before those datasets are available, we use a variety of industry sources to estimate annual revenue back to 1929.

The cost structure for selling purchased music is complex. Over the past few years, consumers have been switching from physical CD's to downloaded files. Based on information from RIAA, we calculate that non-music costs account for approximately 15% of the wholesale price for both CD albums and downloaded singles. The higher physical cost for CD albums is canceled out by the greater number of songs on an album. Accordingly, the switch to digital music does not affect sales costs significantly. In contrast, earlier technological change had much larger impacts. In 1929, recorded music cost approximately $1 per song – about the same price as now. However, we calculate that 70% of that price was spent on the physical disk versus 15% now. Therefore, net music revenue has risen much faster than wholesale revenue for purchased music.

We have less data on other non-artwork costs. Based on the industry literature, we estimate that marketing accounts for about one third of CD sales, royalties and music books.[45] Most live concert organizations pay for marketing themselves and then hire the performers. Therefore, marketing is only 11% of live concert revenue. We also estimate that printing accounts for 30% of sheet music sales. The other non-artwork cost for royalties is administering the rights organizations which collect the money. Based on ASCAP and BMI's annual reports, we estimate that administration accounts for about 10% of sales. The other non-artwork cost for live music concerts are the physical costs of travel and set-up. However, these costs are covered by subsidiary revenue (like T-shirt sales), so the 0% of live concert revenue goes to physical costs (Krueger 2005).

Recording studios and musicians have a significant capital stock of pre-existing songs. The relationship between new investment and revenue depends on the individual music product. CD's typically contain new music, but broadcast songs are often very old.[46] We use Billboard's top 250 charts to estimate the lifespan for CD albums. Based on that data, we estimate that musicians and recording studios spend 92 cents on new investment for every dollar in CD net revenue (revenue after non-music costs like advertising & sales). We use data from sheetmusic.com to estimate the lifespan for printed

[45] The industry literature does not give a single %. Instead, we found typical marketing budgets for successful and unsuccessful CD's. We used our best judgment to get an average marketing budget.
[46] CD's are a durable good, so people may be listening to old CD's they purchased previously.

music. Based on that data, we estimate that musicians spend 42 cents on new investment for every dollar of printed music net revenue. We use data from MusicMonitor, a private dataset produced by MediaGuide, and tunefinder.com to estimate the lifespan for broadcast music. Based on that data, we estimate that musicians spend 49 cents on new investment for every dollar of broadcast royalties. Finally, we use data from Setlist.com to estimate the lifespan for live concert songs. Based on that data, we estimate musicians spent 74 cents on new investment for every dollar of live concert net revenue.

Table 9 shows a simplified version of the calculations for 2007. This table is designed to show the general ideas discussed here.

Table 9: Music Investment from the 2007 Economic Census

	Music sales (CDs, legal downloads, etc.)	8.4
	Royalties	2.3
	Live concert revenue	2.9
	Printed sheet music	0.3
	Adjustment for exports and imports	0.3
equals	Musician and recording studio revenue	14.6
less	Marketing for CD's, royalties and printed music (33% of rev.)	3.9
less	Marketing live concerts (11% of revenue)	0.3
less	CD stamping costs (12% of CD sales)	1.1
less	Administrative costs (10% of royalties)	0.2
less	Printing costs (31% of printed music)	0.1
equals	Adjusted musician & recording studio revenue	9.1
times	Ratio to convert revenue to production cost	80%
equals	Nominal Investment	7.2

Price Indexes: We use a consumer based price index for music. The paper 'Music as a Capital Asset' (Soloveichik 2010) calculates three separate consumer price indexes for music: one for recorded music, one for printed music and one for live concerts. We also calculate an implicit consumer price index for broadcast music. That price index treats advertising as a 'cost' that listeners pay for radio music. The paper goes to a great deal of effort to strip out non-music costs from the sale price for each item to get a price index for the underlying music.

We plan a simpler price index going forward. We will use BEA's pre-existing price index for PCE music purchases as a proxy for purchased music and print music prices. BEA's price index is given in Table 2.4.4U, line 43. We will use BEA's price deflator for live entertainment as a proxy for live concert prices and broadcast music prices. That price index is given in Table 2.4.4U, line 211. The combined

price index is a weighted average of the two consumer price indexes. Table 10 calculates our simplified consumer price index for 1930, 1950, 1970, 1990 and 2005 to 2009.

Table 10: Music Investment Prices from 2005 to 2009

	1930	1950	1970	1990	2005	2006	2007	2008	2009
Price Index for Live Music Concerts	5	7	20	58	100	104	108	110	112
Price Index for CD's, downloads, etc.	49	54	77	101	100	98	96	94	90
Market Share for Broadcast Music	4%	9%	4%	5%	7%	7%	8%	10%	11%
Market Share for Live Music Concerts	37%	32%	9%	15%	17%	25%	26%	32%	33%
Weight for CD Prices	59%	60%	87%	79%	76%	68%	66%	58%	56%
Simplified Consumer Price Index	18	24	65	90	100	100	99	99	97
Full Consumer Price Index	6	13	23	61	100	97	99	98	100

The results for the simplified consumer price index are mixed. From 1995 to 2009, it tracks the full consumer price index very closely. However, the two indexes diverge widely before then. The difference comes from how the two indexes handle tape cassettes. When CD's were first introduced, they were priced about $2 more than tape cassettes. The higher price for CD's was not justified by differences in manufacturing cost - instead studios just had higher margins on CD's. Consumers were willing to accept the higher prices because CD's offer better sound quality.[47] However, we view that better sound quality as part of the electronic industry, and therefore subtract it from music out.[48] Therefore, we treat the switch from tape cassettes to CD's as a price increase for music. In contrast, the BLS treats tape cassettes and CD's as separate product. Accordingly, the higher price for CD's is not counted as a price increase. This disagreement is conceptually similar to the problem of outlet substitution bias studied by Marshall Reinsdorf (1993).

Recording studios charge a lower price for downloaded music than for CD's, but the price difference is almost precisely equal to the physical cost of CD's. Therefore, the cost per song is almost identical for the two products. Going forward, a consumer switch from CD's to digital music will not bias the simplified price index. However, we use the full consumer price index for historical prices.

[47] Of course, it is extremely difficult to distinguish between electronics quality and inherent artistic quality.
[48] Albums have the same physical product as singles, the only difference is that albums have more music. If CD's were really more expensive to manufacture, then we should see CD singles sold at a much higher price than tape singles. In fact, they sold for similar prices. The paper 'Music as a Capital Asset' has more details.

Depreciation Schedules: We suggest a simple geometric rate of 15.5% per year. Like the other entertainment categories, we have estimated a very complex depreciation schedule (Soloveichik 2011). This complex depreciation schedule produces very similar numbers as the simple rate.

Category 5: Miscellaneous Entertainment

This category includes three types of long-lived entertainment: theatrical play scripts, greeting card designs and commercial stock photography. We will discuss each category briefly.

Nominal Investment:

Live Theater: In the 2007 Economic Census, US performing arts groups and independent artists[49] earned $7.5 billion from ticket sales and donations. They also earned $2.3 billion from contract fees for performances. Based on price data from BroadwayLeague.com, we estimated that copyrighted plays pay an estimated 12 percent of their ticket sales and donations and 18 percent of their performance fees in royalties for the script.[50] We also used data from BroadwayLeague.com to estimate the lifespan for play scripts. Based on that lifespan, we calculate that playwrights spend an estimated 68 cents to write new plays for every dollar of licensing revenue. Therefore, investment was $1.2 billion in 2007.

Greeting Cards: In the 2007 Economic Census, US publishing companies sold $4.5 billion worth of greeting cards in 2007. According to the industry literature, copyrighted designs accounts for about 15% of the wholesale value of a greeting card (Smith 1998). We were not able to locate any data on the lifespan for greeting card designs. For now, we will assume they have the same lifespan as books. According, we calculate that greeting card publishers reinvested 58% of that revenue designing new cards. Therefore, we calculate that copyrighted designs earned $0.4 billion in 2007.

Stock Photography: In 2007 Economic Census, US photography agencies licensed $1.6 billion worth of photos to advertisers and other commercials clients. This includes exports abroad and excludes imports from foreign photographers. Based on the industry literature, copyrighted photographs account for about 75% of that revenue. We used data from iStockphoto.com to estimate the lifespan for individual

[49] This does not count popular music concerts, which are already in music.
[50] Ticket prices include payments to the play company, theater house and sometimes the promoter. Only a portion of that revenue is counted in the $9.8 billion. Ticket prices for Shakespeare and other plays off copyrighted are 5%-10% lower. Assuming that non-script costs are identical for Shakespeare plays, we calculate that performing art groups earn 25% less on Shakespeare plays.

pictures. Based on that lifespan, we calculate that photographers reinvest 60% of their licensing revenue shooting new pictures. Therefore, we calculate that US photographers spent $0.7 billion creating commercial pictures in 2007.

Table 11 shows a simplified version of the calculations for 2007. This table is designed to show the general ideas discussed here.

Table 11: Miscellaneous Entertainment from 2007 Economic Census

Scripts for Live Theatre		
	Ticket sales and donations	7.5
less	Marketing costs (33% of revenue)	2.5
Plus	Performance fees	2.3
less	Actor wages, theatre costs, and other necessary costs (82% of net revenue)	8.0
equals	Revenue for long-lived scripts	1.8
times	Ratio to convert revenue to production cost	68%
equals	Nominal Investment	1.2
Greeting Card Designs		
	Publishers sales of greeting card	4.5
times	Ratio to convert sales to copyright design revenue	0.15
equals	Copyright design revenue	0.7
times	Ratio to convert revenue to production cost	58%
equals	Nominal Investment	0.4
Commercial Stock Photography		
	Licensing fees	1.6
times	Ratio to convert licensing fees to copyright revenue	75%
equals	Copyright revenue	1.2
times	Ratio to convert revenue to production cost	60%
equals	Nominal Investment	0.7

Price Index:

Live Theater: We suggest the consumer price index for live theater. That price index is published in Table 2.4.4U, line 211.[51]

Greeting Card Designs: We suggest BLS's PPI for greeting card publishers. That price index is available on BLS's website. The series ID is PCU 511191511191.

[51] Between 1995 and 2005, prices for live music concerts rose much faster than the overall live entertainment index. This inflation appears to have been caused by music piracy (Krueger 2005). For historical price indexes, we will adjust the live entertainment index for the popular music concerts. However, the two indexes have tracked reasonably closely in the past few years. Therefore, we do not think an adjustment is worth analyst time and trouble.

Stock Photography: We suggest the consumer price index for photo studios. That price index is published in Table 2.4.4U, line 217.

All of these price indexes are based on consumer costs rather than input costs. Therefore, there is no need for MFP adjustment.

$$\text{Live Theater Weight in Year t} = (\text{Live Theater Investment}_t)/(\text{Total Miscellaneous Investment}_t)$$

$$\text{Greeting Card Design Weight in Year t} = (\text{Greeting Card Investment}_t)/(\text{Total Miscellaneous Investment}_t)$$

$$\text{Stock Photography in Year t} = (\text{Stock Photo Investment}_t)/(\text{Total Miscellaneous Investment}_t)$$

$$\text{Price Index}_t=(\text{Live Theater Price}_t)^{\text{Theater Weight t}}*(\text{Card Price}_t)^{\text{Card Weight t}}*(\text{Photo Price}_t)^{\text{Photo Weight t}}$$

Depreciation Schedule: We suggest a 9.8% geometric depreciation rate. Aggregate capital stock is very similar if we use three separate geometric rates, one for each category of miscellaneous entertainment. It is also similar if we use three separate complex depreciation rates (Soloveichik 2011).

Category 9: Short-Lived Entertainment Products

This category includes five types of entertainment: newspapers, magazines, short-lived television, radio and internet broadcasting. It is possible that there are small categories of short-lived entertainment we do not study. BEA's main interest is in long-lived entertainment products, so we could not devote much time to this topic. We will discuss each category briefly.

Category 9.1: Newspapers

Nominal Production: In the 2007 Economic Census, US newspaper publishers earned $9.8 billion from consumer sales and $34.6 billion from advertisers. We have no data on writing costs as a share of revenue. We will assume that newspapers have costs similar to books. In other words, marketing accounts for about 19% of revenue. Just like books, we assume that physical costs depend on the media. Printing, delivery and customer service account for 45% of printed revenue, 20% of other media revenue and 2% of online revenue. Newspaper articles are short-lived assets, so nominal production is identical to nominal revenue. Therefore, we calculate the newspaper publishers spent $16.0 billion writing articles in 2007.

We use a variety of datasets to measure revenue 1929-2009. From 2005 to 2009, we use the Service Annual Survey to get newspaper revenue. Before then, the 2004 Service Annual Survey, 2001 Service Annual Survey, 1997 Economic Census, 1992 Economic Census and the 1935, 1939, 1947, 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987 and 1992 Census of Manufacturers give newspaper revenue for the years tracked. We interpolate to fill in the missing data and benchmark to the Economic Census.

Price Indexes: BEA's main price index is taken from the BLS producer price index (PPI) for newspaper publishers. This price index runs from 1979 to 2009. Before then, we use the book price index

described earlier. As a robustness check, we also calculated a quality-adjusted newspaper price from the Census of Manufacturers. This price index had similar trends, but was much jumpier.

Depreciation Schedule: Newspaper articles are too short-lived to be considered capital.

Category 9.2: Magazines

Nominal Production: In the 2007 Economic Census, US magazine publishers earned $19.6 billion from consumer sales and $22.1 billion from advertisers. Out of this $41.8 billion, $0.6 billion is books licensed for serial publication in magazines, so it is already counted in the book industry. Just like books, we assume that physical costs depend on the media. Printing, delivery and customer service account for 45% of printed revenue, 20% of other media revenue and 2% of online revenue. Magazines articles are short-lived assets, so nominal revenue is equal to nominal production. Therefore, we calculate that magazine publishers spent $14.8 billion writing articles in 2007.

We use a variety of datasets to measure revenue 1929-2009. From 2005 to 2009, we use the Service Annual Survey. Before then, the 2004 Service Annual Survey, 2001 Service Annual Survey, 1997 Economic Census, 1992 Economic Census and the 1935, 1939, 1947, 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987 and 1992 Census of Manufacturers give magazine revenue for the years tracked. We interpolate to fill in the missing data and benchmark our estimates to the 2007 Economic Census. Finally, we subtract fiction magazines publishing book chapters because those chapters are already counted in the book industry.

Price Index: BEA's price index is taken from the BLS's PPI for periodical publishers. This price index runs from 1980 to 2009. Before then, we use the book price index described earlier.

Depreciation Schedule: Magazine articles are too short-lived to be considered capital.

Category 9.3: Radio Programs

Nominal Production: In the 2007 Economic Census, radio broadcasters earned $17.2 billion from advertising and received $1.1 billion in donations for public programming.[52] We have no data on non-artistic costs, so we use the same 25% non-artwork share that we assumed earlier for television. We also subtract the $1.1 billion that radio programs spend licensing music because that spending has already been counted in the music industry. Radio programs are short-lived assets, so nominal revenue is equal to nominal production. Therefore, we calculate that US producers spent $12.6 billion producing new radio shows in 2007.

We use a variety of datasets to measure revenue 1929 to 2009. From 2005 to 2009, the Service Annual Survey reports annual sales. Before then, CS data on advertising (Galbi 2008) gives annual radio advertising. Finally, we benchmark all of the time series data to the 2007 Economic Census.

Price Indexes: BEA's main price index is taken from the BLS's PPI for radio broadcasters. This price index runs from 1989 to 2009. Before then, we use the live entertainment price index, which is described earlier.

Depreciation Schedule: Radio shows are too short-lived to be considered capital.

Category 9.4: Short-Lived Television Programs

Nominal Production: We use the same data described earlier for long-lived television programs. The only difference is that we track short-lived genres like news and sports instead. Based on the Kantar data we estimate the short-lived US television programs are responsible for 30% of total television revenue. This is approximately the same as the 29% revenue share for long-lived programs estimated

[52] There is a small subscription radio industry, but the Economic Census does not report it separately. It may be counted in the same line as public radio donations.

earlier. The remaining 43% of revenue is spent on theatrical movies (~7%), imported television (~6%), licensed US television already counted elsewhere (~11%), licensed music already counted in the music industry (~2%) and physical costs like broadcast towers (~16%). All of these costs are subtracted from television revenue when calculating the value of short-lived programs. For short-lived television programs, nominal revenue is equal to nominal production. Accordingly, we calculate that US studios and networks spent $26.8 billion producing new short-lived television in 2007.

Price Indexes: For now, we use the same price index as long-lived television. In future work, we hope to determine which short-lived television genres have costs similar to long-lived fiction television and which short-lived television genres have costs similar to long-lived non-fiction. We will then use Kantar's genre breakdowns to produce a more precise price index for short-lived television.

Depreciation Schedule: Radio shows are too short-lived to be considered capital.

Category 9.5: Internet Broadcasting and Publishing

Nominal Production: In the 2007 Economic Census, companies in the category "other information services" (NAICS Code 5191) earned a total of $11.2 billion from subscriptions and sales: $0.04 billion from print media, $10.3 billion from Internet publishing and $0.9 billion from electronic media publishing. Companies in that category also earned $19.1 billion from Internet advertising and $0.1 billion from advertising on electronic media. We have no data on non-artistic costs, so we use the same 25% non-artwork share that we assumed earlier for television. We assume that all the websites created in this category are short-lived assets, so nominal revenue is equal to nominal production. Therefore, we calculate that Internet publishers spent US producers spent $22.8 billion producing new Internet content in 2007.

From 2005 to 2009, the Service Annual Survey reports annual revenue for the Internet publishing industry (NAICS 516). The numbers in the SAS show revenue in 2007 only half as large as the 2007 Economic Census. This discrepancy may be caused by a different definition of the industry or it could be caused by sampling factors. Despite the discrepancy, we will still use the SAS to estimate Internet broadcasting from 2005 to 2009. Before 2005, we use the 2002 Economic Census. We could not find any data before 2002. However, the average annual growth rate from 2002 to 2007 was 17.5% per year. We use that growth rate to backcast annual revenue from 1990 to 2002. Before 1990, we assume that the industry did not exist.

Price Indexes: We use the price index for long-lived television described earlier.

Depreciation Schedule: Internet publishing is too short-lived to be considered capital.

Appendix B: Method for Estimating Capital Stock of IPP

BEA's capital stock estimates are primarily estimated using the perpetual inventory method (PIM). Using the PIM, volume (i.e., quantity) measures of net stock are calculated by detailed asset-type as the cumulative value of fixed investment through that year less the cumulative value of depreciation through that year less other changes in volume:

$$K_{jt} = K_{j(t-1)}*(1-r_j) + I_{jt}*(1-r_j/2) - O_{jt}$$

Where:

K_{jt} = net stock for year *t* for type of asset *j*

r_j = depreciation rate for type of asset *j*

I_{jt} = investment for year *t* for type of asset *j*

O_{jt} = other changes in volume for year *t* for type of asset *j*

Current-cost (a.ka. replacement-cost) estimates of the net stock of asset *j* are obtained by multiplying the quantity of net stock at the end of year *t* for asset *j* by the end-of-year price index that was used to deflate nominal investment in asset *j*. For most types of assets, BEA's estimates of depreciation are based on geometric depreciation patterns, which are supported by empirical studies of the prices of used equipment and structures in resale markets. Depreciation rates are computed as the declining balance rate divided by the assumed service life. For most nonresidential equipment categories, the declining balance rate is estimated to be 1.65.

Figure 1: Fixed Investment in Software Relative to GDP

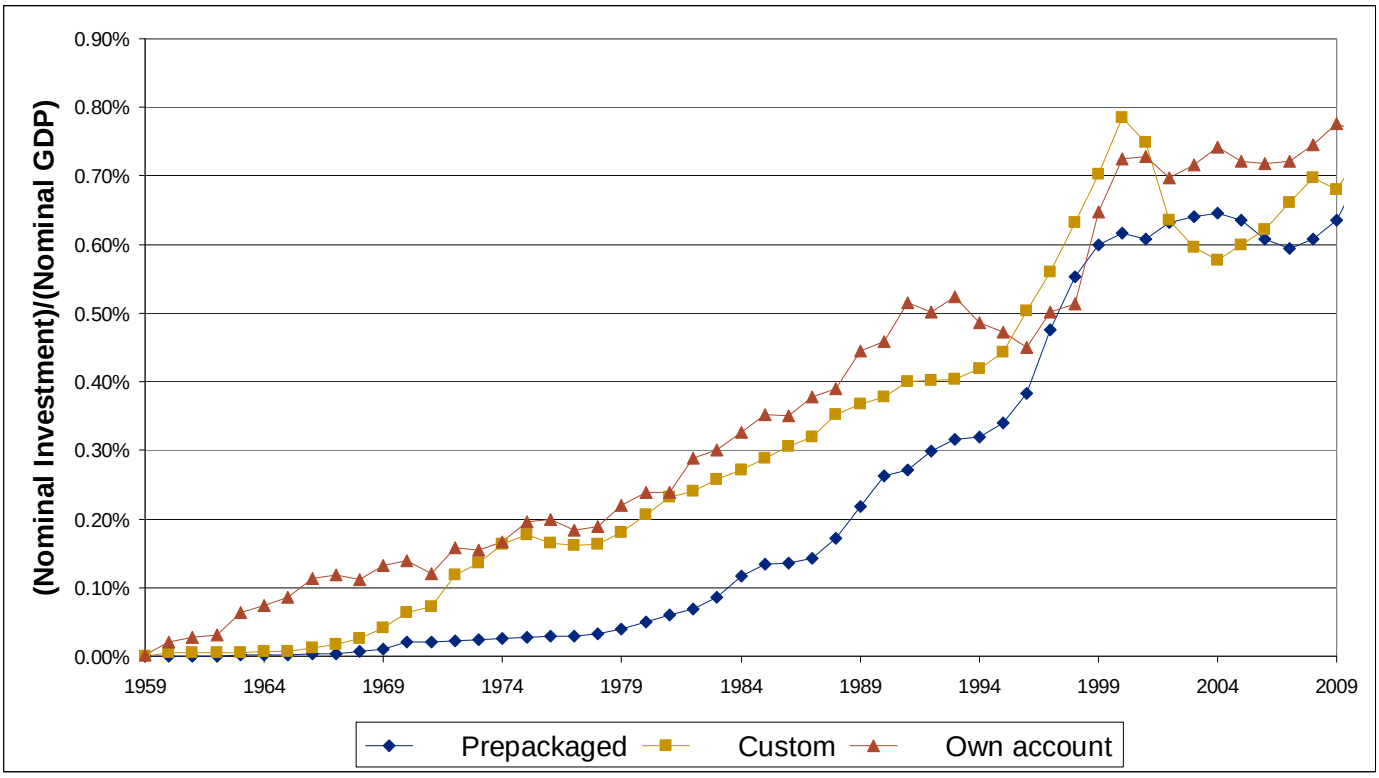

Figure 2: Annual Growth Rates for Investment in Software & Computers and Communications Equipment

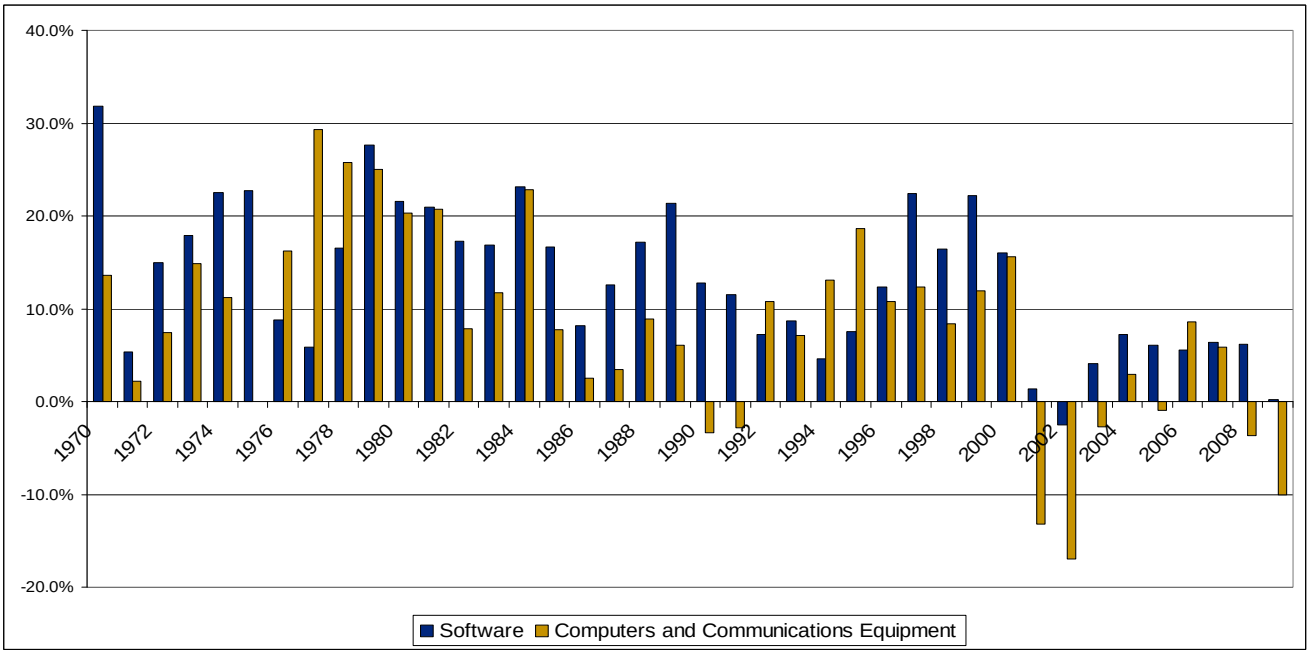

Figure 3: Long-Lived Entertainment Relative to GDP

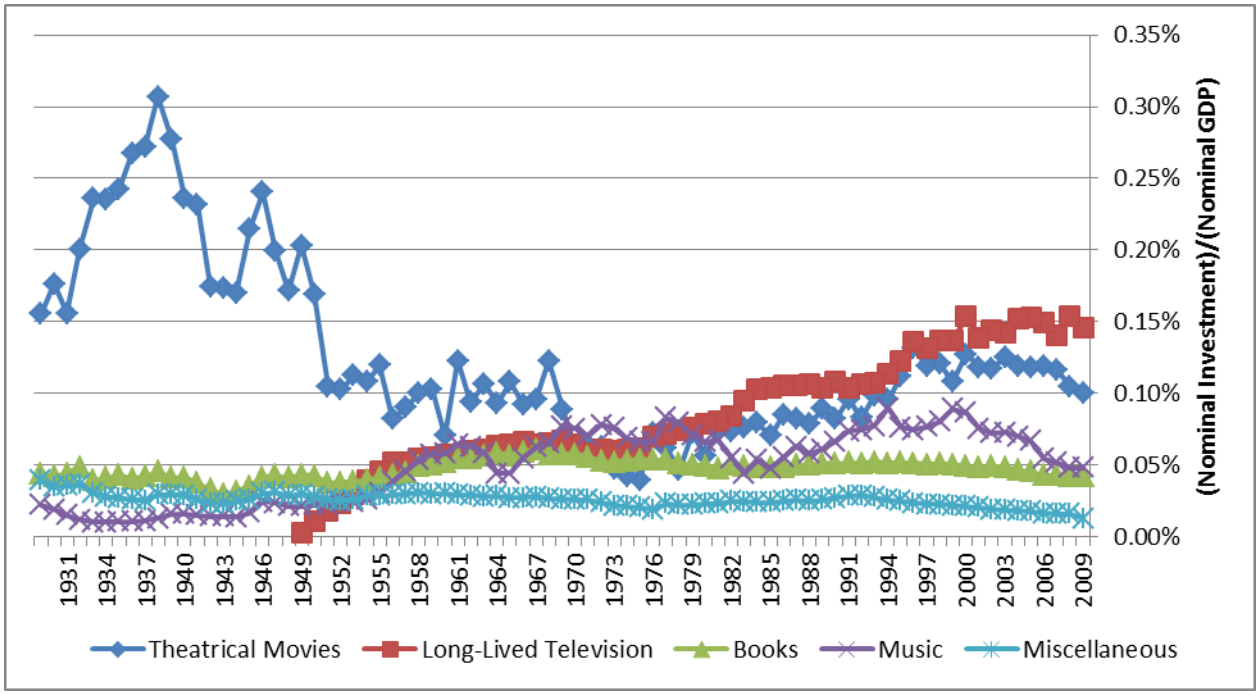

Figure 4: Short-Lived Entertainment Relative to GDP

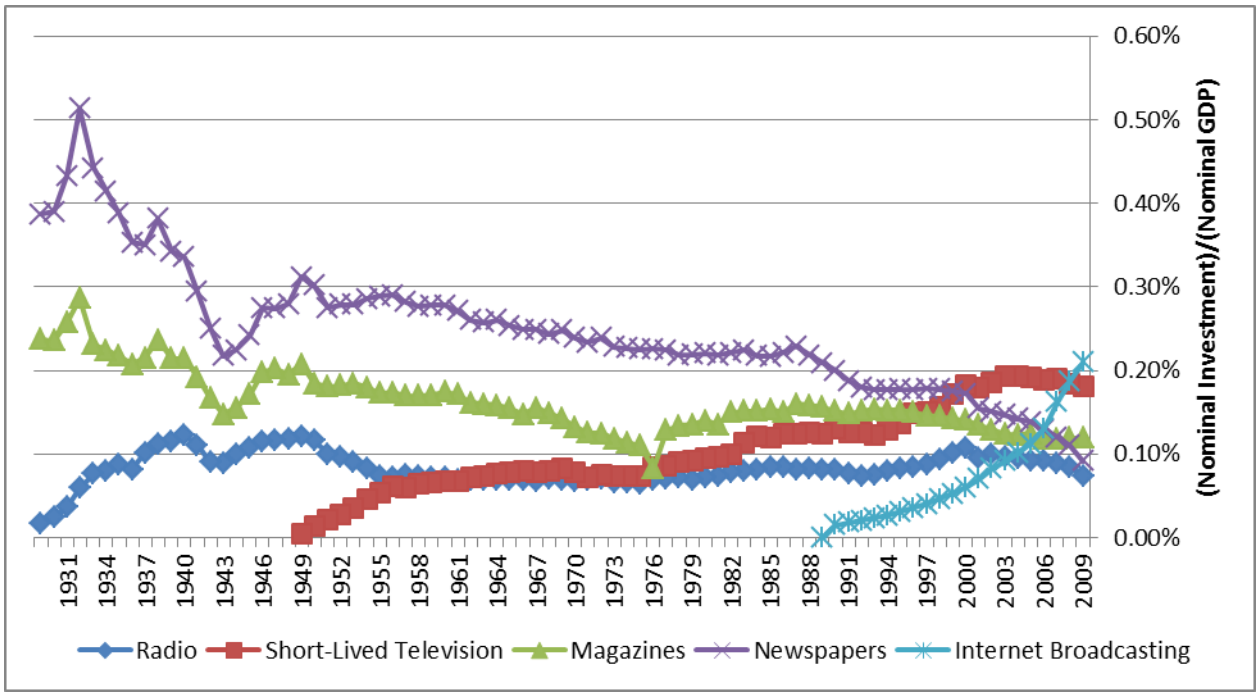

Figure 5: Software Prices by Category

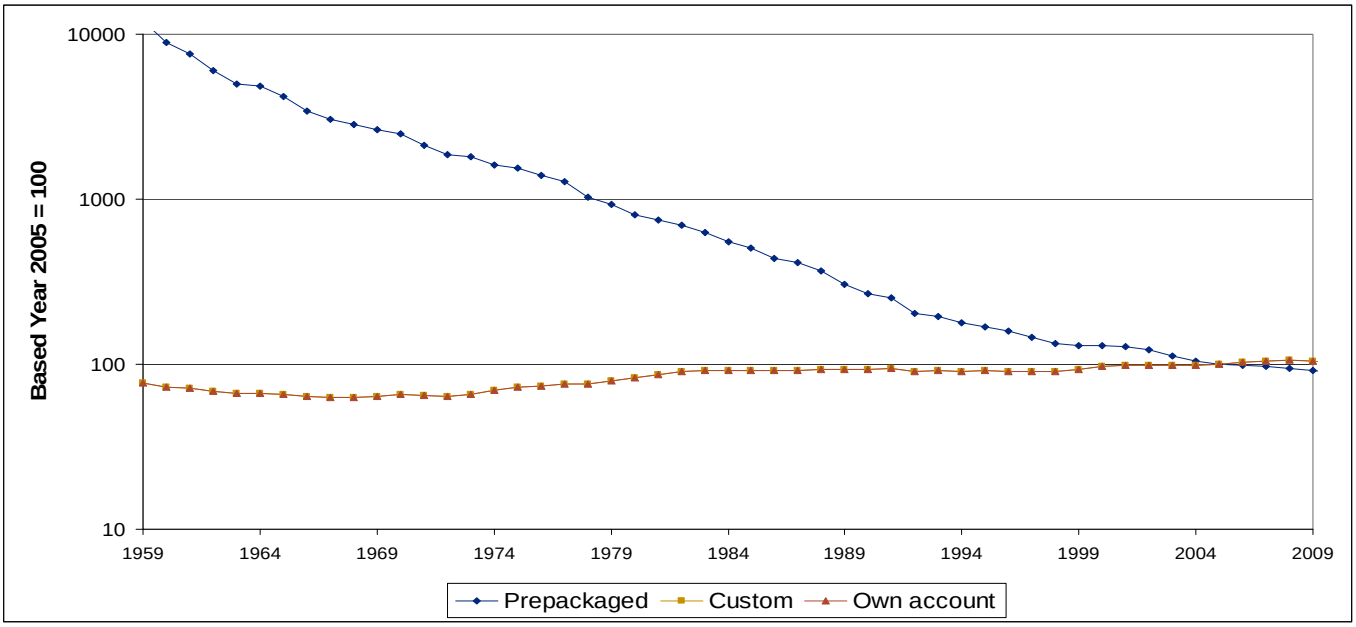

Figure 6: Long-Lived Entertainment Prices by Category

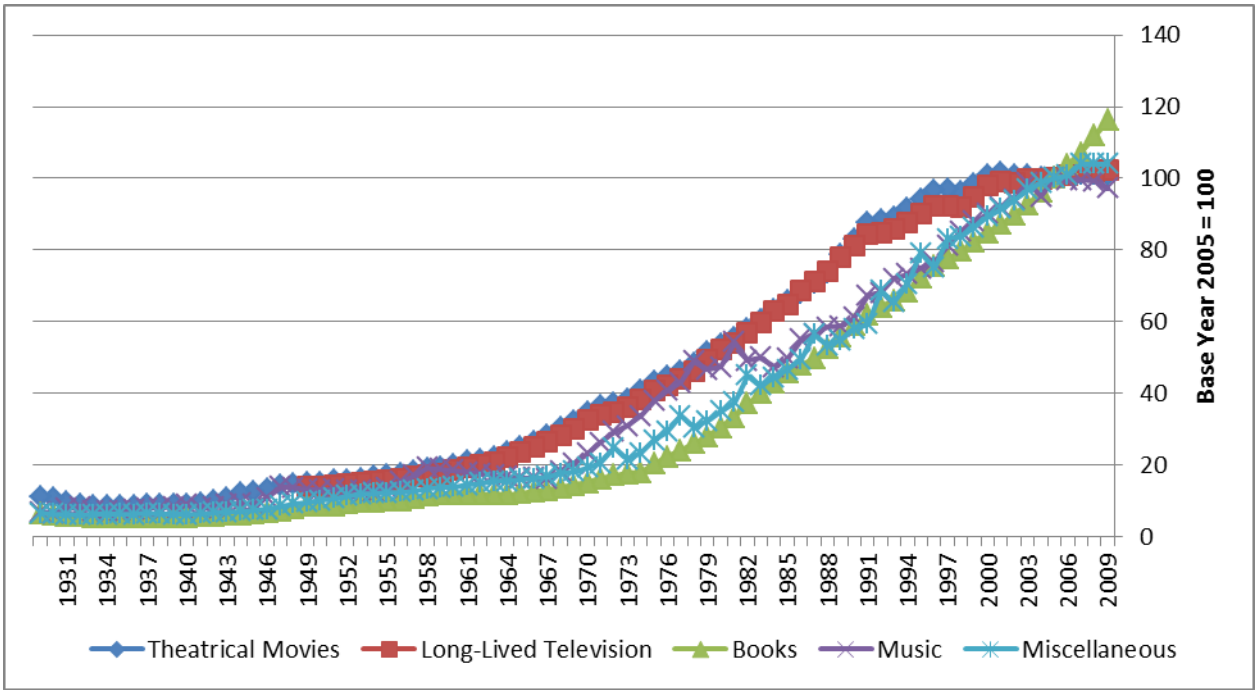

Figure 7: Short-Lived Entertainment Prices by Category

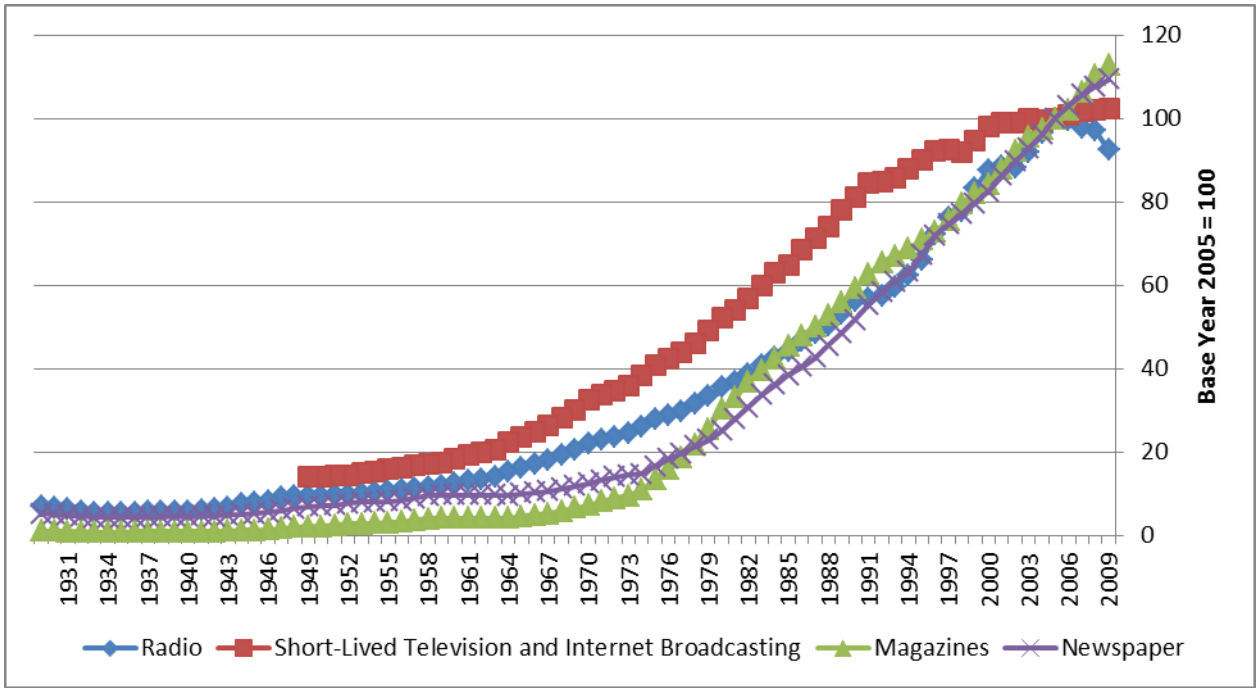

Figure 8: Depreciation Schedules for Software

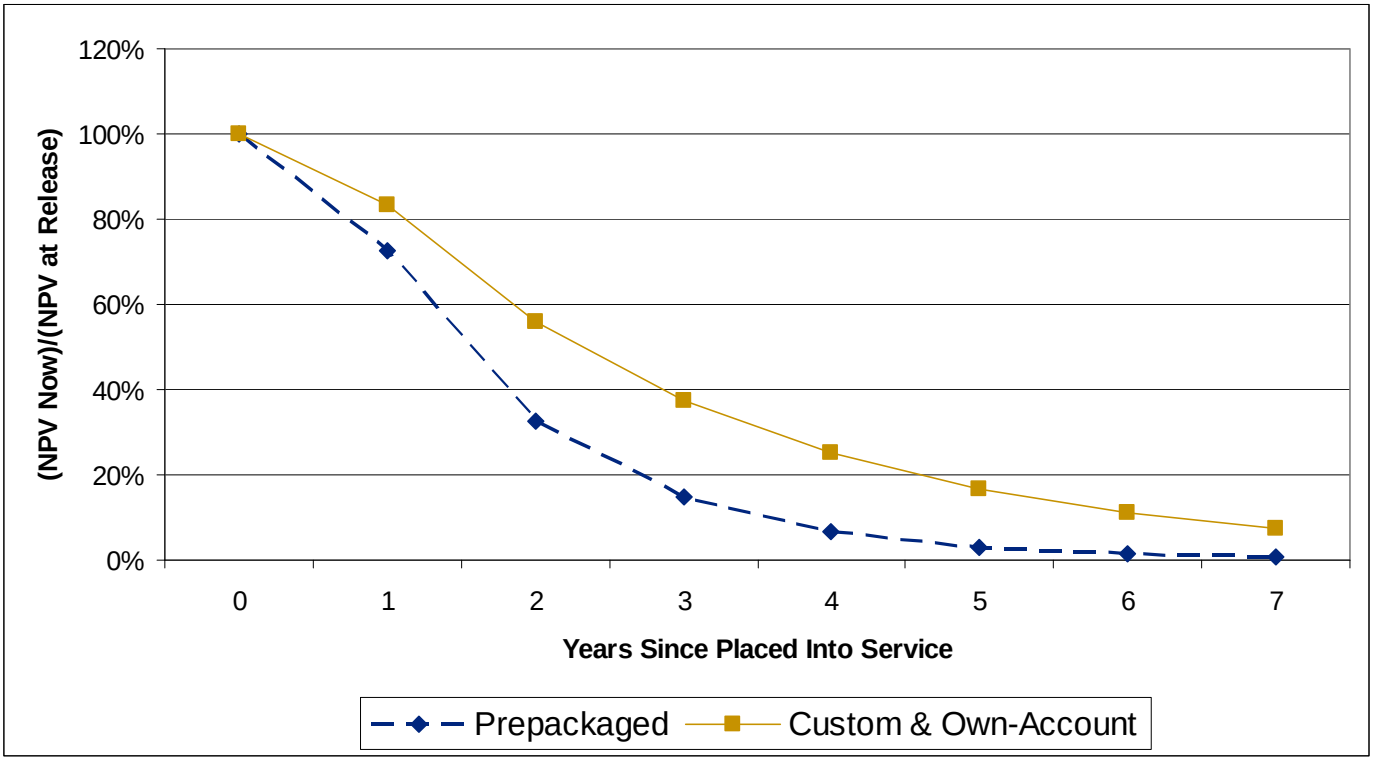

Figure 9: Capital Stock of Software Relative to GDP

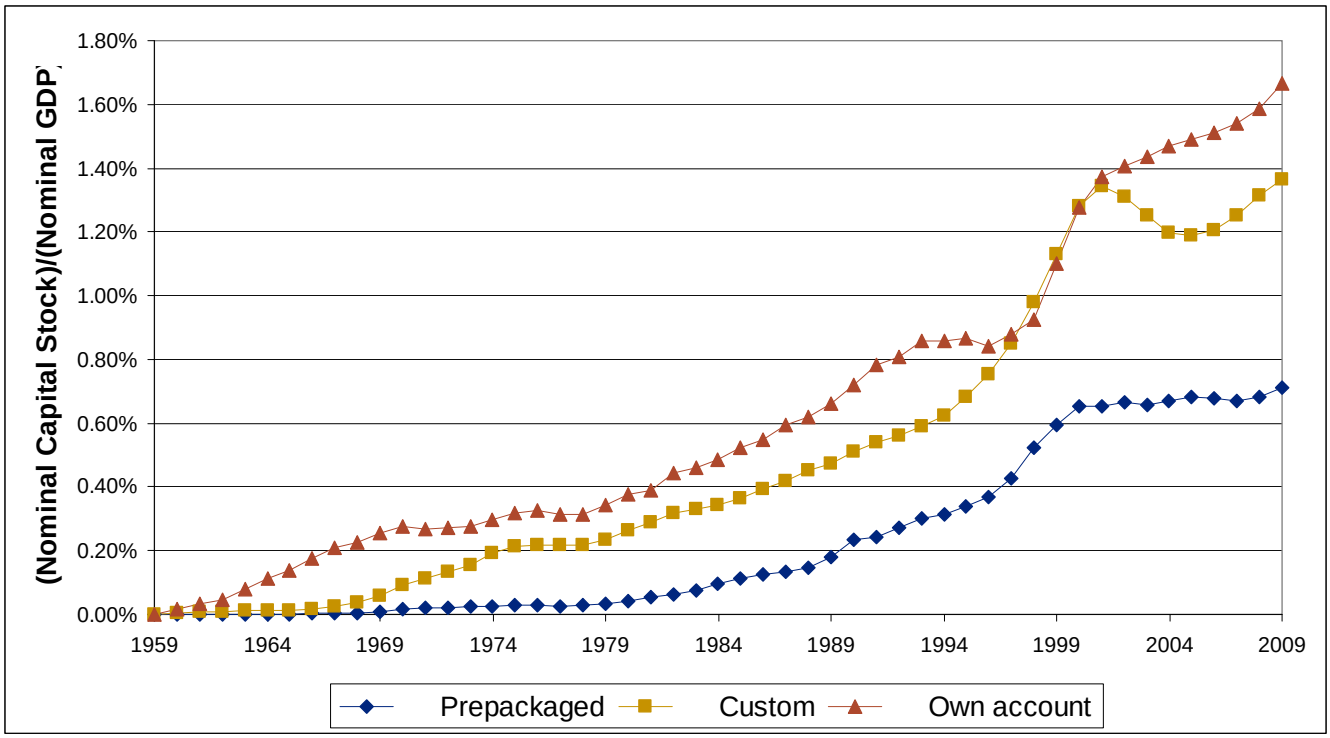

Figure 10: Depreciation Schedules for Long-Lived Entertainment

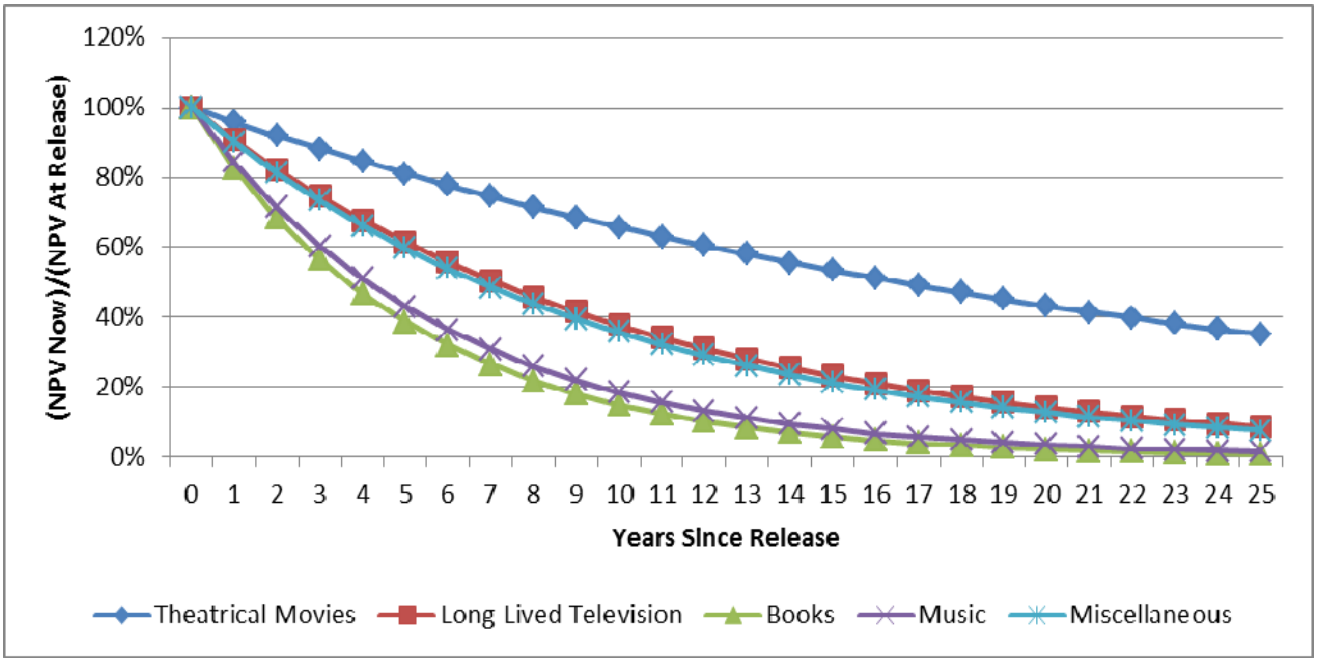

Figure 11: Capital Stock of Entertainment Relative to GDP