Copyright-Protected Assets in the National Accounts

By Rachel Soloveichik and David Wasshausen

In 2007, we estimate that US businesses and governments invested $278 billion in software and US artists produced $50 billion worth of long-lived artwork. 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 artwork 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 artwork. This paper presents data on nominal investment, prices and capital stocks of software and long-lived artwork from 1929 to 2009. We then show how capitalizing software and artwork influence GDP statistics.

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) Artwork 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 artwork is classified as a capital asset.

3) Software has a lifespan of 3-5 years and artwork has a lifespan of 15-50 years. In 2007, the private capital stock of software was $486 billion and the capital stock of artwork was $334 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 artistic 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 artwork 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 artistic originals, which are still in the research phase. BEA may recognize long-lived artwork 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 software and artistic originals produced by its employees. Nevertheless, we count software and artistic originals 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 copyrighted products like newspaper articles briefly. However, the estimates given for production and prices of short-lived artwork are for research purposes only. BEA does not plan to change the treatment of short-lived artwork 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 artwork. 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 artwork 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 $50 billion worth of long-lived artwork. The cost of producing these $328 billion worth of copyrighted material could be treated as either a current expense (expensing) or a capital investment (capitalizing). If production of artistic originals is treated as a current expense, then they

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2 The estimates for artistic originals presented in this paper are preliminary and may differ from the values that will ultimately be recorded in the NIPAs.
play a limited role in the calculation of GDP. 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 artistic originals.

On the other hand, under the capitalizing method, software and artwork 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 artwork, but it does count consumer spending, investment and government services. 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.

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3 While artistic 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 artistic 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 artistic originals, which is counted as part of government or personal consumption expenditures.

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 artistic 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 artistic 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 nonprofits 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).
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. We also need a depreciation schedule for capital stock in each category. We can then calculate real investment and real capital stock for Year $t$:

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

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

In the remainder of section 2, we will give information on nominal investment, price indexes and depreciation schedules for software and long-lived artwork. Short-lived artwork is 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 artwork produced by the market sector in GDP. Amateur programmers and artists often develop software for their own pleasure and distribute it for free. 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 market activity and a few specific types of household production. The covered household production in the

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8 The time series for software starts in 1959. Before then, software investment was close to 0. For artwork, 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.
System of National Accounts (SNA) does not include amateur blogs or garage bands. Therefore, we do not consider amateur software and artwork production as investment. Researchers who are interested in aggregate production of software or artwork will need to adjust the BEA’s published numbers to include non-market production.

The line between software and artwork 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 artwork in the art category. This classification method accounts for artwork with the least disruption to BEA’s pre-existing time series on software production. If we had decided to switch products from software to artwork, then nominal investment in artwork 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 artwork. 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 some was consumed by business as an intermediate input in producing other goods (e.g. software

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10 In practice, we use different methods to estimate production spending for software and artwork. 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 artwork. If done right, that adjustment might keep real investment and capital stock fixed.
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.\textsuperscript{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\% 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.

\textbf{Nominal Investment in Artwork}

According to the Economic Census of 2007, total revenue from sales and license fees for artwork was $285 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 value of artistic originals. In 2007, we estimate that artists spent $120 billion producing new artwork.

\textsuperscript{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.
The $120 billion in artwork production can be split into long-lived artwork and short-lived artwork. Long-lived artwork includes theatrical movies, some television programs, books, music and miscellaneous artwork. These artistic categories will be capitalized in the NIPAs. Short-lived artwork includes some television programs, radio programs, magazines and newspapers. These art 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 purposes.

Figure 3 shows the GDP share of investment in long-lived artwork by category from 1929 to 2009. The most striking thing about Figure 3 is how art categories have changed over time. Most of these changes are driven by technology change. For example, theatrical movies were the largest art 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 0.11% of GDP by 2000.

Although not a candidate for capitalization, short-lived artwork is still interesting to researchers studying copyrights. Figure 4 shows the production costs for short-lived artwork relative to GDP from 1929 to 2009. Like long-lived artwork, the categories for short-lived artwork have changed in relative importance over time. The GDP share for newspapers and magazines has been dropping steadily since 1990. Instead, Americans are turning to television for news, sports and entertainment. 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. Investment in long-lived artwork has hovered around 0.3% of GDP from 1929 to 2009.
Because it is so steady, reclassifying long-lived artwork as a capital investment has little impact on the estimates of long-term GDP growth. In addition, short-lived artwork has hovered around 0.5% of GDP from 1929 to 2009. The steady GDP shares suggest that demand for artwork is roughly proportional to income.

The artwork totals in Figures 3 and 4 are not precisely comparable to the software totals because the estimates in those figures only track artistic originals. Unlike software, artwork copies are generally not considered a capital asset. Most prepackaged software is derived from own-account software held by the software developer. Therefore, programs like Microsoft Office are counted twice: once when they are developed by Microsoft in-house and once when a business buys a copy for their own use. In 2007, pre-packaged software accounts for 29% of total investment.

In addition, Figures 3 and 4 only track artistic originals used to produce copies for the general public. Artwork sold to the general public includes household products like DVDs, private business products like music for in-store background and government products like textbooks. However, it does not include products designed for a single customer, regardless of whether the 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. This treatment is consistent with the international guideline for national accounts, System of National Accounts 2008. 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 artwork.

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13 Many artwork copies have a short useful lifespan, so they are definitely not considered capital assets. For example, a broadcast television program disappears as soon as its over. Other artwork copies are counted as consumer durables. For example, DVDS are sold to households and therefore counted in consumer durables.

14 SNA 2008 does not explicitly exclude non-public artwork, but their discussion is completely focused on public artwork such as theatrical movies, television programs, books and music. In addition, we have not been able to measure production of non-public artwork reliably. Because of the measurement problems, any estimates of historical production, prices and capital stock would be extremely speculative. Therefore, we are not planning to include non-public artwork in the NIPAs.
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 artwork. Therefore, we use input costs to create price indexes. Each category of software and artwork uses different inputs, so we calculate the price index differently. Appendix A gives detailed information by category.

Our price indexes for software and artwork only track legal purchases.\(^{15}\) 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 artwork. The consumer price for pirated software is 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.\(^{16}\) Accordingly, prices for non-market software or artwork 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

\(^{15}\) Television and radio broadcasters charge consumers nothing and make money from selling advertising space. BEA counts that advertising revenue when deriving the value of artwork using the net present value approach. \(^{16}\) SNA 2008 recommends that countries count black market activity in GDP. However, BEA has not chosen to implement that recommendation.
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.

Price Indexes for Artwork

Figures 6 and 7 show the price of artwork by category from 1929 to 2009. The most interesting thing from Figure 6 is the price decreases for television programs and movies over the last decade. At the same time, prices for newspapers, magazines, books, music and miscellaneous artwork have risen steadily. The difference is caused by digital video cameras and computers. The price indexes developed in this paper assume that the main input cost for artwork is entertainment services such as actors, costume designers, musicians, etc. We assume that those inputs account for 100% of the cost of writing articles, books or composing music. These costs have risen from 2000 to 2009, so the price indexes for music, books, newspapers and magazines have risen over the same time period. In contrast, we assume
that entertainment services only account for 75% of the cost of producing a movie or fiction television program. We also assume that video cameras and video editing equipment account for the remaining 25%. Over the past decade, technology improvements have steadily lowered prices for digital video cameras and editing equipment. The price decrease is large enough to offset the increased price for entertainment services. As a result, average input costs for movies and television programs has fallen slightly from 2000 to 2009.

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

The SNA defines artistic originals as artwork with a useful lifespan of more than one year (SNA 2008). This includes theatrical movies, some television programs, books, music and miscellaneous artwork. We have estimated depreciation schedules for these art categories and then calculated capital stocks of artwork. 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.

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. 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

\[ \text{The declining balance rate gives the speed at which an asset depreciates over its lifetime. A declining balance of 1.65 and a lifespan of 3 years is similar to a geometric depreciation rate of } 1.65/3 = 55\% \text{ per year.} \]
an informal survey of business use of software previously conducted by BEA), and tax-law-based lives of software.\(^{18}\)

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 Artwork**

Figure 10 shows the depreciation schedule for theatrical movies, long-lived television programs, books and music.\(^{19}\) 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 they’ve bought a book, consumers can re-read it without paying more money to the publisher.\(^{20}\) In this paper, we only measure the capital stock of original artwork. 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, I deduct all advertising costs from revenue for that particular year. As a result, first year profits are much

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\(^{18}\) For more information on the methodology underlying BEA’s software estimates, see Parker and Grimm (2000).

\(^{19}\) Each miscellaneous art category has its own lifespan. We omit the individual schedules to keep the graph simple.

\(^{20}\) 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.
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.21

Figure 11 shows the capital stock of artwork relative to GDP from 1929 to 2009. On average, long-lived artwork is 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 artistic production seen in Figure 4. However, the differences can be explained by changing art categories. Television programs and movies have a much longer lifespan than books or music. Therefore, the capital value of pre-existing artwork is larger when television programs and artwork are more important and smaller when books or music is more important.

**Conclusion**

This paper described BEA’s recent work on software and artwork. 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 artwork 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 artwork is estimated to be $49.7 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

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21 However, the capital value of artwork + capitalized advertising would be identical to our capital values for artwork alone.
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 artwork 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 artwork 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 have a fixed demand for artwork.
Bibliography


Soloveichik, Rachel (2010) “Theatrical Movies as Capital Assets” available on request

Soloveichik, Rachel (2010) “Music as a Capital Asset” available on request

Soloveichik, Rachel (2010) “Books as Capital Assets” available on request

Soloveichik, Rachel (2011) “Television Programs as Capital Assets”. portions are available on request

Soloveichik, Rachel (2010) “Miscellaneous Artwork as a Capital Asset” available on request


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. 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

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22 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>
<thead>
<tr>
<th>Table 1. Nominal Investment: Prepackaged Software, 2007</th>
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<tr>
<td>[Billions of dollars]</td>
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<tr>
<td>Domestic output (receipts)</td>
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<tr>
<td>plus Imports</td>
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<tr>
<td>less Exports</td>
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<tr>
<td>equals Domestic supply</td>
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<tr>
<td>less Household purchases</td>
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<tr>
<td>less Government purchases</td>
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<tr>
<td>less Intermediate Inputs (software included in other products)</td>
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<tr>
<td>plus Trade, taxes and transportation margins</td>
</tr>
<tr>
<td>equals Private fixed investment *</td>
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* 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.\textsuperscript{23}

\textsuperscript{23} 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.\textsuperscript{24} 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.

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<tr>
<th>Table 2. Nominal Investment: Custom Software, 2007</th>
<th>[Billions of dollars]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic output (receipts)</td>
<td>97.7</td>
</tr>
<tr>
<td>plus Imports</td>
<td>7.0</td>
</tr>
<tr>
<td>less Exports</td>
<td>3.4</td>
</tr>
<tr>
<td>equals Domestic supply</td>
<td>101.3</td>
</tr>
<tr>
<td>less Household purchases</td>
<td>0.0</td>
</tr>
<tr>
<td>less Government purchases</td>
<td>15.6</td>
</tr>
<tr>
<td>less Intermediate inputs (software included in other products)</td>
<td>6.9</td>
</tr>
<tr>
<td>plus Trade, taxes and transportation margins</td>
<td>0.3</td>
</tr>
<tr>
<td>equals Private fixed investment *</td>
<td>79.1</td>
</tr>
</tbody>
</table>

\* 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

\textsuperscript{24} 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 in 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 2007.²⁵ 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.²⁶

²⁵ For more information on own-account software and source data used for historical estimates, see Parker and Grimm (2000).
Table 3. Nominal Investment: Own-Account Software, 2007

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Wages</th>
<th>x 2.02</th>
<th>= Operating expenses</th>
<th>x 0.5</th>
<th>= Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer programmers</td>
<td>17,459</td>
<td></td>
<td>35,267</td>
<td></td>
<td>17,633</td>
</tr>
<tr>
<td>Computer software engineers, applications</td>
<td>27,113</td>
<td></td>
<td>54,769</td>
<td></td>
<td>27,384</td>
</tr>
<tr>
<td>Computer software engineers, systems software</td>
<td>22,368</td>
<td></td>
<td>45,184</td>
<td></td>
<td>22,592</td>
</tr>
<tr>
<td>Computer systems analysts</td>
<td>24,299</td>
<td></td>
<td>49,084</td>
<td></td>
<td>24,542</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>91,239</strong></td>
<td></td>
<td><strong>184,303</strong></td>
<td></td>
<td><strong>92,152</strong></td>
</tr>
</tbody>
</table>

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

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

**Category 4: Theatrical Movies**

**Nominal Investment:** Our main dataset for 2007 is the Economic Census. According to the Economic Census, US movie studios earned $5.4 billion from licensing films to movie theaters, $22.6 billion from licensing films to television, $6.2 billion from DVD sales 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 2007.

Of course, not all of the $37.2 billion is available to cover the cost of producing copyrighted movies. Movie studios spend a lot of money advertising new films, and some money printing film reels and stamping DVDs. We used data from Kantar Media’s ‘Adspender’ dataset to measure advertising. According to Kantar Media, movie studios spent $3.6 billion on advertising time in the US in 2007. Counting foreign advertising and overhead for advertising, total marketing expenditures were $8.8 billion in 2007. In addition, printing film reels typically costs 10% of box office licensing, stamping DVDs
cost 15% of DVD sales and TV studio administration costs 1% of television licensing (Epstein 2005). After allowing for these costs, movie studios earned $26.7 billion = $37.2−$8.8−$5.4*10%−$22.6*1%−
$6.2*15% from their copyrighted films.

Theatrical movies are a long-lived capital asset, so nominal production may be very different from nominal revenue. We use production data from the website IMDB.com to calculate quarterly filming costs from 1929 to 2007. (Please see the paper ‘Theatrical Movies as Capital Assets’ (Soloveichik 2010) for details on the imputation procedures.) Based on the IMDB data, we calculate that movie studios spend 52 cents producing new movies for every dollar in revenue that they earn from their copyrighted films.27 Going forward, we plan to use the Census Bureau’s Service Annual Survey to get yearly revenue from box office licensing, television licensing and DVD sales. We will then calculate nominal investment by the formula:

\[
\text{Investment in Year } X = (\text{Revenue in Year } X) \times 52\%
\]

This formula is much easier to implement than one that the present discounted value of every movie filmed in year X. Furthermore, it produces similar results for most years. However, it may produce misleading results for years with major strikes or other supply disruptions. In those years, we may need additional information to adjust the nominal investment estimates.

<table>
<thead>
<tr>
<th>Table 4. Nominal Investment: Theatrical Movies, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Billions of dollars]</td>
</tr>
<tr>
<td>Licensing fees from movie theatres</td>
</tr>
<tr>
<td>Licensing fees from television</td>
</tr>
<tr>
<td>DVD Sales</td>
</tr>
<tr>
<td>Licensing fees from merchandising</td>
</tr>
<tr>
<td>equals Theatrical movies revenue</td>
</tr>
<tr>
<td>less Advertising and overhead costs</td>
</tr>
<tr>
<td>less Printing film reel costs (10% of theatre revenue)</td>
</tr>
<tr>
<td>less TV administration costs (1% of TV revenue)</td>
</tr>
<tr>
<td>less DVD stamping costs (15% DVD sales)</td>
</tr>
<tr>
<td>equals Adjusted film revenue</td>
</tr>
</tbody>
</table>

27 At first glance, the 53% licensing revenue suggests that the movie industry is extremely profitable. However, there is a long lag between production and revenue. I assume that movie studios discount future profits at 10% (real) per year. Therefore, they demand a substantial mark-up for the time value of their money.
<table>
<thead>
<tr>
<th>times</th>
<th>Ratio to convert revenue to production cost</th>
<th>52%</th>
</tr>
</thead>
<tbody>
<tr>
<td>equals</td>
<td>Nominal Investment</td>
<td>14.0</td>
</tr>
</tbody>
</table>

**Price Index**: We use input-cost approach for estimating a price index for theatrical movies. The main input for movies is live performance costs like writing scripts, setting up scenery, designing costumes, acting out roles, etc. The main cost of live performances is labor services, but inputs like trailers to house the actors and crew, raw materials for the scenery and costumes are also important. 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 assume that live performances in the live entertainment industry use similar inputs to live performances in the movie industry – so the prices should move similarly. BEA’s personal consumption expenditure (PCE) 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.

The other important input for movies is photographic equipment to record and process the live performances. BLS produces a PPI for photographic equipment used in the motion picture industry, but that PPI only goes back to 2008. BLS also has a broader PPI for photographic equipment in general, however, imports are not reflected in the PPI and imports account for a large portion of photographic equipment costs. Since 1990, consumer prices for photographic equipment have fallen much faster than US production costs. Studios probably benefited from the cheap imports too. As a result, we use the BEA PCE price index for photographic equipment that is published in NIPA Table 2.4.4U, line 45 (photographic equipment). Prior to 1959, we use the price index of audio-video, photographic and information processing equipment as a proxy for photo equipment prices. That price index is published in Table 2.4.4, line 14.

We then average the two price indexes to get a price index for theatrical movies.
Movie Prices in Year $X = (\text{Service Sector Prices}_X)^{0.75} \ast (\text{Photographic Equipment Prices}_X)^{0.25}$

In other words, services account for about 75% of movie costs and photographic equipment accounts for about 25% of movie costs.

The paper ‘Theatrical Movies as a Capital Asset’ (Soloveichik 2010) calculates prices for theatrical movies in 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. IMDB also gives the nominal production budget for a selected sample of movies. Based on the IMDB data, we calculated a price index for the movie industry. The price index from IMDB matches closely with the input-based price index developed earlier. However, the price index from IMDB is extremely labor intensive to calculate. Furthermore, it is volatile before the 1990s. Therefore, we will use the input-based price index in the national accounts.

**Depreciation Schedule:** Theatrical movies have a standard lifecycle. First, the studio advertises the movie extensively. Next, the studio releases the movie to theaters worldwide. After a few months, the movie is withdrawn from the theaters and released on DVD. Finally, the movie is released to television. Movies are almost never withdrawn from the home video or television market, so consumers continue to watch old movies for decades after their initial release.

We use a variety of industry datasets to track profits over time. Kantar Media provides monthly advertising expenses for individual movies in their ‘Adspender’ database. The-numbers.com provides weekly box office data on their website. Alexander and Associates ran a consumer survey of home video rentals and purchases from 1988 to 2002. They generously shared their data with us and we calculated quarterly home video revenue for individual movies. Finally, Nielsen Media Research

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28 The listing is generally taken from the credits, and may miss some people. Major movies are more likely to be complete.
provides rating data for movies shown on US broadcast and US cable television. We combined their
dataset with schedule information from Tribune Media Services to calculate quarterly television revenue
for individual movies. We were not able to find any data on merchandise licensing over time, so we
assume that merchandise licensing tracks the other revenue streams

After collecting all this data, we calculated depreciation schedules from the revenue data. First, we benchmarked all of the industry datasets to the 2007 Economic Census to get consistent annual revenue and costs from release to copyright expiration.\(^{29}\) We then calculated the value of a movie according to the recursive formula:

\[
\text{Net Present Value (NPV) in Year } 0 = \text{Revenue}_0 - \text{Non-Artwork Costs}_0 + (\text{NPV in Year } 1)/(1+\rho)
\]

\[
\text{Net Present Value (NPV) in Year } 1 = \text{Revenue}_1 - \text{Non-Artwork Costs}_1 + (\text{NPV in Year } 2)/(1+\rho)
\]

\[\ldots\]

\[
\text{Net Present Value (NPV) in Year } X = \text{Revenue}_X - \text{Non-Artwork Costs}_X + (\text{NPV in Year } X+1)/(1+\rho)^{30}
\]

In that formula, \(\rho\) is the annual discount rate. We use an annual discount rate of 10% real.

Category 5: Television Programs

Nominal Investment and Production of Short-lived Programs: Our main dataset for 2007 is the
Economic Census. Unlike movies, television production occurs in a number of industries. In 2007, US
television studios earned $10.2 billion from licensing their shows worldwide, $2.1 billion from selling
DVDs and $1.1 billion from licensed merchandise. Television broadcasters earned $32.3 billion from
selling advertising space and $2.3 from public funding and licensing. Finally, cable networks earned

\(^{29}\) In practice, no major movies have gone off copyright because Congress keeps on extending the limit.
\(^{30}\) We calculate NPVs after year 20 with the infinite sum formula: \(\text{NPV}_X = (\text{Revenue}_X - \text{Non-Artwork}_X)/(\rho+\text{dep. rate})\)
$21.9 billion from selling advertising time and $17.3 billion from licensing their program to cable distributors. In total, US television stations and studios earned $87.1 billion in 2007.

About $13 billion of the television revenue comes from cable stations showing theatrical movies.\(^{31}\) The licensing revenue for those theatrical movies has already been counted in the movie industry. Therefore, we calculate that US television stations and studios earned $74.0 billion from television programs. These revenue numbers count exports of US shows abroad and exclude imports of foreign shows.

BEA accounts for long-lived television programs and short-lived television programs differently in the National Income and Product Accounts. Therefore, we need to estimate how much studios spend on each category. In order to estimate the market share for long-lived television, we purchased ratings data from Nielsen Media. That ratings data gives viewership by market type, program and genre. Based on the ratings data, we estimate that about 48% of studio revenue comes from long-lived programs like sit-coms, dramas and documentaries. This production spending is classified as investment activity. The remainder of production is for short-lived programs like sporting-events, news or reality television. This production spending is considered a current expense.

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.\(^{32}\) 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

\(^{31}\)Theatrical movies earned a total of $22.6 billion in television licensing, but that includes foreign licensing.

\(^{32}\)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.
that television networks spend 75 cents on licensing payments to television studios for every $ in revenue.\textsuperscript{33} We can then calculate the nominal production of short-lived programs:

\[
\text{Production of Short-Lived Programs in Year X} = \text{Total Revenue}_x \times 52\% \times 75\%
\]

We need an additional factor to estimate nominal investment in long-lived television programs. Television studios have a significant capital stock of pre-existing dramas, sitcoms and documentaries. Even if studios ceased production entirely, the pre-existing capital stock would still provide revenue for decades to come. On average, we estimate that television studios spend 83 cents producing long-lived programs for every dollar in revenue they earn from licensing payments for long-lived programs.

\[
\text{Nominal Investment in Long-Lived Programs in Year X} = \text{Total Revenue}_x \times 52\% \times 75\% \times 83\%
\]

We use a variety of datasets to estimate television industry revenue from 1949\textsuperscript{34} to 2009. Between 1998 and 2009, we use the Service Annual Survey (2009, 2005 & 2004 editions). Before 1998, we use revenue data for cable distributors (Kagan 2006) to proxy for cable network revenue. We use advertising expenditures from the CS Ad expenditure dataset (Galbi 2008) to proxy for television broadcaster revenue. We use aggregate sales of licensed merchandise to proxy for merchandise licensing revenue from 1977 to 2005 (EPM Communications 2006). Before 1977, we assume that merchandise licensing revenue tracked the overall television industry. We could not find any data on television studio revenue before 1998, so we assume that television studio revenue tracked network revenue (broadcast+cable). Finally, we benchmark all of the datasets to the 2007 Economic Census.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|}
\hline
\textbf{Table 5a. Nominal Production of Short-Lived Television Programs, 2007} & [Billions of dollars] \\
\hline
General licensing fees (worldwide) & 10.2 \\
DVD sales & 2.1 \\
Licensing fees from merchandising & 1.1 \\
General advertising & 32.3 \\
Public funding & 2.3 \\
Cable advertising & 21.9 \\
\hline
\end{tabular}
\end{table}

\textsuperscript{33} Cable television networks often produce their shows in-house. I calculate implicit licensing payments for them.

\textsuperscript{34} The television industry started in 1946, but the early shows had very little revenue.
<table>
<thead>
<tr>
<th>Licensing fees for cable programs</th>
<th>17.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>equals</td>
<td>Total television revenue</td>
</tr>
<tr>
<td>less</td>
<td>Adjustment to remove cable movie revenue</td>
</tr>
<tr>
<td>equals</td>
<td>Adjusted TV program revenue</td>
</tr>
<tr>
<td>times</td>
<td>Ratio of licensing fees to total revenue</td>
</tr>
<tr>
<td>equals</td>
<td>Licensing Fees for all television</td>
</tr>
<tr>
<td>times</td>
<td>Ratio of short-lived revenue to total revenue</td>
</tr>
<tr>
<td>equals</td>
<td>Production spending on short-lived television</td>
</tr>
<tr>
<td>equals</td>
<td>Revenue from long-lived television programs</td>
</tr>
<tr>
<td>times</td>
<td>Ration to convert revenue to investment</td>
</tr>
<tr>
<td>Equals</td>
<td>Nominal investment in long-lived programs</td>
</tr>
</tbody>
</table>

**Price Indexes**: We use an input based price index that is very similar to the theatrical movie index. Like movies, the two main inputs for television programs are live performance costs and photographic equipment. However, the weights assigned are a little different. We assume that fiction television programs like sitcoms, dramas and television movies use the same input mix as theatrical movies (75% labor services and 25% photographic equipment). However, non-fiction television programs like documentaries or cooking shows spend less on labor services and more on photographic equipment.

For example, many reality shows have no script or (paid) actors and very limited sets. Instead, they follow subjects in their daily life and then splice scenes together to get a coherent plot. We have already purchased viewership data from Nielsen that gives the market share for non-fiction television over time.

We calculate:

\[
\text{Photo Equipment Weight in Year } X = 0.25 + 0.25 \times \text{(Non-fiction Market Share}_X\text{)}
\]

\[
\text{Television Price}_X = (\text{Service Sector Prices}_X)^{1-\text{Photo Equip Weight}} \times (\text{Photographic Equipment Prices}_X)^{\text{Photo Equip Weight}}
\]

This television price index is identical to the movie equipment price index when fiction television is 100% of the market and very different when fiction television is not present in the market. In the

---

35 Production costs equal revenue for short-lived programs because they are assumed to depreciate immediately.
Nielsen data, fiction television accounts for about 29% of total viewership in 2007 and less in earlier time periods. 36

As a robustness check, we also used IMDB data to calculate television prices. IMDB provides fiction television data very similar to the theatrical movie data described earlier. The only difference is that production budgets are rarely reported, so we must impute them. Once again, I found that the IMDB price index is relatively close to the input-based based price index. Like theatrical movies, we use the input-based price index because it is easier to calculate and less volatile.

**Depreciation Schedules:** We are only interested in long-lived television for the capital stock estimates. For the depreciation schedule, we track the lifespan of individual television episodes. For example, we want to track revenue from Episode 7, Season 3 for “The Simpsons”, not just total revenue for “The Simpsons”. For genres like soap operas, individual television episodes are short-lived – but the series lasts forever. The SNA considers those genres short-lived and therefore excludes production costs from investment (SNA 2008). Even for long-lived genres like dramas, the series can still last longer than individual episodes. Therefore, BEA’s capital stock of individual television programs may underestimate the total value of all copyrighted material in the television industry. 37

BEA has not yet been able to purchase all the data necessary to calculate depreciation schedules for television. For the purpose of this paper, we created a preliminary depreciation schedule. The final depreciation schedule may be significantly different.

BEA will use a variety of industry datasets to track profits over time. Kantar Media provided a special dataset giving monthly advertising for television shows. Their dataset tracks network promos and provides an estimate of the value of that advertising. In most cases, Kantar Media does not report

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36 BEA does not actually have viewership by genre before 2004. However, BEA has revenue by cable channel back the 1980s. Most cable channels offer a relatively stable set of genres. For example, the Discovery Channels has lots of science shows and few sit-coms. Therefore, we can estimate the non-fiction share back to the 1980s.

37 Television studios may also use trademarks or other legal structures to protect their shows formats.
the individual television episode advertised. Instead, they report the series promoted.\textsuperscript{38} We assume that networks advertise to increase viewership for their latest episodes. Nielsen Media Research provides rating data for individual time slots shown on US broadcast and cable television. We will combine their dataset with schedule information from Tribune Media Services to identify the precise episode shown. For home video, we use survey data from Alexander and Associates.\textsuperscript{39} Finally, we benchmarked all the databases to the 2007 Economic Census and estimated quarterly revenue and quarterly sales costs from an episodes initial release date until copyright expiration. We then calculate depreciation schedules with the same procedure as theatrical movies.

\textbf{Category 6: Music}

\textbf{Nominal Investment:} Musicians typically keep legal ownership of their copyrighted music, so it might seem that we should only count musician revenue when valuing music. In practice, recording studios provide expensive production inputs like sound stages and get long-term distribution contracts in return. If an album is successful, the recording studio makes large profits from the distribution contract. From an economic standpoint, these long-term contracts give partial ownership of the music to recording studios. Therefore, we will count both musician and recording studio revenue when valuing music.

BEA’s main dataset 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 $2.6 billion from royalties\textsuperscript{40}; US musical groups earned $2.9 billion from live concerts\textsuperscript{41}; and US publishers earned

\textsuperscript{38} Many promos don’t identify the episode at all. Instead, they just push the new season.
\textsuperscript{39} Alexander and Associate’s home video data runs from 1988 to 2002. It is possible that depreciation schedules have changed since then.
\textsuperscript{40} 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.
\textsuperscript{41} This only includes popular music concerts. We count symphony orchestra in live theater.
$0.4 billion from printed sheet music. US musical groups frequently perform abroad and non-US groups perform in the US — so the ticket sales are probably 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 earn $9.5 billion from CD sales worldwide, $2.5 billion from royalties worldwide and $0.4 billion from printed music worldwide. In total, US musicians and recording studios earned $15.3 billion in 2007.

Once again, musicians and recording studios have non-artwork costs. Based on the industry literature, we estimate that marketing accounts for about one third of CD sales, royalties and music books.42 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 stamping CDs accounts for 11% of CD sales and printing accounts for 30% of sheet music sales. Royalties have no physical costs, but administration accounts for about 10% of sales. Live music concerts use subsidiary revenue (like T-shirt sales) to pay for administration, so their out-of-pocket costs are 0. After subtracting all the non-music costs, US musicians and recording studios earned $9.7 billion from their copyrighted music in 2007. They then reinvested $5.6 billion of that money on new music production.

We use a variety of industry datasets to estimate music revenue from 1929 to 2009. The Recording Industry Association of America (RIAA) provides CD sales, legal downloads and other purchased music from 1973 to 2009. Before 1973, we use the academic paper ‘The Record Industry: The Growth of a Mass Medium’ (Gronow 1983) to track record sales back to 1929. For royalties, we use annual report data for the big three US rights organizations between 1984 and 2009.43 Before 1984, we use the book ‘American Popular Music and Its Business’ (Sanjek 1988) to get occasional figures for ASCAP and BMI’s royalties and then interpolate to fill in years with missing data. For live concert tickets, 42 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. However, we did find data that tracked total advertising spending over time. Between 1995 to 2010, out of pocket advertising has been a fixed % of total music industry revenue. 43 We did not collect the annual reports directly. Instead, we rely on the book ‘Music, Money and Success’ (Brabec and Brabec 2008)

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[Billions of dollars]</td>
</tr>
<tr>
<td>Music sales (CDs, legal downloads, etc.)</td>
</tr>
<tr>
<td>Royalties</td>
</tr>
<tr>
<td>Live concert revenue</td>
</tr>
<tr>
<td>Printed sheet music</td>
</tr>
<tr>
<td>Adjustment for exports and imports</td>
</tr>
<tr>
<td>equals Musician and recording studio revenue</td>
</tr>
<tr>
<td>less Marketing for CD's, royalties and printed music (33% of rev.)</td>
</tr>
<tr>
<td>less Marketing live concerts (11% of revenue)</td>
</tr>
<tr>
<td>less CD stamping costs (12% of CD sales)</td>
</tr>
<tr>
<td>less Administrative costs (10% of royalties)</td>
</tr>
<tr>
<td>less Printing costs (31% of printed music)</td>
</tr>
<tr>
<td>equals Adjusted musician &amp; recording studio revenue</td>
</tr>
<tr>
<td>times Ratio to convert revenue to production cost</td>
</tr>
<tr>
<td>equals Nominal Investment</td>
</tr>
</tbody>
</table>

Price Indexes: We use live entertainment prices as a proxy for music production costs. That price index is published in Table 2.4.4U, line 45 (photographic equipment). Before 1959, I use the price index of audio-video, photographic and information processing equipment as a proxy for photo equipment prices. That price index is published in Table 2.4.4, line 14.

In theory, we could adjust for the prices of audio equipment. However, audio equipment is a much smaller share of music production than video equipment is for movies and television. With modern technology, garage bands can record and distribute albums from a personal computer. Accordingly, the weight for audio equipment would be very small.
As a robustness check, we also calculated music prices with a consumer-based index. In ‘Music as a Capital Asset’, we calculated price indexes for four separate music categories: a) CD’s and other purchased music; b) Royalties from radio and television broadcast; c) Live concert tickets and d) Printed sheet music. We then combined the four price indexes to get an overall music price index. The consumer-based index tracks service prices reasonably closely, but it is more volatile and harder to calculate. Therefore, we will use the service sector price index.

Depreciation Schedule: We use a variety of industry datasets to track profits over time. Kantar Media provides monthly advertising expenses for individual albums or concerts in their ‘Adspender’ database. Billboard provides a Top 250 chart of CD’s sold each week.\(^{44}\) MusicMonitor breaks down radio songs by year of initial release and reports the market share for each year. Tvtunefinder.com provides the individual songs used in television shows.\(^{45}\) Setlist.com reports the individual songs performed at live music concerts. Musicnotes.com provides the top selling sheet music each week. We then used Internet databases to identify the initial release date for each album or song in the sample. Finally, we benchmarked all the databases to the 2007 Economic Census and estimated quarterly revenue and quarterly sales costs from an album’s initial release date until copyright expiration. We then use that profit data to calculate depreciation schedules with the procedure as theatrical movies.

**Category 7: Books**

**Nominal Investment:** Like music, we count author royalties and publisher profits when valuing books. Our main dataset for 2007 is the Economic Census. In 2007, US publishers sold $26.7 billion worth of books. The $26.7 billion covers all genres of books, from literary classics to romance novels and math

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\(^{44}\) This top 250 covers about 70% of total sales. Within the charts, less popular CD’s are a little older than the top 10. We adjust for the missing data by weighting the top 100- top 250 more heavily. As a robustness check, we also used RIAA’s platinum awards to calculate annual sales for CD’s. The results were very similar.

\(^{45}\) Broadcast networks pay royalties every time the show is aired. In order to get a music depreciation rate, we assume a depreciation rate for television episodes. That rate may change when we finish our television research.
textbooks. In 2007, print books accounted for most of the revenue, but we also count audio books, Internet books and books licensed for serial publication in magazines. Like music, these numbers include imported books from non-US authors and don’t count exported books by US authors. Based on Nielsen Bookscan data, we estimate that non-US authors account for 20% of consumer book purchases. We have not been able to find any data on exports or textbook imports. For simplicity, we will assume that book imports are exactly equal to exports. Therefore, US authors and publishers sold $26.7 billion worth of books in 2007.

We use data from the American Association of Publishers (AAP) to calculate non-writing costs. Based on their survey data, we calculate that marketing accounts for 19% of publisher revenue and printing accounts for 45% of publisher revenue. After subtracting all the non-music costs, US publishers and authors earned $9.6 billion from their copyrighted books in 2007. They then reinvested $5.5 billion of that money writing new books.

We use a variety of datasets to estimate book revenue from 1929 to 2009. Between 2005 and 2009, we use the 2009 Service Annual Survey. Between 1973 and 2005, we use annual sales data from the American Association of Publishers. Between 1929 and 1973, the Census of Manufacturers reports book sales for years they survey. We then interpolate to fill in the missing data. Finally, we use magazine sales data from the Audit Bureau of Circulation to calculate how much books earned from serial publication in magazines. We find that serial publication was common before 1945 and then faded to almost nothing. For example, Tarzan and Sherlock Holmes were first published in magazine serials. We then benchmark those revenue numbers to the $5.5 billion spent writing new books in 2007.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>[Billions of dollars]</td>
</tr>
<tr>
<td>Domestic book sales (including imported books)</td>
</tr>
<tr>
<td>less Imported books (20% of domestic book sales)</td>
</tr>
<tr>
<td>plus Exported books (assumed to equal imports)</td>
</tr>
<tr>
<td>equals Sales of domestically produced books</td>
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<td>equals</td>
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<tr>
<td>times</td>
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<td>equals</td>
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</tbody>
</table>

**Price Indexes:** Our main price index is taken from the BLS’s producer price index (PPI) for book publishers. This price index runs from 1985 to 2009. Before then, we use a variety of price indexes to proxy for book prices. From 1980 to 1984, we use the BLS’s PPI for magazine publishers as a proxy. From 1929 to 1979, BEA has two pre-existing price deflators for consumer book purchases: a price index for recreational books and a price index for educational books. These price indexes are given in Table 2.4.4, lines 17 and 22. We create a composite price index:

\[
\text{Book Price}_x = (\text{Recreational Book Price}_x)^{0.5} \times (\text{Educational Book Price}_x)^{0.5}
\]

**Depreciation Schedules:** Our main dataset is taken from Nielsen’s Bookscan database. Bookscan provides weekly sales data for individual book editions in US retail stores. Kantar Media provides monthly advertising expenses for individual book titles or publishing houses in their ‘Adspender’ database. We then matched the book titles with Internet resources to identify the initial publication date for books in the sample. Finally, we benchmarked all of the datasets to the 2007 Economic Census and calculate depreciation schedules using the same procedure as theatrical movies.

**Category 8: Miscellaneous Artwork**

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

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46 We exclude textbooks and other revisable genres because there is no way to tell when an individual chapter was first written. For simplicity, we assume that textbook chapters depreciate at the same rate as normal books.
Category 8.1: Scripts for Live Theater

Nominal Investment: In the 2007 Economic Census, U.S. performing arts groups and independent artists\(^{47}\) earned $9.8 billion from ticket sales, donations and performance fees. Based on the industry literature, we estimate that theaters spend about 26% of revenue on marketing expenses and 56% of revenue on actor wages, theater costs and other necessary costs. Long-lived play scripts earned licensing fees of 18% of revenue.\(^{48}\) Based on market share data from BroadwayLeague.com, we calculate that theaters reinvested 68% of that revenue, writing new play scripts in 2007. Therefore, total investment in play scripts was $1.2 billion in 2007.

We use a variety of datasets to measure revenue 1929-2009. From 1998 to 2009, we use the 2009 Service Annual Survey and 2001 Service Annual Survey. From 1972 to 1997, we use the 1997 Economic Census and 1972, 1977, 1982, 1987 and 1992 Census of Services. Those surveys only give revenue every five years, so we interpolate to fill in the missing data. Before 1972, we use BEA’s pre-existing estimates of spending on live theater performances. We then benchmark those datasets to the $1.2 billion of investment in 2007.

<table>
<thead>
<tr>
<th>Table 8. Nominal Investment: Scripts for Live Theatre, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Billions of dollars]</td>
</tr>
<tr>
<td>Ticket sales, donations, and performance fees</td>
</tr>
<tr>
<td>less Marketing costs (26% of revenue)</td>
</tr>
<tr>
<td>less Actor wages, theatre costs, and other necessary costs (56% of revenue)</td>
</tr>
<tr>
<td>equals Revenue for long-lived scripts</td>
</tr>
<tr>
<td>times Ratio to convert revenue to production cost</td>
</tr>
<tr>
<td>equals Nominal Investment</td>
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</tbody>
</table>

\(^{47}\) This does not count popular music concerts, which are already in music.  
\(^{48}\) This includes profits for investors who bankroll a play premiere. We do not have nationality data for the play script. Like books, we assume imports and exports cancel out.
Price Index: BEA’s main price index for plays is based on BEA’s pre-existing deflator for live theater. That price index is published in Table 2.4.4U, line 211. We then adjust the BEA’s price deflator to account for the fact that live music concert prices rose significantly faster than the overall performing arts industry. As discussed earlier, we track live music concerts in the music industry, and so that inflation has already been counted in the music industry. Before 1959, we use the average top price for Broadway tickets as a proxy for overall theater prices (Baumol and Bowen 1966).49

Depreciation Schedule: BEA’s data is taken from BroadwayLeague.com. That website reports the weekly ticket revenue and attendance for every major Broadway play from 1984 to 2009. We then matched the play titles with Internet resources to identify the initial writing date for plays in the sample.

Category 8.2: Greeting Card Designs

Nominal Investment: 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 estimate that greeting card publishers reinvested 58% of that revenue designing new cards. Therefore, we calculate that copyrighted designs earned $0.4 billion in 2007.

We use a variety of datasets to measure revenue 1929 to 2009. From 1998 to 2009, the Service Annual Survey gives greeting card sales. Before then, we use the 1992 Economic Census and the 1935, 1939, 1947, 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987 and 1992 Census of Manufacturers. Many of these datasets only give sales in the survey year, so we interpolate to fill in the missing data. Finally, we benchmark all the estimates to the 2007 Economic Census.


49 They report musical and non-musical prices separately. We average them to get overall inflation. We also smoothed across three years to minimize short-term noise.
<table>
<thead>
<tr>
<th>[Billions of dollars]</th>
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<tbody>
<tr>
<td>Publishers sales of greeting card</td>
</tr>
<tr>
<td>times Ratio to convert sales to copyright design revenue</td>
</tr>
<tr>
<td>equals Copyright design revenue</td>
</tr>
<tr>
<td>times Ratio to convert revenue to production cost</td>
</tr>
<tr>
<td>equals Nominal Investment</td>
</tr>
</tbody>
</table>

**Price Indexes:** BEA’s main price index is taken the BLS PPI for greeting card publishers. This price index runs from 1986 to 2009. Between 1982 and 1986, we used the BLS PPI for periodical publishers. Between 1954 and 1982, we used data from the Census of Manufacturers to create a rough price index. For selected years, the Census of Manufacturers asks both the # of greeting cards printed and total earnings. We then used those numbers to calculate the average wholesale price for a greeting card.\(^5^0\) Before 1954, we use the book price index as a proxy for greeting card prices.

**Greeting Card Designs:** We could not find any data to calculate depreciation rates. We will use the book depreciation rate in the capital stock calculations.

**Category 8.3: Commercial Stock Photography**

**Nominal Investment:** 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 and 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.

We use a variety of datasets to measure revenue 1929 to 2009. From 1998 to 2009, the 2009 and 2005 Service Annual Survey reports annual sales. Between 1972 and 2002, the Census of Services \(^5^0\)We also experimented with adjusting for card type. This has little effect on average inflation rates. We interpolate between missing years.
and the Economic Census reports sales every five years. Between 1920 and 1980, the US population Census gives a count of photographers and their (self-reported) earnings. We then interpolate to get annual revenue from 1929 to 2009. Finally, we benchmark all time series to the $0.7 billion of investment given by the 2007 Economic Census.

<table>
<thead>
<tr>
<th>Table 10. Nominal Investment: Commercial Stock Photography, 2007</th>
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<tbody>
<tr>
<td>![Table]: Licensing fees</td>
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<tr>
<td>times Ratio to convert licensing fees to copyright revenue</td>
</tr>
<tr>
<td>equals Copyright revenue</td>
</tr>
<tr>
<td>times Ratio to convert revenue to production cost</td>
</tr>
<tr>
<td>equals Nominal Investment</td>
</tr>
</tbody>
</table>

**Price Index:** BEA’s price index for commercial photography is taken from BEA’s pre-existing price deflator for photo studios. That price index is published in Table 2.4.4U, line 217. Before 1959, I use the price index of audio-video, photographic and information processing equipment. That price index is published in Table 2.4.4, line 14.

**Category 9: Short-Lived Artwork**

This category includes three types of artwork: radio programs, newspaper and magazines. It is possible that there are small categories of short-lived artwork we do not study. BEA’s main interest is in long-lived artwork, 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

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51 This deflator tracks consumer photo services (like wedding pictures), so its not a perfect proxy for commercial photography. Commercial photography has probably been affected much more by the Internet.
revenue. We will assume that newspapers have costs similar to books. In other words, marketing accounts for about 19% of revenue and printing, delivery and customer service account for 45% of 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.


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. We have no data on writing costs as a share of revenue, so we assume that magazines have costs similar to books. 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.

**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 production costs as a share of revenue, so we use the 75% television share. Radio programs are short-lived assets, so nominal revenue is equal to nominal production. Therefore, we calculate that US producers spent $13.7 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.

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\(^{52}\) 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.
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 Artwork Relative to GDP

Figure 4: Short-Lived Artwork Relative to GDP
Figure 5: Software Prices by Category

Figure 6: Long-Lived Artwork Prices by Category
Figure 7: Short-Lived Artwork 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 Artwork
Table 11: Artwork Depreciation Schedules

<table>
<thead>
<tr>
<th>Years Since Release</th>
<th>Theatrical Movies</th>
<th>Television Programs</th>
<th>Books</th>
<th>Music</th>
<th>Misc. Artwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>1</td>
<td>114%</td>
<td>90%</td>
<td>80%</td>
<td>67%</td>
<td>91%</td>
</tr>
<tr>
<td>2</td>
<td>98%</td>
<td>81%</td>
<td>61%</td>
<td>49%</td>
<td>74%</td>
</tr>
<tr>
<td>3</td>
<td>85%</td>
<td>73%</td>
<td>49%</td>
<td>39%</td>
<td>64%</td>
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<tr>
<td>4</td>
<td>82%</td>
<td>66%</td>
<td>41%</td>
<td>33%</td>
<td>56%</td>
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<tr>
<td>5</td>
<td>81%</td>
<td>59%</td>
<td>35%</td>
<td>28%</td>
<td>49%</td>
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<td>6</td>
<td>82%</td>
<td>53%</td>
<td>30%</td>
<td>24%</td>
<td>44%</td>
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<tr>
<td>7</td>
<td>81%</td>
<td>48%</td>
<td>26%</td>
<td>21%</td>
<td>40%</td>
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<td>8</td>
<td>79%</td>
<td>43%</td>
<td>23%</td>
<td>19%</td>
<td>36%</td>
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<td>9</td>
<td>73%</td>
<td>39%</td>
<td>20%</td>
<td>17%</td>
<td>33%</td>
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<tr>
<td>10</td>
<td>68%</td>
<td>35%</td>
<td>17%</td>
<td>16%</td>
<td>29%</td>
</tr>
</tbody>
</table>

Figure 11: Capital Stock of Artwork Relative to GDP