Music as a Capital Asset

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Abstract

In 2002, I estimate that musicians and recording studios created original songs, including recorded performances, with an estimated value of $7.1 billion. These songs were sold on CDs in 2003 and will be played on the radio, on television and at live concerts for decades 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 music and other entertainment, literary and artistic originals as an investment activity and then depreciate those songs over time. As a first step in changing the treatment of music in the National Income and Product Accounts (NIPA), I collected data on music production and calculate what the NIPA would be if songs were classified as a capital asset.

To preview, my empirical results are: 1)In 2002, musicians and record studios created original music with a nominal value of $7.1 billion producing recorded music, approximately 0.07% of real GDP; 2)The recorded music industry has been shrinking dramatically since 2000. Between 2000 and 2007, real GDP growth is reduced by 0.005 percentage points per year if recorded music is treated as a capital asset; 3) Original music remains valuable for decades after it is first produced. I calculate that the aggregate capital value of all original music was $34 billion in 2002.

Introduction

The music industry has changed dramatically since 2000. Real sales of CD's have decreased by almost 50% from 2000 to 2007. At the same time, nominal concert revenue has more than doubled since 2000. There are many papers in the economics literature documenting these changes and analyzing why those changes occurred (Krueger 2005) (Mortimer and Sorenson 2005) (Liebowitz 2004). However, there are few papers tracking the aggregate music industry over time. In this paper, I will examine three separate channels for musicians to earn money: sales of music, royalty income and live concerts. I will then combine those three revenue sources to estimate the total value of original music created each year.

In 2002, I estimate that musicians and recording studios created original songs with a value of $7.1 billion, including the expected revenue from live concert tickets. I define "original songs"as the complete intellectual property associated with music, including the musical composition, lyrics, original records and even music videos. The cost of producing this $7.1 billion in music could be treated either as a current expense or it could be treated as an investment. If original songs have a useful life of less than one year, then the production costs for music should be treated as a current expense. In that case, the final revenue from the sale of music is all that matters for gross domestic product (GDP), and production costs for music are an expense in the same way that CD manufacturing and music advertising is an expense. The BEA currently uses this method to account for music production.

In contrast, items with a useful lifespan of more than one year are generally classified as capital assets. If original songs have a long useful life, then the production costs for music should be treated as a capital investment. In that case, the capital investment in music is added to GDP as part of private investment and added to the pre-existing captial stock of music to get the

total capital stock of original music. This capital stock of copyrighted music then returns a flow of value to its owner, and that flow is counted in GDP as part of capital services. GDP counts both the flow of value and the initial investment. As a result, GDP is always higher when a good is changed method 1) to method 2). Finally, the total capital stock of copyrighted music is depreciated, which is known as consumption of fixed capital (CFC). In addition to the well known GDP, BEA also estimates net domestic production (NDP). NDP = GDP – CFC. Because NDP does not include the cost of maintaining the capital stock, it is generally viewed as a better long-term measure of the total sustainable output of an economy.

In this paper, I will show that it is possible to calculate GDP, CFC and NDP when music production is treated as a capital investment (method 2). I can't directly observe total expenditures creating original music, the total amount of music capital or the flow of services provided by music capital. Nevertheless, I can observe the revenues earned by a song over time. I define the value of a song as the net present value of the future revenues it will earn for its copyright holders, starting from the first time the song is performed and ending when consumers lose interest and switch to newer songs. I also assume that unobserved production costs for music are, on average, equal to the net present value of songs created. In other words, a group of musicians who create songs worth $1 million spent $1 million worth of time and energy composing it. As a result, it is possible to account for song production and song depreciation in the same framework that is already used to account for physical capital production and depreciation. This is the framework recommended by the international guidelines for national accounts, System of National Accounts 2008, for all expenses releated to the production of entertainment, literary and artistic originals (SNA 2008 10.115).

From a theoretical point of view, whether live concert revenue should be included in estimating the value of artistic capital is controversial. On the one hand, musicians typically perform pre-existing songs at concerts rather than composing new songs for each concert. This suggests that live concert revenues could be viewed as a return on pre-existing capital stock of copyrighted music. On the other hand, musicians expend substantial amounts of time and energy performing their songs at concerts. This suggests that the musician's profits from ticket sales could be viewed as a wage payment for labor, not capital. In this paper, I will treat live concert revenues as a return on pre-existing copyrighted music. I choose this method because musicians typically earn money from CD sales, airplay royalties and live concerts simultaneously. In recent years, musicians have been raising prices on live concerts to compensate for CD piracy (Krueger 2005). As a result, excluding live concerts would cause my estimates to miss the substitution that is occurring.

To preview, my empirical results are:

1) Original songs have a useful lifespan of at least 50 years, but more than half of their value comes from sales in the first year.

2) The nominal sales of recorded music fell from $12.6 billion in 2000 to $10.4 billion in 2007. The nominal royalty revenues rose from $0.9 billion in 2000 to $1.5 billion in 2007. The nominal revenue from live concerts has increased from $1.7 billion in 2000 to $3.9 billion in 2007.

3) Prices for live concerts have risen significantly faster than the rest of the music industry. This price growth cannot be explained by quality improvements or input cost growth (Mortimer and Sorenson 2005). Instead, bands are simply raising the ticket price for concerts over the last decade (Krueger 2005).

Taken together, results 2) and 3) show that the treatment of live concert revenue has little effect on real GDP growth since 2000 with music classified as a capital asset. When concert revenues are included in the industry, nominal revenue remains steady and prices increase. When concert revenues are excluded, nominal revenue falls dramatically and prices remain steady. Real music production drops between 2000 and 2007 in both scenarios. Under both scenarios, real GDP growth falls by approximately 0.005% per year when music production is classified as an investment activity.

This research on capitalizing music production is part of a broader research project on changing the treatment of intangible assets in the national income and product accounts. Other researchers at the BEA have developed a satellite account measuring the annual investment and capital value of R & D (Robbins and Moylan 2007), educational investments (Fraumeni, Reinsdorf, Robinson and Williams 2008) and the role of intangible assets in foreign direct investment (Bridgman 2008). In a previous paper, I estimated the quarterly investment and capital value of theatrical movies (Soloveichik 2008). I am currently working to estimate the annual investment and capital value of other forms of artistic capital such as books, television programs and plays.

This paper consists of four sections. In section 1, I describe my data on nominal revenues earned by the music industry and calculate the nominal value of music production back to 1929. In section 2, I describe my price index and calculate the real value of music production back to 1929. In section 3, I describe the various way in which an original song can earn money and estimate the total revenues earned by recording studios and musicians over time. Finally, in section 4, I estimate the total stream of revenue received and expenses incurred by musicians for every year after a song is released. I then use that revenue stream to estimate the depreciation

schedule for original songs. Finally, I combine the real production data from section 2 with the depreciation schedule to estimate capital stocks of music from 1929 to 2006.

1. Nominal Music Production

Musicians earn money from their original songs in four possible ways: 1)They can record the songs and sell them, either on CD or as a download for computers, Ipods or ringtones for cellphones (or records or tapes, etc.). In order to simplify the discussion, I will often refer to this market as CD sales, but my data includes all legal media; 2)They can license the songs for radio play, television broadcast, commercials, theatrical films or live performance by another artist; 3)They can sell the songs on sheet music for individuals to play themselves; 4)They can perform the songs at a live concert and earn money by selling tickets.

In this paper, I define the value of a copyrighted song as the expected present value of future revenues minus future costs. For example, suppose that a song earns \$X in Year 0, \$Y in Year 1 and \$Z in Year 2. Given a discount rate, ρ, the value of a song at release is:

$$\text{Net Present Value at Release} = \$X+\$Y/(1+\rho)+\$Z/(1+\rho)^2$$

In this paper, I discount future revenues at the $\rho = 10\%$ real. In other words, a musician is indifferent between being paid \$1 now and \$1.10 (inflation adjusted) next year. I chose the discount rate of 10% real because the music industry is extremely risky, and so discount rates should be high enough to compensate for the risk.[1] Because I am focusing on revenues, I do not

[1] My estimates of nominal production, real production, depreciation and capital stock are all sensitive to the discount rate used to calculate the net present value of music. Please e-mail me for alternative estimates when a different discount rate is used.

include any piracy or other illegal copies which do not pay royalties to the musicians or recording studios.

Revenues Across Distribution Channels 1985-2007

Figure 1 shows the net present value of music sales by year of initial release. The main data source for Figure 1 is the Recording Industry Association of America (RIAA) annual reports on sales for CD's, Internet downloads, ringtones, etc. (Vogel 2004) (RIAA 2003-2007). I then adjusted the RIAA data to account for retailer mark-up (Cohen 2004), classic CD's sold for years after initial release, re-release of old songs on compilation albums, imports of songs by non-US musicians and exports of songs by US musicians to abroad. Taken together, these adjustments allow me to calculate annual production of music by US musicians using the RIAA data on US sales. Appendix 1 contains much more detail on the exact adjustment procedures used.

The most striking result from Figure 1 is that nominal revenues from the sale of music have been plummeting since 2000. The RIAA data include digital downloads and ringtones – so the decline isn't just a shift from CD's to Ipods. Instead, consumers are not buying as much music. These findings are not new to this paper. A number of industry and academic experts have discussed this phenomenon in recent years. The industry sources are adamant that the main cause the revenue decline is illegal downloading (Hiatt and Serpick 2007) (RIAA website). The economic literature is more mixed, but generally agrees that illegal downloads are a major cause of revenue declines (Oberholzer-Gee and Strumpf 2005) (Mortimer and Sorenson 2005) (Krueger 2004) (Liebowitze 2004).[2]

[2]Many of the economic papers focus on a much more micro level than the RIAA is concerned with. For example, Oberholzer-Gee and Strumpf (2005) found that CD sales did not drop during time when Napster worked better for

Figure 2 shows the net present value of music royalties by year of initial release for every year from 1985 to 2007. Most royalty payments are for performance royalties, which are paid every time a song is played on the radio, broadcast on television or performed live by another artist. The main data source for performance royalties is the annual reports by ASCAP and BMI (Brabec and Brabec 2008). ASCAP and BMI handle more than 95% of performance royalties in the US, and so their annual reports are a very good proxy for the total performance royalties paid in the US. The remainder of royalties are synchronization royalties, which are payments for the right to include a song in a television program, theatrical film or commercial.[3] Finally, I adjusted the performance royalty and synchronization royalty data to account for non-US musicians, exports and classic songs played years after their original release. These adjustments allow me to calculate the value of US music production from revenue data. Appendix 1 gives much more detail on the data used on the process for adjusting revenue.

The most striking result from Figure 2 is that the net present value of royalties from new music grows much slower than overall royalty revenue. Intuitively, more music is being produced each year than is destroyed through depreciation. Therefore, revenues from the licensing of old music are rising even though the production of new music is relatively flat.[4]

Figure 3 shows the net present value of live concert revenues by year of initial release. The main datasource for Figure 3 is Pollstar, an industry group that tracks the live concert market (Krueger 2005), (Pollstar 2006), (USA Today 2005), (Cohan 2007), (Grossberg 2003) and

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reasons completely exogenous to the US music industry. They use that short-term stability as evidence that Napster did not affect CD sales in the long-term. However, it possible that piracy does affect CD sales, but it takes more than a few days for the results to be seen.
On the other hand, the RIAA seems to assume that all downloads are illegal. It is common for new artists to post songs for their fans to legally download. These new artists may be responsible for some of the drop in CD sales.

[3] I have not been able to locate any annual data on synchronization royalties. Based on the 2002 Economic Census and the industry literature, I estimate that synchronization royalties are about 15% of performance royalties for every year from 1985 to 2007.

[4] The results in Figure 2 are quite sensitive to my price index for royalties.

(Weaver 2003). In order to construct Figure 3, I assume that people attend live concerts in order to hear particular songs. Therefore, concert revenues should be allocated to the year when the songs played were initially written. When there are multiple songs with different composition dates performed, revenue is allocated in proportion to the number of songs for each date. My dataset on which songs are played at live concerts will be described in more detail in section 3. I then adjusted the Pollstar data for imports and exports of music. These adjustments allow me to calculate the value of US music production from revenue data. Appendix 1 gives much more information on the process used for adjusting revenue.

The most striking result from Figure 3 is that nominal concert revenues increased by 119% between 2000 and 2007. This increase has already been analyzed in earlier papers. Mortimer and Sorenson (2005) argue that this increase can be attributed to music piracy. They show that the expected revenue from recording an album has shrunk significantly since 2000. Therefore, musicians devote less of their time and energy to recording new albums, and more to touring. Krueger (2005) also finds a large increase in nominal prices for concert tickets. He argued that the price increase occurred because CD albums and live concerts by the same artists are complementary goods. In the past, artists underpriced their live concerts to encourage CD sales. However, artists now get very little revenue for CDs (because they're mostly pirated), and so they charge the market clearing price for live concerts.

\Total Music Production 1985-2007

I estimate aggregate music production in a three stage process. First, I benchmark the revenue statistics given in Figure 1, 2 and 3 to the 2002 Economic Census. Next, I deduct non-

music production costs such as advertising, packaging and retailer profits. I was not able to obtain a time series on sheet music sales, which accounted for 6% of the music market in 2002. For simplicity, I will assume that sheet music is always 6% of total industry revenue.[5] Finally, I add the benchmarked revenue for CD's, royalties, live concerts and sheet music together to get total music production.

My primary dataset for benchmarking music revenues is the 2002 Economic Census. According to the 2002 Economic Census, the sound recording industry earned $0.66 billion dollars from the sale of sheet music and music books, $1.21 billion from performance royalties, $0.19 billion from synchronization royalties for commercials[6] and $9.17 billion from the sale of CD's, records and cassettes. In a separate section, the 2002 Economic Census also reports that taxable music groups earned $2.42 billion from concerts.[7] The numbers from the Economic Census are quite consistent with the industry statistics given earlier. In Figure 1, total CD, tape and download sales for 2002 was $8.2 billion, about 20% below the Economic Census's estimate for 2002. In Figure 2, total performance royalties received were $1.25 billion and synchronization royalties were $0.19 billion, only slightly above the Economic Census's estimate of $1.21 billion in performance royalties and $0.19 billion. Finally, in Figure 3, concert revenues were $2.23 billion in 2002, only slightly below the Economic Census's estimate of $2.42 billion. The small discrepancies between industry data and the Economic Census could be

[5]The 1997 Economic Census does not split out sheet music licensing from other royalties. According to my dataset, about 10% of sheet music are public domain songs. These songs can be (legally) downloaded free or printed by any publisher without payments to the original musician's family. I will therefore reduce the Economic Census's revenues by 10%.

[6] In this paper, I will **not** include synchronization royalties paid by theatrical films or television programs because these royalties have already been counted in the value of theatrical films or will be counted in the value of television programs. However, I will include synchronization royalties paid by advertisers because commercials are not considered artistic originals (SNA 2008).

[7] Non-taxable musical groups earned an additional $1.6 billion. I exclude this revenue because I believe that most of the revenue is for classical orchestras, which rarely compose original songs.

explained by slightly different industry classifications, different treatment of imports and exports[8] or other differences in survey methodology.

Figure 4 shows the aggregate revenues and the aggregate value of newly released songs. Overall, I find that nominal revenues and nominal production have been stagnant since 2000. On the other hand, nominal revenues and nominal production were growing at approximately 9% per year between 1985 and 2000. However, I need to know non-music costs such as manufacturing and marketing to estimate the value of music production over time.

Selling, manufacturing and distribution expenses are the easiest non-music cost to calculate. According to the industry literature, recording studios spend 15% of their CD or cassette revenues for manufacturing & shipping (Cohen 2004). For digital music such as Itunes, manufacturing and shipping is free. Based on the ASCAP and BMI annual reports, I estimate that royalty organizations keep about 15% of the royalties they collect to pay for their administration costs.[9] Finally, I estimate that bands earn enough money from merchandise sales (such as T-shirts) to cover their touring costs and the promoter's share of ticket sales. Accordingly, sales, manufacturing and distribution costs for live concerts are effectively 0% (Krueger 2005). I was unable to find any industry-specific estimate of the production costs for sheet music, but in a separate paper I calculate that printing, shipping and other production costs account for approximately 40% of the wholesale price for books (Soloveichik 2009).

[8] In my industry analysis, I first collected data on total US sales, and then adjusted those US sales for imports and exports using industry data. As an alternative to the industry data on imports and exports, I also examined BEA's own data on imports and exports of music. Based on careful analysis of BEA's own data, I concluded that BEA's trade in services survey measures a different definition of trade in services and a different sample universe than the industry data. As a result, I cannot combine BEA's data on imports and exports with industry data on domestic consumption. Accordingly, I will rely exclusively on industry data to estimate domestic consumption, imports and exports of music. I will then benchmark the industry data to the 2002 Economic Census to derive total domestic production of music.

[9] Synchronized royalty payments are not negotiated through an organization. However, I assume that agents charge the same 15% for handling negotiations.

Marketing expenses are much more complex to calculate. According to the industry literature, advertising accounts for about 1/3rd of the non-manufacturing costs for CD's (Cohen 2004 and my own calculations). I have not been able to find any industry literature on advertising for royalties and live concerts. In this paper, I will assume that advertising is always 1/3rd of total industry revenue net of manufacturing, and advertising is distributed between recording studios, royalty organizations and live concert promoters in proportion to their market share. I will also assume that all marketing expenses occur in the first year after a song is released.

Figure 5 shows my estimate of the annual value of music released from 1985 to 2007. One interesting finding from Figures 4 and 5 is that the ratio of Artistic Capital to Total Music Revenue was a little over 40% in 2002. In a previous paper on the movie industry, I found a similar ratio of Artistic Capital to Total Movie Revenue (Soloveichik 2008). This ratio might be a subject for future research.

Historical Music Production 1929-1984

I have not been able to find any consistent industry data tracking music revenue from 1929 to 1984. I have located a paper that estimates the unit volume of record sales from 1920 onwards, but that paper does not report revenues or manufacturing cost (Gronow 1983).[10] I have also found isolated quotes reporting the licensing revenue for ASCAP or BMI in a particular year (Sterling and Kittross 1978), but no consistent time series. Early in the century, sheet music was a major money-maker for musicians (Sanjek 1988), but the only data I could find on sheet music

[10] Prior to the 1970s, jukeboxes accounted for a large portion of record sales. Based on Mortimer's work with DVDs (2008), I conjecture that records were significantly more expensive when jukeboxes accounted for most of the market.

sales is from the Census of Manufacturers – which gives inconsistent estimates over time. Finally, I could not find any consistent data on live concert revenues over time.

Because of the lack of good industry data on sales, I will use Census data to estimate music production over time.[11] Every 10 years, the Census counts the US population and also surveys a sample population on their employment, earnings, occupation and other interesting variables. I use the employment and salary for musicians as an extrapolator for music profits.[12] In 1990, the Census reported aggregate earnings for all musicians at $2.7 billion (nominal), about 40% lower than the total music industry profits estimated earlier in Figure 5. This discrepancy is consistent with the fact that recording studios keep a substantial portion of CD profits to pay for inputs like sound equipment, talent scouts and administrative overhead. In my analysis, I assume that musician's salaries were 60% of total industry profits for the entire time period 1929 to 1985.

Figure 6 shows my estimate of nominal music revenues from 1929 to 1984. I find that music revenues growth remained steady from 1930 to 1940 and then grew steadily over time. Because my data are based on the decennial Census, I am forced to impute nominal revenues for intermediate years. The exact imputation procedures are available upon request. One important result of my imputation is the music production appears artificially smooth. Therefore, I cannot estimate the exact growth rate for any given year – only the long-term average growth rate.

In a previous paper on theatrical movie production, I used IMDB data on exact filming dates to produce quarterly production estimates for the entire movie industry. These aggregate

[11] I also considered using the Current Population Survey, which provides annual employment data. Unfortunately, the sample sizes were too small to get reliable annual data. I also could not use the Consumer Expenditure Survey because the survey does not track non-consumer spending like royalty payments. I also could not use the BLS employment data because the time series for musicians started in 1990, too late for my historical needs. Finally, I considered using union membership data as a count of musicians, but that procedure misses early African-American musicians, who were banned from most unions.

[12] A random sample of the Census data is available at Ipums.org. The Census samples are large enough that the standard error for my aggregate estimate is relatively small.

production estimates sometimes changed dramatically from quarter to quarter when studios started or stopped filming big movies (Soloveichik 2008). Unfortunately, I can't provide the same quarterly data for music with any degree of confidence. The music industry generally does not report the exact dates a song was first recorded in the studio. Furthermore, the final recording accounts for relatively little of the time spent producing a CD. Much of the musician's time is devoted to writing the song, practicing the song and editing the song before final recording (Thall 2006). In all of my analysis I will assume that music production takes one year and production is uniform over that year. Therefore, inventory is assumed to be around half of annual production.

2. Real Production

It is difficult to develop a price index for copyrighted songs. Each song is a unique artistic creation, and so I can never compare the cost of producing two identical songs over time. Furthermore, the main input to producing a song is the musician's time and energy. It is impossible for me to determine which songs the musician slaved over, and which ones were easy to write. In this paper, I will create a consumer-based price index to estimate the cost of purchasing a unit of music over time. I define a unit of music as one song purchased on tape, CD or legal download, one minute of radio listening, one live concert and one book of sheet music.

My price index assumes that the quality of musical **composition** has remained constant over time. I do not assume that the quality of the music listening experience has remained fixed

over time.[13] Ipods are a big improvement over CD players and CD players were a big improvement over records and tapes. Similarly, radio sound quality has improved with the introduction of FM radio, satellite radio and digital radio. However, I believe that these quality improvements should be attributed to the consumer electronics market and not the music industry. After all, recording studios can and do re-release classic songs on CD or Itunes. These songs are often digitally remastered so their sound quality is better than the first release on record or tape.

My consumer-based price index only tracks legal music consumption. In other words, the number or price of illegal downloads and pirated CD's has no impact on my price index. The number and market share of illegal downloads has been increasing rapidly over the last decade (RIAA website). By 2006, consumers downloaded approximately 1 billion tracks per month (Hiatt and Serpick 2007) – more than ten times the legal sales of music. Accordingly, the average consumer price for music has fallen substantially even while the legal price for music stays fixed. However, BEA's general practice is to ignore illegal activity when measuring prices. For example, we don't discount prices for goods which are shoplifted frequently. Furthermore, I don't have good time series data on how many songs are pirated per year.[14] As a result, I can't calculate the average consumer price for music over time. Instead, I will only track prices for legal music consumption.

[13] This index may produce flawed results if the market size for music has changed over time for reasons unconnected to music quantity, music quality or music prices. For example, the invention of CD's might suddenly double the demand for music. Holding the quality and quantity of songs fixed, this doubled demand means that each new song is worth twice the value of an identical song last year. However, the supply of music is elastic, and so music production is likely to rise if an exogenous shock raises the interest level in music. Furthermore, new music technology is also associated with lower costs of music production. In the long-term, new music technologies have an ambiguous effect on profits earned by musicians per song.

[14] There are industry groups that estimate the number of tracks downloaded from peer to peer networks. However, there is much less data on less organized piracy such as copying CD's or e-mailing songs between friends. Even if I had good data on total piracy, I still wouldn't be able to create a quantity index without knowing the relative weight to use for legal versus illegal songs.

There are a variety of ways in which music is purchased. In this section, I will construct four separate consumer price indexes for music: 1) A per-song price index for CD albums, cassettes, downloads and other music sales; 2) A per-minute price index for radio airplay and television broadcast; 3) A per-event price index for live concerts; 4)A per-book price index for sheet music and song books. I will then combine those four price indexes into a single composite price index, and use that composite to deflate nominal production from Figure 5 and 6.

Price Index for Retail Sales 1976-2007

My price data for retail sales is taken from RIAA's annual reports. These annual reports provide both the units shipped and the retail value of shipments for a variety of formats such as ringtones, digital albums, CD albums, etc. I can then calculate average retail prices for each format according to the simple formula:

Average Price for Format X= (Total Value of X)/(# Units of X).

As a robustness check, I also computed the average price for audio products as a whole and compared it to BLS's price index for "Audio discs, tapes and other media".[15] I find that the two track reasonably closely from 1999 to 2007, suggesting that the RIAA data is a valid proxy for actual retail data.

In this paper, I want to measure the price of the intellectual property contained on a CD, but **not** the price of the CD as a physical good. I will do that by comparing the retail prices for

[15]In the past, recording studios charged $2-$4 more for a CD album than the same album on tape. Therefore, the average price per album rose faster than the average price per CD album or tape album. The BLS's price index for audio media started in 1999. By that time, CD's had almost completely replaced tapes, and so the BLS's price index will not biased by this substitution.
As I discussed earlier, I believe that the quality improvement from tapes to CD's should be attributed to the electronics industry – not the music industry. Accordingly, I consider the price increase from tapes to CD's to be inflation from the standpoint of musicians. In other words, a musician produces the exact same music for a CD and tape – he or she just charges more to compensate for better electronics.

albums and singles. Physically speaking, a single and an album look identical, and they cost the same amount for the recording industry to manufacture, ship or sell on-line. However, an album typically contains 10-20 songs and are sold for $15-$25 in stores. At the same time, a single contains 1 song and is sold for approximately $5 in stores. The price difference between the two is the value of the artistic assets contained on the CD. I can therefore estimate the price of an individual song:

Price Per Song = (Album Price – Single Price)/(Average # of Songs Per Album[17] – 1)[18]

Price per physical CD = (Price per single CD – Price Per Song)

Price for digital file = (Price for single download – Estimated Price Per Song)

This formula provides a price per physical CD of around $4 in 2004. By comparison, an independent market research firm estimates that it costs around $3.39 cents to manufacture, ship and sell a CD at a big box retailer like Walmart. The same industry report also states that small music retailers have higher costs, but does not provide any specific numbers. Even without an exact number, this analysis is quite close to my estimate of $4 per physical CD in 2004. (Cohen 2004).[19]

Figure 7 shows a price index for songs from 1976 to 2007. I find that average price per song has only increased by 77% from 1976 to 2007. In comparison, the PCE services deflator has risen by 300% over the same time period. The slow growth in song prices is particularly surprisingly in light of the fact that the price of a physical CD or cassette has risen by 500%

[17] In this analysis, I use that overall average # of songs per album for each year (about 15). I also experimented with using a separate average for each year. This yielded very similar results on average, but the yearly data was noisier.
[18] It might seem that this formula only works when the average quality of singles and albums is identical. In fact, creative industries have a general practice to charge the same price for all their products, regardless of quality (Orbach and Einav 2007).
[19] In particular, the article reports that CD's cost $1.70 to manufacture and ship and $3.69 for retailer overhead for each sale. However, Walmart uses CD's as a loss leader for other products, and therefore is willing to lose about $2.00 per CD. Independent music stores typically charged higher prices for CD's.

since 1976 (based on the formula described earlier).[20] In other words, the area with little technological improvement, composing music, has enjoyed a very low inflation rate. In contrast, the area with rapid technological improvement, listening to music, has increased in price much faster. I

Price Index for Broadcast Royalties 1984-2007

I will compute a price index for royalties on a per minute per listener basis. The two main licensing organizations, ASCAP and BMI, both charge a fixed fee to radio or television stations for playing their songs.[21] In 2007, radio stations and television stations paid approximately the same amount of money for licensing rights (Brabec and Brabec 2008). Furthermore, Americans spend approximately the same amount of time watching television and listening to the radio.[22] Therefore, I can calculate royalty prices according to the simple formula: Price Per Minute = (Royalties Paid)/[(#Minutes TV + # Minutes Radio)*#Americans]

Figure 8 shows the price index for broadcast music over time. I find that the royalty rate has increased steadily over time. In 1984, musicians charged an average of 0.076 cents per person per minute. In other words, a musician would receive $76 if a television station played a one-minute song on a show watched by 100,000 people. In 2007, musicians charged an average of 0.27 cents per minute. This is equivalent to a 5.4% per year increase in royalty prices. By comparison, the PCE services deflator only increases at the rate of 3.5% per year and CD prices increased by only 2.6% per year.

[20] This price index combines CD's and cassettes into one homogenous good. Inflation rates would be even lower if I tracked CD's and cassettes separately.
[21] This fee only covers the right to play over the radio or television. Advertisers and broadcasters must pay additional royalties if they use a song as part of their program (like a jingle or theme song).
[22]Radio stations are much more likely to play music than television stations, and so it might seem that they should pay higher licensing revenue. However, this is balanced out by the fact that radio is often used as background noise, and so commands much less attention for each song.
My time data is taken from the American Time Use Survey, Arbitron data and other industry sources.

Price Index for Live Concerts

I take my price index for live concerts from the paper "Rockonomics: The Economics of Popular Music" (Krueger and Connolly, 2005). They calculate a large number of possible price indexes. In this paper, I will use their Fisher price index by artist. Krueger and Connoly's price index goes until 2003. I then collected Pollstar's reports of average ticket prices for 2003-2007 in order to extend the time series further. For simplicity, I assume that average ticket prices rose at exactly the same rate as Krueger and Connolly's carefully constructed price index. I have data on average ticket prices back to 1995. I found that annual growth rates don't match up perfectly with Krueger and Connolly's data, but overall price growth is quite similar.

I find that concert prices increase significantly faster than inflation, as shown in Figure 9. Between 1981 and 2007, concert prices increased by an average of 7.8% per year, more than double the overall PCE service deflator. Concert prices also rose much faster than the BEA's general deflator for live entertainment, which rose at 4.2% per year.[23] So, the price growth for concerts cannot be explained by a general trend in the live entertainment industry. Furthermore, the quality of concerts has remained relatively fixed over time (Mortimer and Sorenson 2005). Instead, bands are simply raising the ticket price for concerts over the last decade (Krueger 2005).

Price Index for Sheet Music and Song Books

[23] This deflator includes music concerts as well as plays, dance performances, etc. I calculate that non-music concert prices rose at 3.7% per year from 1981 to 2007,

As discussed earlier in section 1, I was not able to find any time series data on sheet music sales or sheet music prices. Instead, I will use the consumer price index for recreational reading as a proxy for sheet music and song book prices. This price index is available from the BLS website for anybody to download.

I find that songbook prices increase slightly slower than inflation, as shown in Figure 10. Between 1981 and 2007, retail prices for recreational reading increased by only 3.4% per year. Over that same time period, the PCE services deflator increased by only 3.8% per year.

Overall Price Index & Real Production for Music 1984-2007

Figure 11 combines the separate price indexes in Figures 7, 8, 9 and 10 to get a single overall price index.[24] I find that prices for the entire music industry track the PCE services price index reasonably well. Figure 12 uses the prices indexes developed earlier to estimate real production of music from 1985 to 2007. I find that real music revenue shrunk by 4%-5% per year between 2000 and 2007. The decrease is similar when live concerts and included and when live concerts are excluded. On the one hand, nominal music revenue grew faster when live concerts are included in the music industry. On the other hand, prices also rose faster when live concerts are included in the music industry. The two effects almost cancel out, so real growth does not change much when the treatment of live concerts is changed.

Historical Price and Real Production Indexes 1929-2007

[24]The price index shown is a chain weighted index, which uses the previous year's revenues shares to determine weights. Contrary to economic theory, I find that the revenue share for CD's are falling even as their relative prices fall. Therefore, the Fisher index would be slightly above my chain-weighted index.

The price indexes developed earlier in this section are all consumer based. Unfortunately, I don't have consumer price information before 1985, and so I can't construct a consumer-based price index back to 1929. Instead, I will use musician's wages to construct a labor-based price index. This labor-based price index assumes that musicians produce the same amount of music per hour in 1929 and 2009. Such a labor-based index still allows for technological improvements like CD's, satellite radio and Ipods that may improve the music listening experience – but it assumes no technological progress for music composition. I drew my dataset on labor inputs from the 1920 – 2000 US Census and the 2001-2007 American Community Survey (ACS).

The labor-based price index matches closely with the retail-based price index from 1985 to 2007, as shown in Figure 13. On the other hand, the labor-based quantity index does not match nearly so well from 2000 to 2007, as shown in Figure 14.[25] According to the retail-based index, real music production fell by 20% between 2000 and 2007. At the same time, aggregate hours worked by musicians rose by 21% from 2000 to 2007. These results are consistent with research by Mortimer and Sorenson (2005). They found that artists were able to compensate for music piracy by increasing the number and price of live concerts. In contrast, recording studios have experienced sharp declines in revenues from music piracy. Therefore, the earnings for musicians have risen even as the music industry has declined.

As a robustness check, I also experimented with creating an alternative historical index based on music consumption, as shown in Figure 15. This index is based on historical data on a number of possible proxies for music consumption, including jukebox production, musicial instrument sales, etc. I find that my index of music consumption is much lower than the labor-

[25] This labor index does not require any assumptions about nominal revenues or prices of music over time. Instead, I simply aggregate the hours worked by all musicians in the Census without quality adjustment.

based production index from 1929 to 1940, tracks the labor-based production index reasonably closely from 1940 to 2000 and then diverges again after 2000. Therefore, I have some confidence that the labor-based quantity index produces historical estimates within the right ballpark. Please e-mail me for more details about the music consumption index.

Section 3: Revenue Streams From Original Music

In this section, I will estimate the revenue streams and costs separately for each channel. I will then combine the separate revenue streams to get an overall depreciation rate for original songs.

In this paper, I will use four separate datasets to estimate the rate at which studios receive revenue from their copyrighted movies: 1)Billboard charts of album sales in the United States; 2) Music Monitor's tracking of radio airplay by month of airplay and year of original song release; 3)A website listing the songs played in a sample of television programs and theatrical movies; worldwide box office charts; and 4) A webiste listing the songs played in a sample of live concerts. All of these datasets required extensive cleaning before they could be used. Please contact me for more information on the exact data cleaning procedures.

Purchased Music Sales (CD's, Itunes, Records, Cassettes, etc.)

Figure 16 shows the lifespan for an individual song on CD. I found that the typical song sells most of its copies soon after release. More than half of all album sales occur in the first quarter after an album is released, and only 13% of album sales occur more than one year after

release. Because a popular song can be re-released on compilation albums, the lifespan for songs is slightly longer than the lifespan for an particular album. However, compilations account for only 12% of CD sales on average. In addition, many compilation albums are released within five years of the original song release. Therefore, the vast majority of sales revenue occurs within the first two years after a song is released on CD.

The lifespan on CD given in Figure 16 relies on a number of assumptions. Billboard's charts only report sales for best-selling 250 albums. According to industry sources, the best-selling albums account for approximately 70% of total sales. In my analysis, I adjust for the missing data by over-weighting sales for CD's ranked 150-250. This procedure implicitly assumes that CD's ranked 150-250 have the same average age as CD's ranked 250+. In addition, Billboard's charts do not provide actual sales figures, only ranked sales. My estimates of the lifespan of songs change significantly when I use different formulas to impute gross sales based on chart rank.

As a robustness test, I also experimented with using an alternative dataset on CD sales from the Recording Industry Association of America (RIAA).[26] I find that the RIAA and Billboard dataset produce almost identical depreciation profiles, as shown in Figure 16. According to both datasets, more than 75% of CD sales occur in the first year after a song is released. Sales then decrease rapidly, and very few albums sell any significant quantities more than five years after initial release. In the remainder of my paper, I will use the the Billboard revenue data to estimate depreciation profiles for songs. Results remain very similar when I use the RIAA depreciation profile.

[26] The RIAA does not directly measure sales. Instead, they give out awards for albums that ship 0.5 million, 1 million, 2 million, etc. copies. This awards data is available on their website. I use Billboard data to estimate sales of compilation albums and movie soundtracks. It would have been extremely labor intensive to recalculate these small revenue sources. I then adjusted the Billboard data to account for the fact that compilation albums and soundtracks account for a lower market share in the RIAA data than on Billboard.

It is important to note that the short lifespan for CD **sales** does not necessarily mean that nobody is listening to old songs. CD's are durable goods, and so consumers may be buying a CD soon after release and then listening for decades. In fact, the main reason for the short lifespan of CD sales is probably saturation of the target market. In other words, fans want to own a new CD as soon as it is released. Furthermore, there is an active resale market for used CD's, and so new fans of an artist can buy his or her CD's without the recording studio making any money.[27]

Royalties and Sheet Music Sales

Musicians earn royalties in a variety of ways. Musicians earn performance royalties whenever a radio station rebroadcasts an pre-existing song. Musicians also earn synchronization royalties whenever a television program, commercial or theatrical movie combines their song with film to create a new artistic work.[28] Finally, musicians earn performance royalties once again when a television station broadcasts a program with a pre-existing song, even though the producer has already paid synchronization royalties for the song. In addition to all of these royalties, composers also earn royalties whenever their songs are sold on sheet music or music books.

My radio royalty data is taken the company Music Monitor. This company tracks airplay by song more than 2,000 radio stations across the US. In my analysis, I requested a dataset

[27] During the 1990's, recording studios earned significant amounts of money from consumers who replaced their record collection with CD's of the same songs. However, it is straightforward to transfer songs from CD to digital files, and so consumers are unlikely to pay for new releases on a digital format.

[28] As discussed in Section 1, I will not count synchronization royalties in the aggregate music market because they have already been counted in the theatrical movie industry or will be counted in the television industry. However, I will still count those royalties when I calculate depreciation rates.

tracking market share by month and year of airplay. For example, songs composed in 1946 accounted for 0.016% of the radio market in March of 2006. I can then estimate the depreciation rate by tracking the radio market share for a year over time. Because the sample of radio stations is very large, it might seem that this procedure produces a very precise estimate of the depreciation rate. In fact, I only observe 41 months of data, from January of 2006 to May of 2009.[29] My estimates may be biased if this period was unusual in any way.

My television and movie royalty data is taken from the website tvtunefinder.com. This website identifies the songs performed for a sample of popular TV shows. I then looked up the release date for a stratified sample of songs listed on tvtunefinder. It is important to note that the shows listed in tvtunefinder.com are not necessarily representative of the entire industry, and they may be biased in any number of ways. Nevertheless, I was not able to find any more authoritative datasets.

Figure 17 show the average market share by age of songs for radio royalties, synchronization royalties and television broadcast royalties. I find that radio royalties, synchronization royalties and sheet music sales decrease extremely fast at first. For example, songs released in 2005 acounted for 27% of the radio market in January of 2006, but only 16% of the radio market in December of 2006. On the other hand, I find that royalties from television broadcast diminish significantly slower. Intuitively, the slower decrease can be explained by the fact that the original musician gets new royalties each time the show is re-run in syndication.[30]

[29] The dataset provided by Music Monitor starts in January of 2004. However, the market share for classic songs dropped dramatically during 2004 and 2005. This market share decline is not a data error by Music Monitor – Arbitron data reports a similar decline in the market share for Oldies stations. Nevertheless, I believe that including this unusual time period would produce a misleading depreciation curve. I therefore started the sample in January of 2006, after the taste shift had already occurred.

[30] I do not yet have any data on the lifespan for television programs. In this analysis, I assume that television programs depreciate at the rate of 40% per year. I also assume that theatrical movies account for 10% of songs played on TV, and those movies depreciate at 3% per year (Soloveichik 2008)

Based on the radio airplay data, I estimate that older songs depreciate much slower. In January of 2006, songs released before 1995 accounted for 26.4% of the total radio market. These same songs accounted for 23.7% of the total radio market in May of 2009. This is equivalent to an annual depreciation rate of 3.8% per year. I found similar results for synchronization royalties and sheet music sales, but the datasets for those revenue sources were too small to estimate the long-term depreciation rate precisely. I will therefore use the same 3.8% rate to depreciate those royalties.

I also experimented with estimating the lifespan for sheet music sales. My sheet music data is taken from the website musicnotes.com. Unfortunately, I found that musicnotes.com data had so much random noise that I could not compute a meaningful depreciation curve. However, the general depreciation pattern was similar to that of television performance royalties. Therefore, I will assume that sheet music sales depreciate at the same rate as television performance royalties. Please e-mail me for more information about the sheet music results.

Live Concert Revenues

All of my data on concert songs is taken from the website Setlist.com. This website collects the program of songs performed (called a set) at concerts for a sample of 379 artists. The main data starts with concerts during the 1960s, and continues until concerts at the end of 2008. It is important to note that the musicians listed on Setlist.com are not a comprehensive sample of the industry, or even a random sample of the most influential artists. Setlist.com is a website created by unpaid fans of a particular musician or band. Individual fans e-mail in set lists or post the set lists on the website. I do not know if the musicians on Setlist.com are representative of the entire industry, or whether the concerts posted on Setlist.com are

representative of the entire concert market. I was also unable to check directly whether the songs posted on Setlist.com are accurate. Nevertheless, Setlist.com is the best data I could find to estimate the vintage of songs performed at concerts. I then weighted each concert by the venue's reported capacity (as listed on Onlinegigs.com). For example, a concert at Madison Square Garden, which holds more than 20,000, counts for more than a concert at a local bar.[31]

Similar to the earlier results, I find that songs depreciate by rapidly at first, as shown in Figure 18. On average, songs less than one year old account for 29% of the market share, more than double the market share for songs one year old. I also find that old songs depreciate very slowly. [32] Based on a sample of all songs played at least five time, I estimate that classic songs depreciate at approximately 8%-9% per year. This is slightly higher than the depreciation rate for radio royalties, which I estimated at approximately 4% per year.

Section 4: Depreciation Rates of Music Over Time

Combined Depreciation Rates

In Figures 15-17, I showed that the lifespan for songs is different on CD, radio, television and live concerts. Therefore, the average lifespan for a song depends enormously on the weights given to each revenue stream. In my analysis, I will use the net revenue statistics given by the 2002 Economic Census and the industry literature to weight each revenue stream. In particular, I assume that CD sales account for 66% of industry net revenue, royalties account for 10% of industry net revenue, sheet music accounts for 3% of industry net revenue and live concerts

[31] I restrict the sample to concert venues that were listed in onlinegigs.com. Depreciation is slightly faster when I impute capacities for venues with missing data or weight all venues equally.
[32] This depreciation rate assumes that bands continue to charge the same price over time. Anecdotal evidence suggests that bands charge much higher ticket prices later in their career, after they have built a devoted fan base. The higher ticket prices would reduce depreciation rates.

account for 20% of industry net revenue. The depreciation schedule would be very different if I used a different weighting method.

There are many possible reasons why a copyright might decrease in value over time. For example, all consumers in a target market might have already bought the CD. Alternatively, a song might fall out of fashion because of cultural change. In this paper, I will not attempt to distinguish between the various reasons a consumer might stop buying an old song. I will simply attempt to estimate the schedule at which musicians and recording studios earn money from their songs, and the costs associated with those revenues.

Figure 19 shows the depreciation schedule for original songs based on net revenue after subtracting sales and advertising costs. These costs are discussed in much more detail in section 1. I find that original songs depreciate by approximately 50% in the first year of life. This is still high, but much lower than I estimated earlier. The depreciation rate then slows dramatically and finally stabilizes at approximately 4%.

Comparing My Estimate of Depreciation Rates with Market Transactions

I will check the depreciation schedule show in Figure 19 by comparing it to known market transactions. My dataset of music catalog sales is primarily taken from the book "The Business of Music" (Krasilovsky and Shemel 2007). That book describes a number of acquisitions in the music industry from 1988 to 2002. I also include the multiple sales of the Beatle catalog, as described in a New York Times article about Michael Jackson (O'Brien 2006). I then used the depreciation schedules given in Figure 19 to predict the price for each catalog at the time of sale.[33] Table 2 gives more details about each transaction.[34]

[33]I use RIAA award data and total production data to proxy for aggregate production. For example, Beatles songs earned 56% of all gold awards in 1969. I therefore assume that Beatles songs accounted for 56% of the aggregate

It is important to note that a recording studio might sell for more or less than the value of its music. On the one hand, recording studios only own partial rights to most songs in their catalog. For example, the recording studio might own the right to sell records of a song – but they are required to pay a fee to the musician for every copy they sell. Furthermore, musicians generally keep the right to perform their songs in concert without paying any royalties to the recording studio. The exact ownership of each song depends on the contract between studios and musicians, and is often kept private. On the other hand, recording studios own many more assets than just music catalogs. For example, a studio might have pre-existing contracts with popular artists, a well developed brand image, relationships with retailers and general industry experience.

Overall, I find that my predicted prices are significantly lower than the actual acquistion prices, as shown in Table 2. I also find that the mark-up between predicted price and actual price varies enormously across catalog sales. Nevertheless, I am reassured by the fact that the two prices are within the same general ballpark. The observed differences in price can easily be explained by non-music intangible assets mentioned in the last paragraph. I will continue to use the depreciation schedules described in Figure 20 for my empirical analysis.[35]

Capital Stocks of Music Over Time

Figure 19 combines the real production estimates given in Figures 11 and 13 with the depreciation schedules given in Figure 18. Consistent with the decline in music production, I

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value released in 1969. My estimates of prices for individual catalogs are quite sensitive to the exact method used to estimate initial value.

[34]Music catalogs may include foreign musicians in addition to US production. In addition, music catalogs may include synchronization royalties, which I choose to count in theatrical movie and television accounts. I increase the value of music production by approximately 25% a year to adjust.

[35] It is also possible that depreciation profiles have changed over time. In theory, BEA could use separate depreciation profiles for 1960s songs and 1990s. However, that would be extremely difficult to implement.

find that the real capital stock of music has declined since 2000. In 2007, the total value of all music capital was $34 billion, about six times annual production. As a robustness check, I also computed the capital stocks using a simple geometric depreciation rate of 20% per year. I found that the aggregate capital stock of music did not change much when I used this simplification

Conclusion

In this paper, I showed that it is possible to calculate GDP, CFC and NDP when music production is treated as a capital investment and songs are treated as a capital asset. Using my calculations, BEA could bring the GDP statistics in line with System of National Accounts recommendation for music production (SNA 2008).

To review, my empirical results were:

1)In 2002, musicians and record studios created original music with a nominal value of $7.1 billion producing recorded music, approximately 0.07% of real GDP;

2)The recorded music industry has been shrinking dramatically since 2000. Between 2000 and 2007, real GDP growth falls by 0.005% per year if recorded music is treated as a capital asset;

3)Original music remains valuable for decades after it is first produced. I calculate that the aggregate capital value of all original music was $34 billion in 2002.

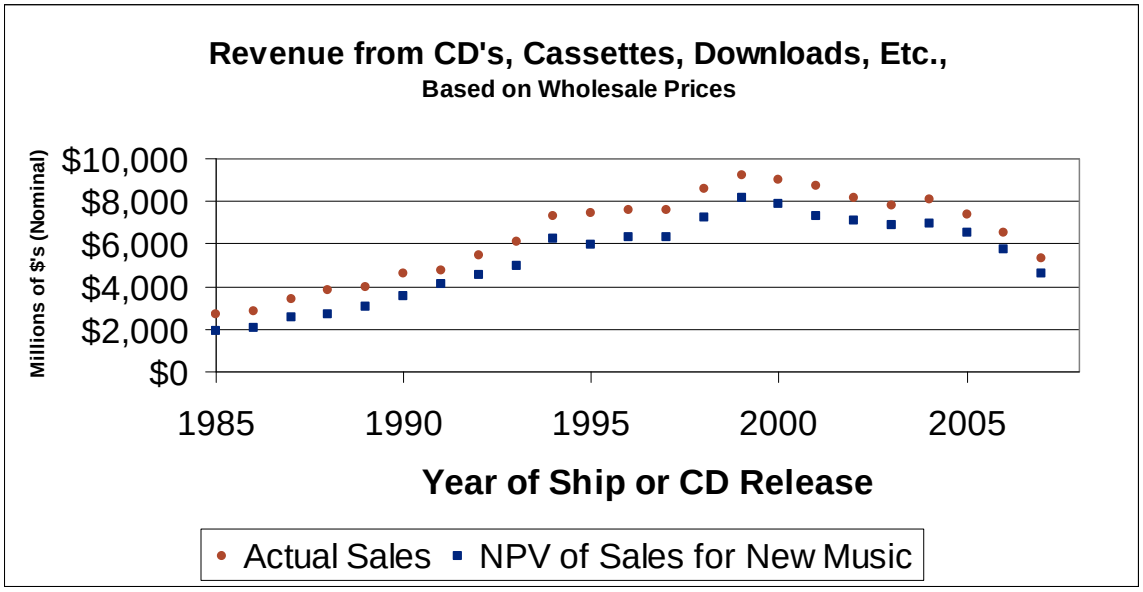
Table 1: **List of Datasets Used and How They Are Used**

Dataset	Description of Dataset	Used to Create
2002 Economic Census	The Economic Census is conducted every 5 years by the Census Department. It surveys businesses in the United States.	Nominal Music Revenue, Nominal Music Production & Depreciation Schedules
Allmusic.com	This website lists the release date, # of tracks, original source, and other information for albums & singles. It also lists the nationality for musicians.	Nominal Music Production, Price Index for Purchased Songs
Billboard.biz	This website ranks songs by weekly popularity. It also provides sales rank, title, musician, recording studio and suggested retail price for all major songs since 1985. In addition, I also found summarized Billboard information for earlier songs.	Nominal Music Production, Price Index for Purchased Songs & Depreciation Schedules
MusicMonitor	This company tracks radio airplay for a wide variety of songs across the United States. In particular, they list % Airplay by year of first release	Depreciation Schedules
Setlist.com	This website reports the songs play (sets) at individual concerts for selected musicians.	Depreciation Schedules
Arbitron Radio Surveys	Arbitron tracks radio listening time across the United States.	Price Index for Royalites
American Time Use Survey & TVB	The ATUS tracks all time use in the US, included television watching time. The TVB tracks only television watching	Price Index for Royalties

Table 2: **Selected Music Catalog Sales**

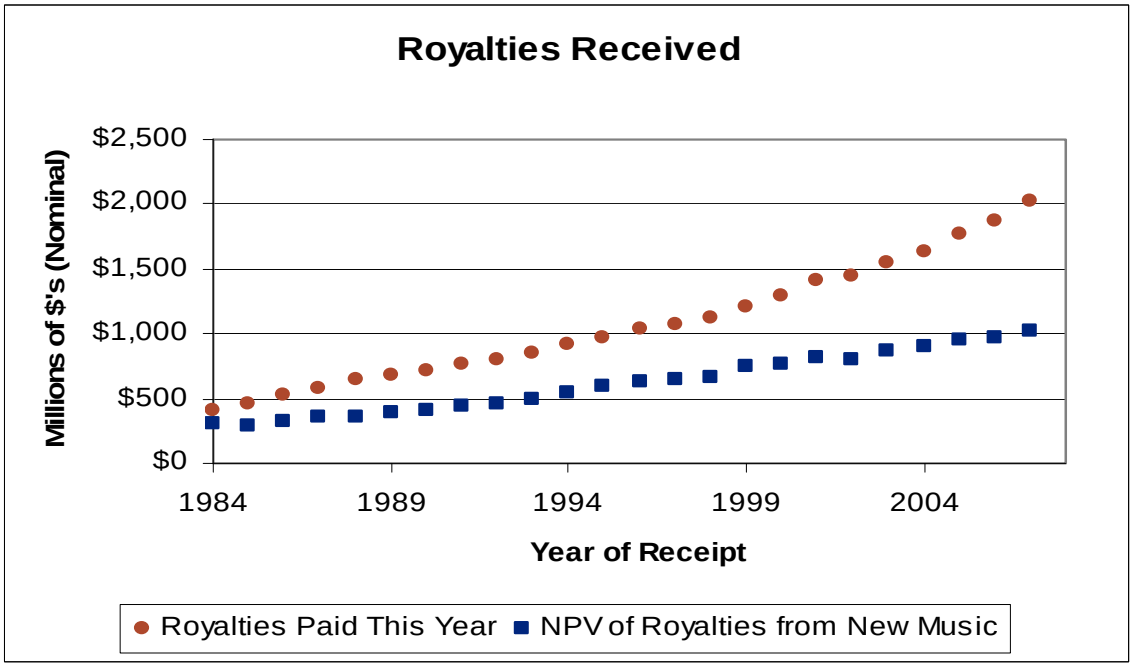
		Predicted Price		
Year	Description of Deal	Without Concerts	Including Concert	Actual Sales Price
1985	Michael Jackson bought the Beatles catalog	$171 million	$209 million	$47 million
1988	Sony acquired Columbia Records	$1.60 billion	$2.21 billion	$2 billion
1989	A consortium led by MCA acquired Motown records	$101 million	$143 million	$61 million
1990	EMI acquired Virgin Records	$235 million	$293 million	$872 million
1990	MCA acquired Geffen Records	$313 million	$454 million	$550 million
1992	Polygram acquired Motown records.	$237 million	$303 million	$301 million
1995	Michael Jackson sold a 50% stake in the Beatles catalog to Sony	$149 million	$196 million	$200 million+ ($100 million+ for 50% stake)
2002	BMG acquired Jive	$1.05 billion	$1.57 billion	$3 billion
2005	Michael Jackson sold a 25% stake in the Beatle catalog to Citibank	$141 million	$200 million	$1 billion ($250 million for a 25% stake)

Figure 1



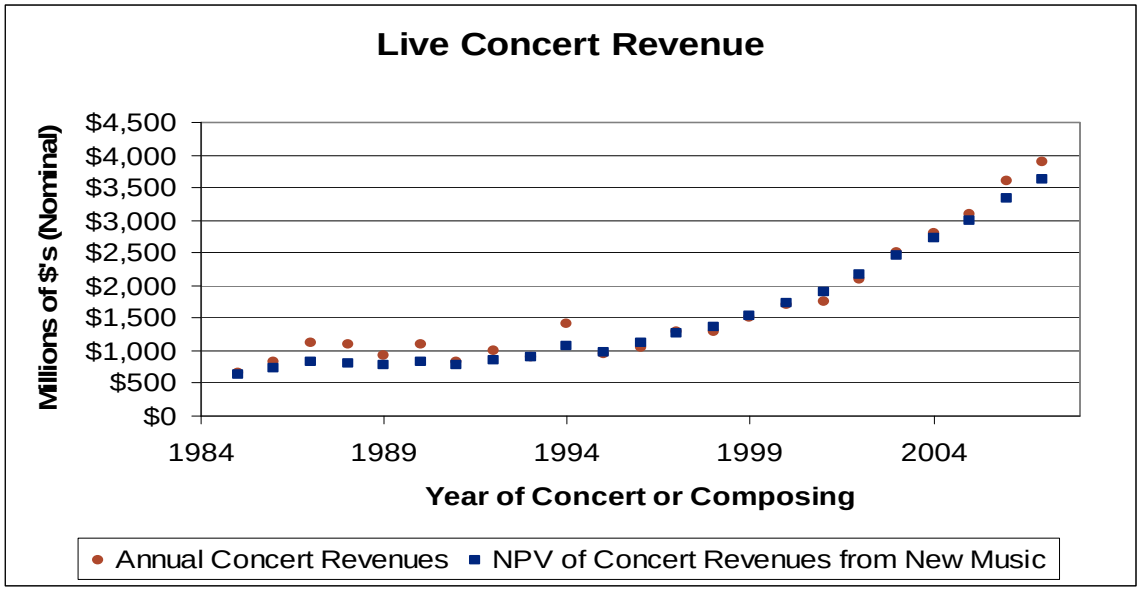
Source Data: RIAA Annual Reports (Vogel 2004 and RIAA Website), Billboard Charts, IFPI sales data

Figure 2



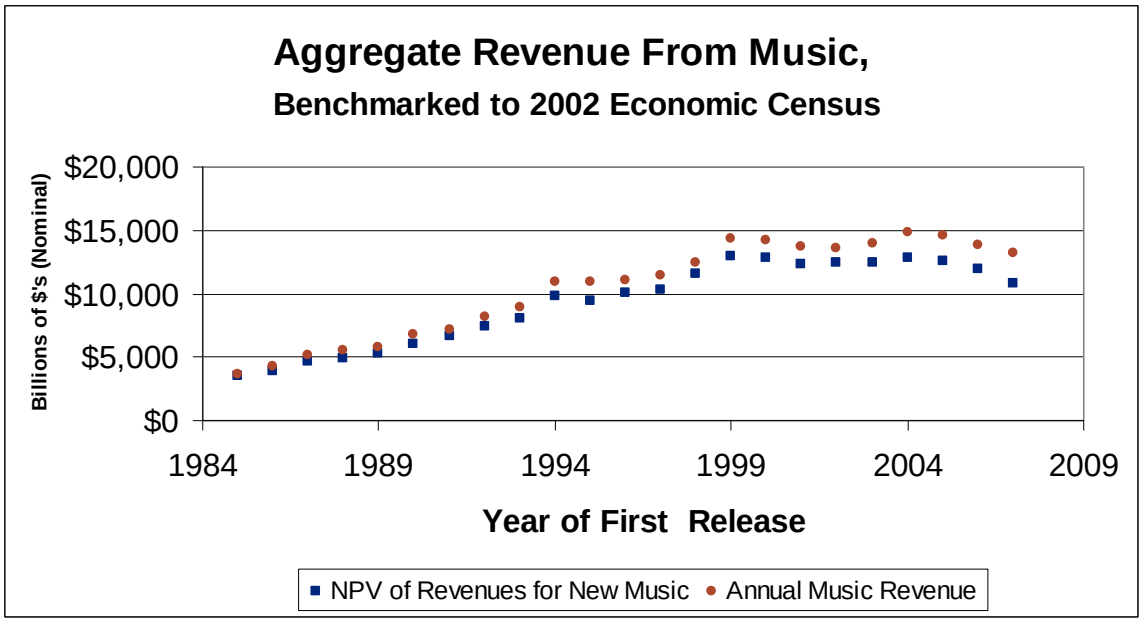
Source Data: BMI and ASCAP Annual Reports (Brabec and Brabec 2008), Economic Census, Industry literature, Billboard Charts and NMPA

Figure 3



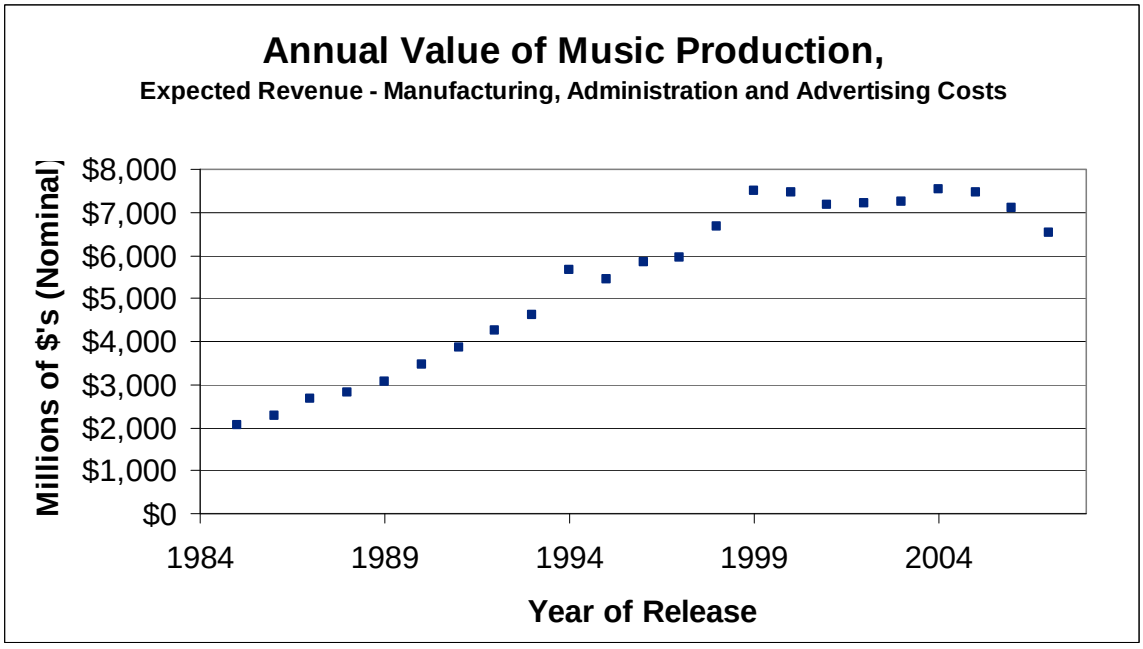
Source Data: Pollstar Concert Prices (Krueger 2005 and media reports), Setlist.com

Figure 4



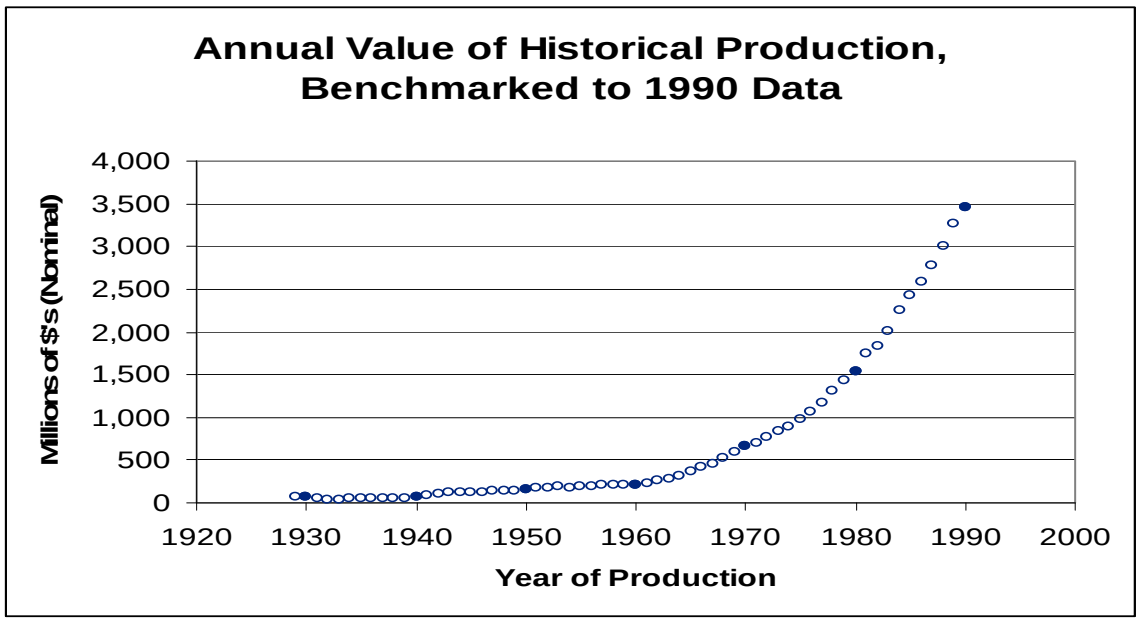
Source Data: 2002 Economic Census (Sound Production Industry), Figures 1-3

Figure 5



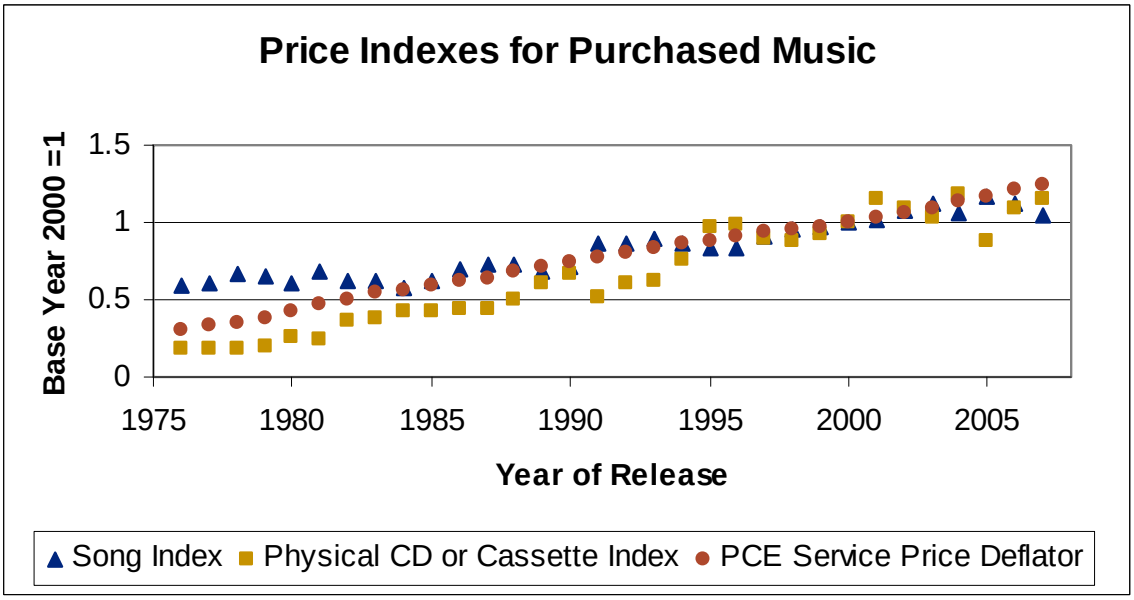
Source Data: 2002 Economic Census, Figures 1-3, Industry Literature

Figure 6



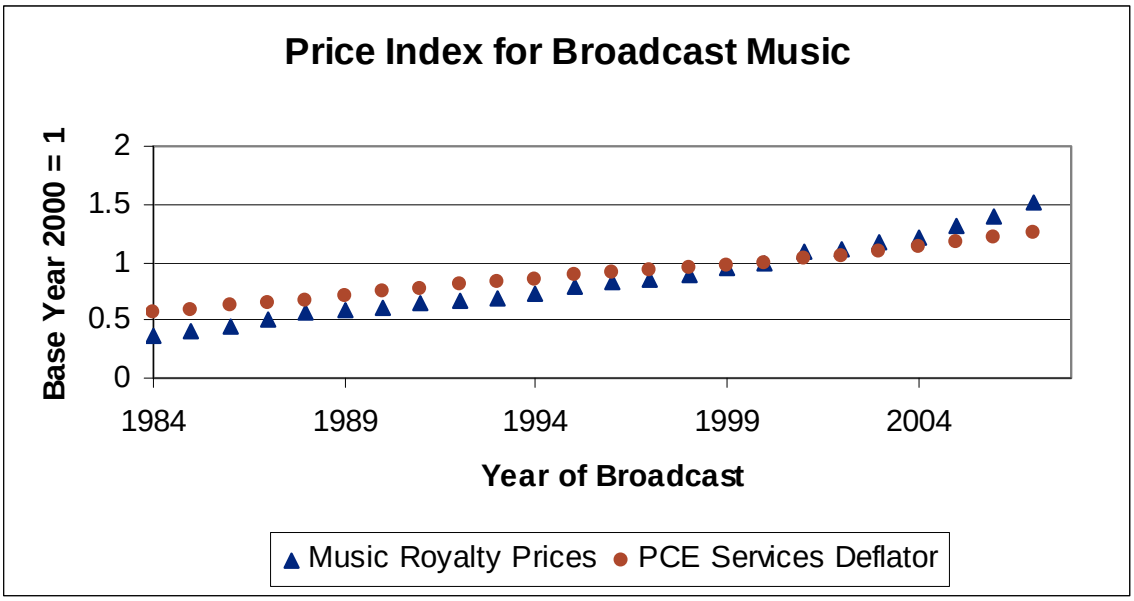
Source Data: 1920-1990 US Census, 1929-1990 GDP Per Capita

Figure 7



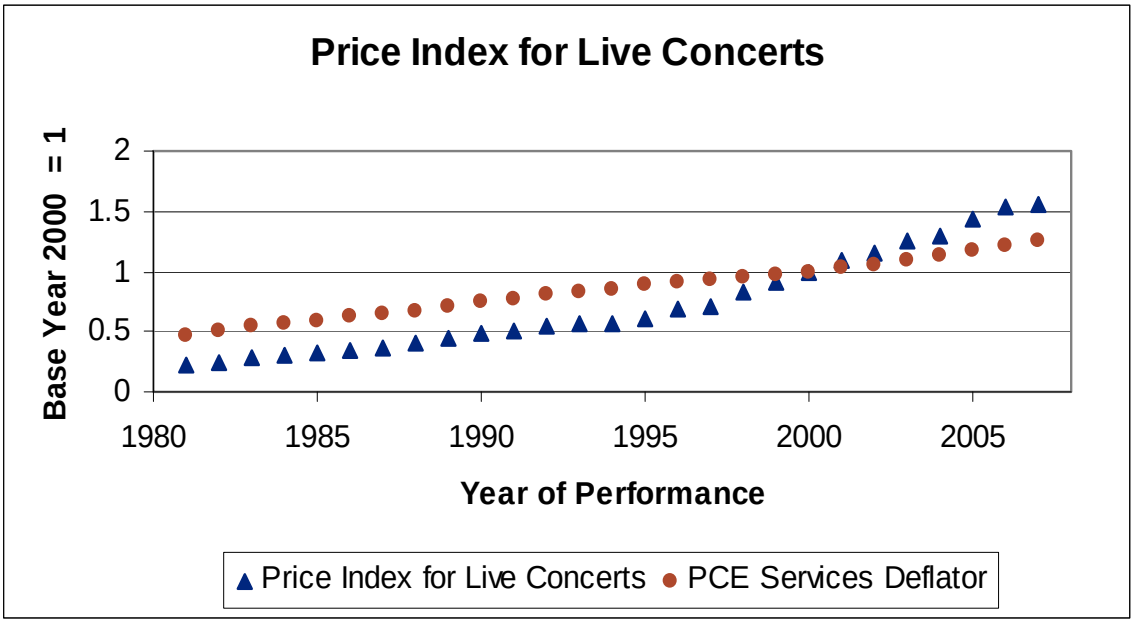
Source Data: RIAA Annual Reports (Vogel 2004 and RIAA Website), Billboard Charts

Figure 8



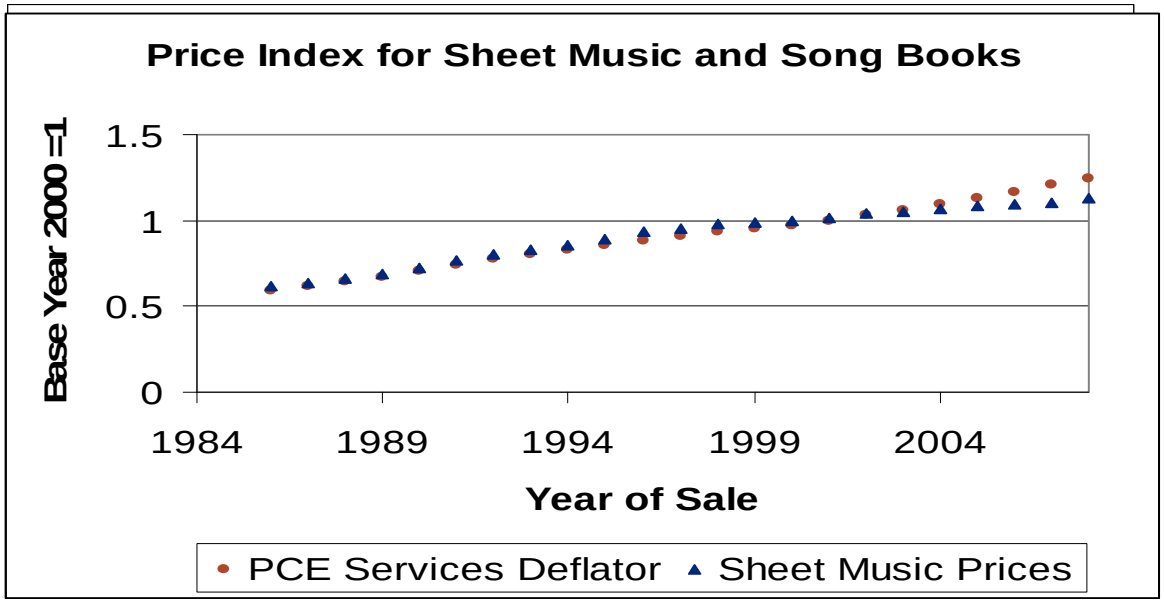
Source Data: ASCAP and BMI Annual Reports (Brabec and Brabec 2008), American Time Use Survey, Television Bureau of Advertising, Arbitron Radio Tracking Data

Figure 9



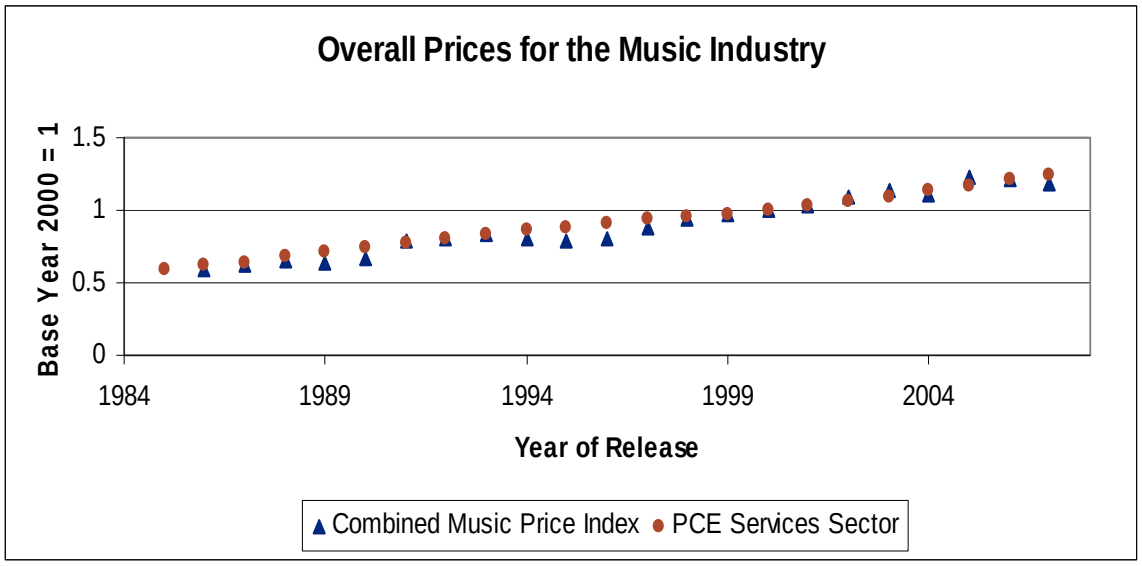
Source Data: Krueger 2005, Pollstar Reports (Various Media Stories)

Figure 10



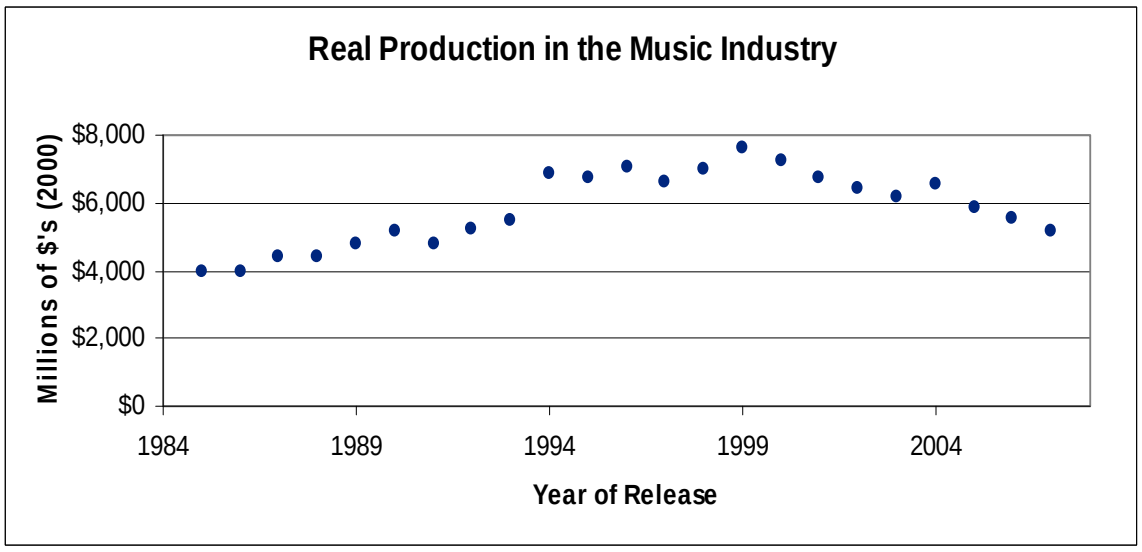
Source Data: BLS Retail Price Index for Recreational Books

Figure 11



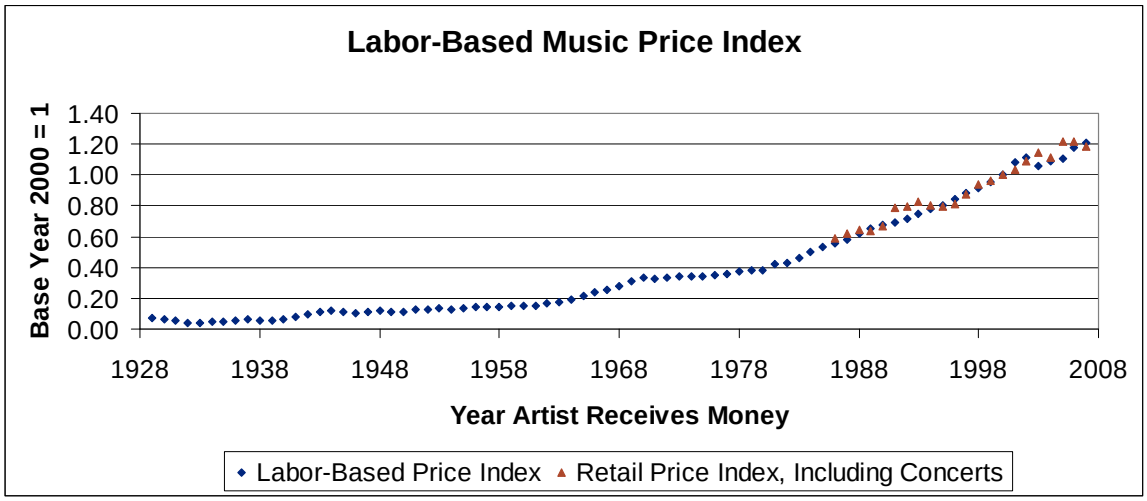
Source Data: Price Index from Figures 7, 8, 9 and 10. Revenue shares from Figures 1, 2, 3

Figure 12



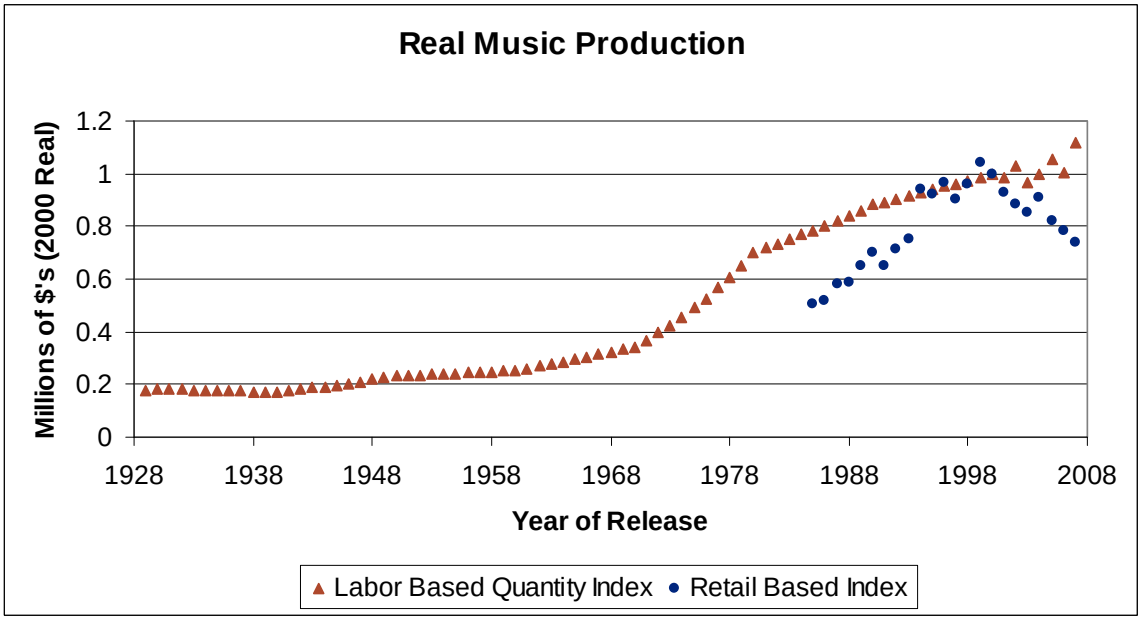
Source Data: Nominal Production from Figure 5, Price Index from Figure 10

Figure 13



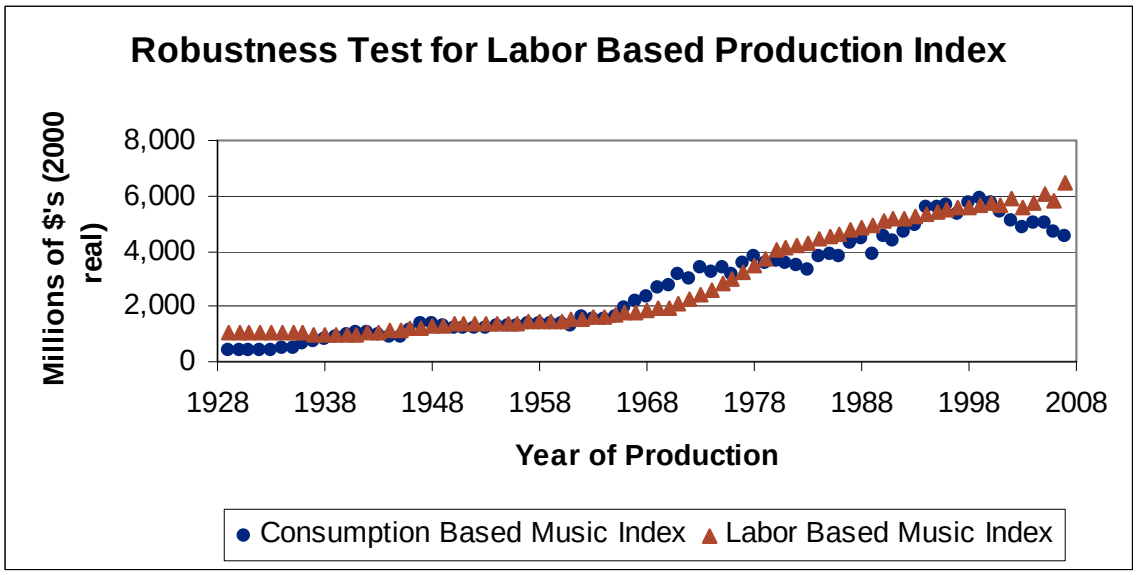
Source Data: Retail Price Index from Figure 11. Labor-Based Price Index from 1920-2000 US Censuses and 2000-2007 American Community Survey.

Figure 14



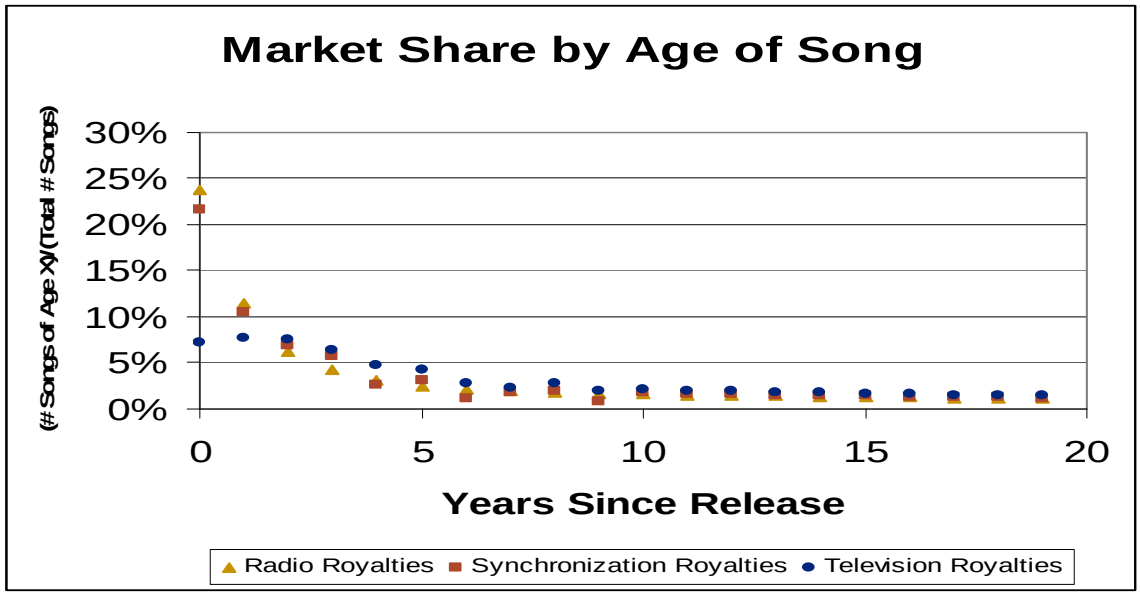
Source Data: Retail Based Quantity Index from Figure 12. Labor Based Quantity Index from 1920-2000 US Censuses and 2000-2007 American Community Survey

Figure 15



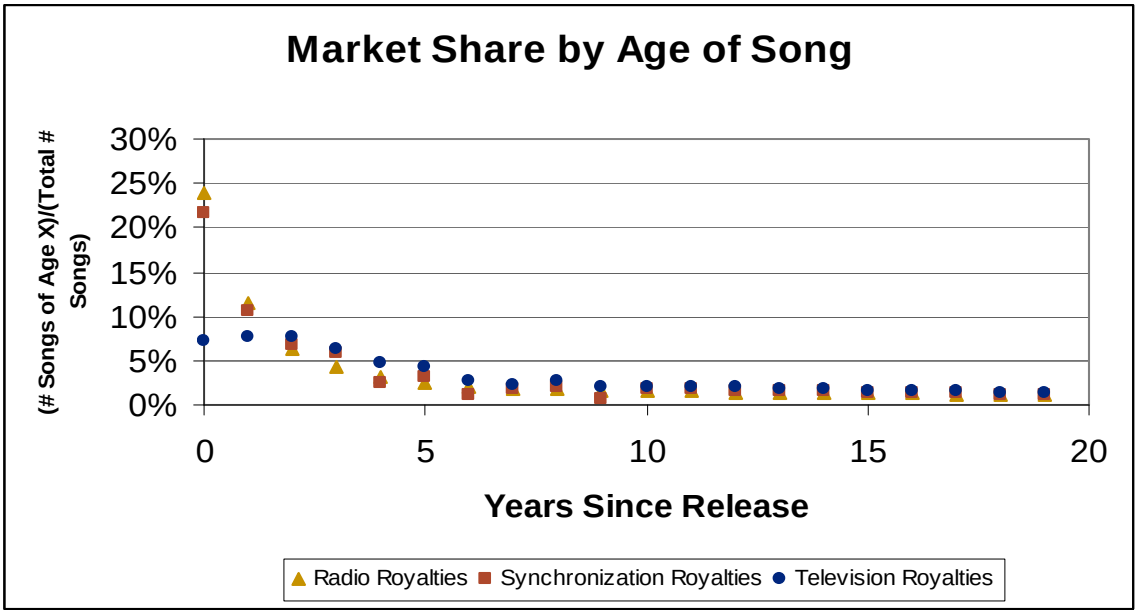
Source Data: Labor Based Index from Figure 14, Consumption-Based Index from Piano Sales Data 1880-1959, BEA Musical Instrument Sales 1959-2007, Jukebox sales from tomszone.com, # Musicians from 1920-2000 US Census and 2000-2007 ACS, Record Sales from Gronow (1983), Radio and Television time from Sterling & Kittross, Arbitron data and TVB data

Figure 16



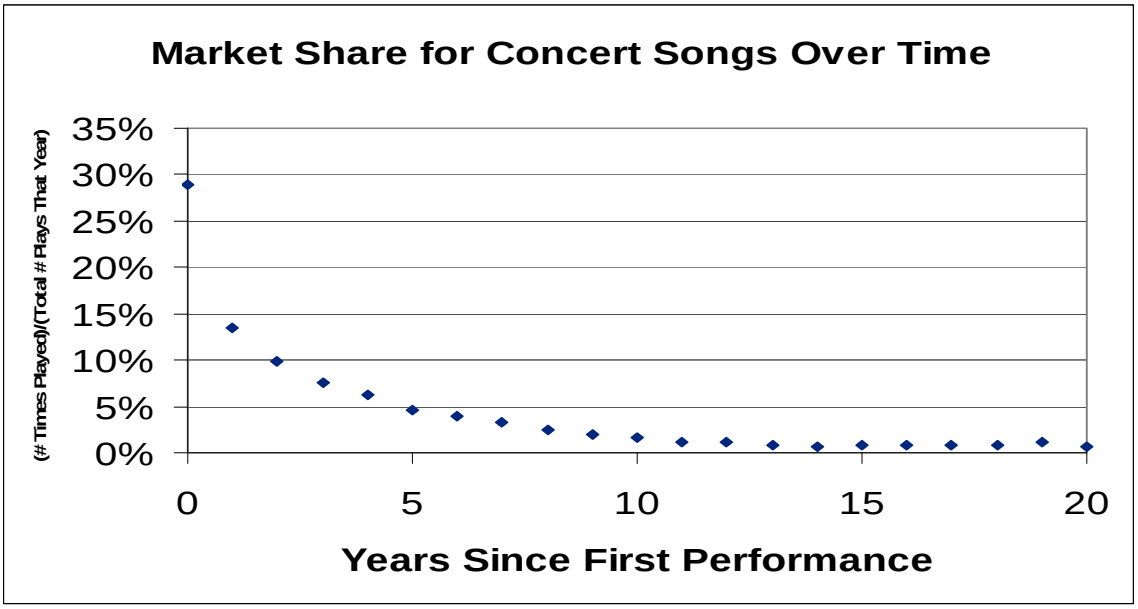
Source Data: Billboard Charts, RIAA awards from RIAA.com

Figure 17



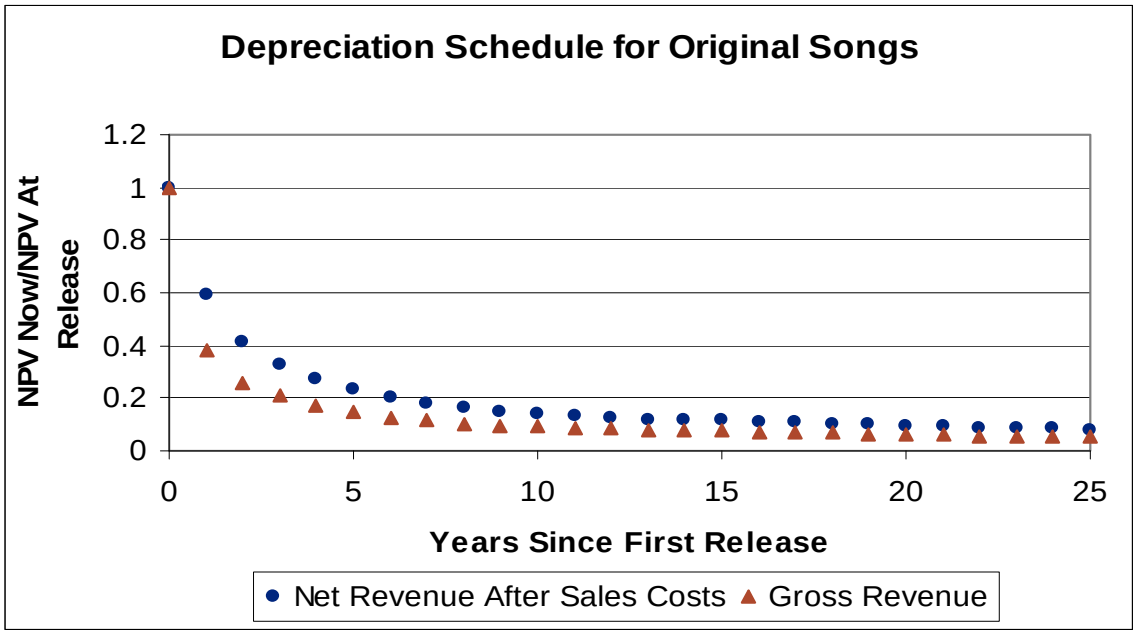
Source Data: Radio Royalties from Music Monitor, Synchronization Royalties and Television Performance Royalties from tvtunefinder.com

Figure 18



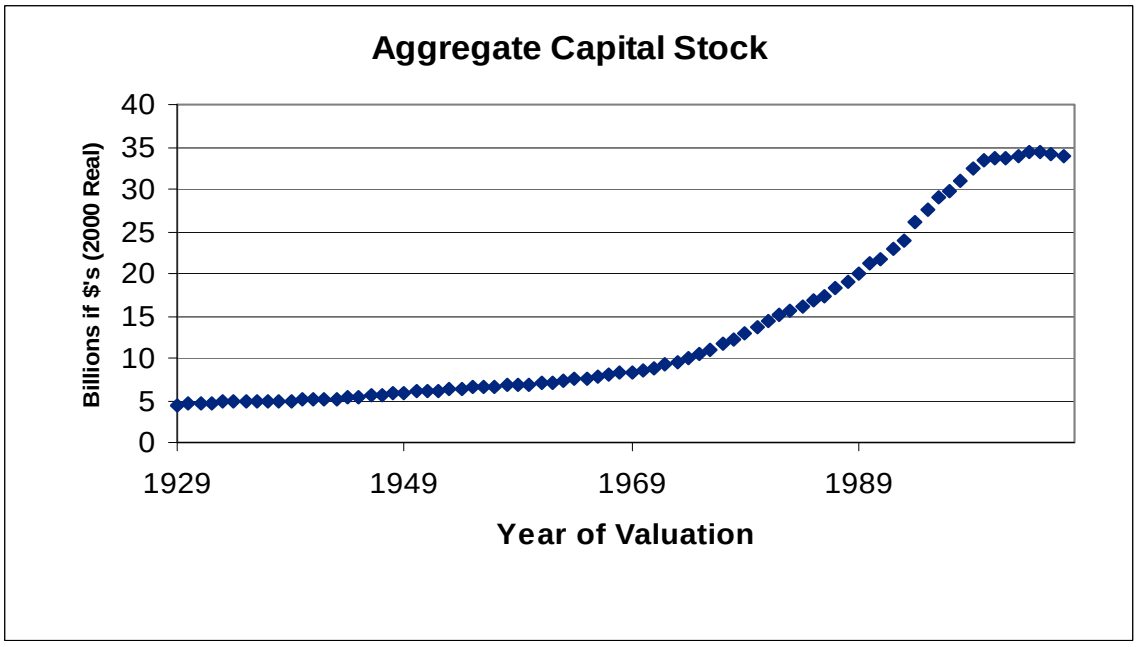
Source Data: Setlist.com

Figure 19



Source Data: Depreciation Schedule from Figures 16-18. Revenue Shares from 2002 Economic Census

Figure 20



Source Data: Real Production from Figures 12 and 14. 1880, 1900 & 1920 Censuses, Depreciation Schedule from Figure 19

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Appendix 1: Description of Revenue Adjustments

Adjustments for Figure 1 (CD Sales)

I use Billboard chart data to translate RIAA's annual sales data to an estimate of net present value of music sales by year of release. I first downloaded Billboard's top 200 and top pop charts from 1985 to 2007. I then imputed sales according to the formula: CD's Sold = (1/Rank ^.667)*(Average Monthly Sales). I calibrated this formula with data from Music Media's global sales charts, which report both sales rank and also estimated sales numbers.

I then selected a stratified subsample of albums and looked up whether the album is a new release CD (versus re-release of old songs) and what year the album was first released. On average, I estimate that two thirds of CD's sold are new release albums that are within one year of initial release. Based on the depreciation profile estimated in Figure 17, I estimate that sales after the first year account for 28% of the total value of a song. Accordingly, I calculate the following formula:
Net Present Value of New Releases = (Total RIAA Sales) * (% Sales that Are New Releases) * (1+28%)

I estimate imports of music using Billboard chart data and online databases. In order to calculate US imports, I assume that all country of production follows the musician's nationality. For example, all profits from the Beatles music are attributed to the United Kingdom (where the Beatles were born), all profits from Michael Jackson are attributed to the United States, etc.[36] On average, about 80% of CD's sold in the United States are produced by US musicians,[37] and the market share for imports has been rising over time. Accordingly, the RIAA sales data slightly understate the true growth in US production.

I estimate exports of music using international sales data from the IFPI, international charts from a wide variety of countries and online sale database. I first downloaded IFPI's estimates of annual CD sales by country. I then collected charts for each major country and looked up nationality for a stratified subsample of artists on those charts. I find that the share of American music varies enormously across countries: approximately 4% of Japanese CD's were produced by Americans, 15% of French CD's, 28% of German CD's, 32% of British CD's and 73% of Canadian CD's. On average, I estimate that American artists account for 24% of European sales and 12% of sales in the rest of the world (excluding US). I then weighted each country's % American by the total CD sales in that country. Based on those figures, I estimate that exports account for only 20% of the total value of an American musician's songs. My dataset was detailed

[36] I use the country of residence at the time a musician started their career to determine nationality. It is common for popular musicians to maintain several homes in various countries, and sometimes change their legal residence for tax reasons.
Recording studios often retain a large portion of the profits from a CD, and so I could potentially adjust for nationality of recording studio. However, musicians generally work with a recording studio from their home country (Cite), and so that adjustment would add complexity without changing results.
[37] Excluding re-release CD's and classic CD's. The US share is slightly smaller over the full sample.

enough to estimate yearly export shares, and so I will assume that export shares have been roughly constant over time.[38] Accordingly, I calculate the following formula: Value of US Production = (Total RIAA Sales) * (1-% Sales that Are Imports) * (1+20%)

Table 3: Annual Adjustment Factors 1985-2007 for Digital and Analog Sales

Year	Wholesale Revenue, Based on RIAA Data	% New Release CD's	(NPV of Sales Year 1-100) / (Value of Sales Year 0)	% CD's produced by American Artists	Value of Exports/(Value of All Sales)	NPV of Revenue by Year of Release
2007	$5,297	67.7%	0.31	80.8%	0.21	$4,593
2006	$6,551	68.0%	0.31	80.9%	0.21	$5,718
2005	$7,404	67.1%	0.31	82.7%	0.21	$6,522
2004	$8,073	65.5%	0.31	83.1%	0.21	$6,969
2003	$7,811	67.5%	0.31	82.0%	0.21	$6,865
2002	$8,162	68.2%	0.31	80.6%	0.21	$7,121
2001	$8,755	64.9%	0.31	80.9%	0.21	$7,292
2000	$8,979	67.1%	0.31	82.5%	0.21	$7,889
1999	$9,221	65.9%	0.31	84.3%	0.21	$8,126
1998	$8,597	67.4%	0.31	78.5%	0.21	$7,213
1997	$7,622	65.4%	0.31	79.9%	0.21	$6,313
1996	$7,610	66.0%	0.31	79.5%	0.21	$6,327
1995	$7,480	61.9%	0.31	81.4%	0.21	$5,980
1994	$7,327	66.7%	0.31	80.1%	0.21	$6,216
1993	$6,100	65.3%	0.31	79.1%	0.21	$4,999
1992	$5,479	66.1%	0.31	79.3%	0.21	$4,552
1991	$4,756	68.8%	0.31	79.0%	0.21	$4,104
1990	$4,578	66.4%	0.31	73.8%	0.21	$3,557
1989	$3,995	66.4%	0.31	72.8%	0.21	$3,065
1988	$3,798	66.4%	0.31	67.7%	0.21	$2,707
1987	$3,380	66.4%	0.31	71.1%	0.21	$2,532
1986	$2,824	66.4%	0.31	69.9%	0.21	$2,079
1985	$2,664	66.4%	0.31	67.0%	0.21	$1,881
Data Source	RIAA Annual Reports	Billboard Charts 1985-2007	Depreciation Curve from Figure 15	Billboard Chart Data	IFPI Sales Data, miscellaneous charts across the World	

[38]The two top importers of US songs are UK and Germany. I downloaded their charts from 1980 to 2007 and estimate % American for each year. I found a lot of random variation, but no consistent trend in the US share. As a robustness check, I also compared US sales to world sales for a sample of 97 top albums. Restricting the sample to US musicians, I found that US sales account for about 80% of total worldwide sales, and the ratio has remained relatively constant over time, though there is considerable variation across artists.

Adjustments for Figure 2 (Royalty Revenue)

Because my paper is focused on the production of music, I would like to report the annual value of royalties by year of first release rather than year of sale. In other words, a 2008 replay of 'Lucy in the Sky with Diamonds' should be attributed to the 1960s, when the Beatlers originally wrote the books. I will estimate annual production according to the formula:

Production = [(Actual Sales)-(Predicted Sales With No New Production)]*[(NPV of all Sales)/(Sales in First Year)]

For example, suppose that revenue from a new song decreases at 50% per year ($1 Year 0, $0.50 Year 1, $0.25 Year 2, etc.). Using that hypothetical depreciation rate, the net present value (NPV) of a new song is 1.82 times its sales in the first year (at 10% discount rate). In 2006, annual sales of all songs were $1.9 billion. Without any new production, sales in 2007 would be $1.9*0.5 = $0.95 billion. In fact, annual sales were $2 billion. Therefore, I calculate that NPV of royalties for all songs released in 2007 were ($2-$0.95)*(1.82) = $1.94 billion. Of course this formula requires a known price index for royalties and a known depreciation curve. I use the price index given in Figure 8 and the depreciation curve given in Figure 17 to calculate the real royalties, the real stock of pre-existing music and the real value of new music production from 1985 to 2007.

I estimate imports and exports for royalties using methods very similar to the methods used earlier to estimate imports and exports for CD's. In particular, I take my import share for new music royalties exactly from Table 1. I also assumed the share of American music is the same for CD sales and royalties for each individual country. However, average export share is slightly different because I use royalty revenue rather than CD sales to weight each country's data. Once again, I don't have detailed enough data to estimate annual export share. I will assume that export shares are fixed over time.

Table 4 Adjustments for Figure 2 (Royalty Revenues)

Year	ASCAP and BMI Royalty	% New Songs/Total Sales	(NPV of Sales Year 1-100) / (Value of Sales Year 0)	% Songs by American	Value of Exports/(Value of All Sales)	NPV of Revenue by Year of Release
2007	$2,029	17%	2.07	81%	0.20	$1,024
2006	$1,864	17%	2.07	81%	0.20	$967
2005	$1,763	18%	2.07	83%	0.20	$959
2004	$1,633	18%	2.07	83%	0.20	$903
2003	$1,548	18%	2.07	82%	0.20	$860
2002	$1,441	19%	2.07	81%	0.20	$804
2001	$1,415	19%	2.07	81%	0.20	$809
2000	$1,285	20%	2.07	83%	0.20	$763
1999	$1,208	20%	2.07	84%	0.20	$745
1998	$1,130	20%	2.07	78%	0.20	$659
1997	$1,075	20%	2.07	80%	0.20	$646
1996	$1,040	21%	2.07	79%	0.20	$627
1995	$973	20%	2.07	81%	0.20	$599
1994	$911	20%	2.07	80%	0.20	$547
1993	$853	20%	2.07	79%	0.20	$498
1992	$798	20%	2.07	79%	0.20	$467
1991	$758	20%	2.07	79%	0.20	$446
1990	$721	21%	2.07	74%	0.20	$405
1989	$685	21%	2.07	73%	0.20	$389
1988	$651	22%	2.07	68%	0.20	$359
1987	$581	23%	2.07	71%	0.20	$353
1986	$519	24%	2.07	70%	0.20	$328
1985	$464	25%	2.07	67%	0.20	$292
Data Source	BMI and ASCAP Reports	Depreciation Curve from Figure 16		Billboard Chart Data	NMPA Royalty Revenue, international music charts	

Adjustments for Figure 3 (Concert Revenue)

I estimate annual production according to the formula:

Production =[(# New Songs Played)/(Total # Songs Played)]*[(NPV of all Sales)/(Sales in First Year)]

For example, suppose that songs composed in 1985 accounted for 5% of industry revenue from 1985 to 2005, and total industry revenue was fixed at $1 billion per year from 1985. With a 10% discount rate, (NPV of all Sales)/(Sales in First Year) = 9.08. The total value of new production in 1985 is 5%*$1 billion *9.08 = $0.45 billion. In my actual statistics, I use the price index given in Figure 9 and the market share breakdown given in Figure 18.

I estimate imports and exports for live concerts using data from Setlist.com. This dataset gives the locations, dates and songs performed from a sample of live concerts from 1960s on. Based on that dataset, I estimate that approximately 92% of concert in the US are performed by American musicians and American musicians perform approximately 8% of their concerts abroad. Unfortunately, my dataset is not large enough to produce annual estimates. Therefore, I take the average for each year.

Table 5 Adjustments for Figure 3 (Live Concert Revenue)

Year	Pollstar Data	% Market Share for New Songs	(NPV of Sales Year 1-100) / (Value of Sales Year 0)	Imports - Exports	NPV by Year of Release
2007	$3,900	33%	1.77	-1%	$3,632
2006	$3,600	33%	1.77	-1%	$3,348
2005	$3,100	33%	1.89	-1%	$3,013
2004	$2,800	33%	1.90	-1%	$2,730
2003	$2,500	33%	1.93	-1%	$2,465
2002	$2,100	33%	2.09	-1%	$2,177
2001	$1,750	33%	2.23	-1%	$1,901
2000	$1,700	33%	2.03	-1%	$1,729
1999	$1,500	33%	2.07	-1%	$1,548
1998	$1,300	33%	2.14	-1%	$1,373
1997	$1,300	33%	1.91	-1%	$1,270
1996	$1,050	33%	2.16	-1%	$1,115
1995	$950	33%	2.09	-1%	$988
1994	$1,400	33%	1.27	-1%	$1,066
1993	$900	33%	1.99	-1%	$904
1992	$1,000	33%	1.57	-1%	$864
1991	$830	33%	1.77	-1%	$771
1990	$1,100	33%	1.23	-1%	$826
1989	$935	33%	1.46	-1%	$772
1988	$1,100	33%	1.18	-1%	$805
1987	$1,128	33%	1.18	-1%	$826
1986	$825	33%	1.62	-1%	$725
1985	$660	33%	1.86	-1%	$633
Data Source	Krueger (2005) & media stories	Age Market Share Curve from Figure 18		Setlist.com	