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Working Paper

Revenue, New Products, and the Evolution of Music Quality since Napster

Institute for Prospective Technological Studies Digital Economy Working Paper, No. 2015/03

Provided in Cooperation with:

Joint Research Centre (JRC), European Commission

Suggested Citation: Aguilar, Luis; Duch-Brown, Néstor; Waldfogel, Joel (2015) : Revenue, New Products, and the Evolution of Music Quality since Napster, Institute for Prospective Technological Studies Digital Economy Working Paper, No. 2015/03, European Commission, Joint Research Centre (JRC), Seville

This Version is available at:

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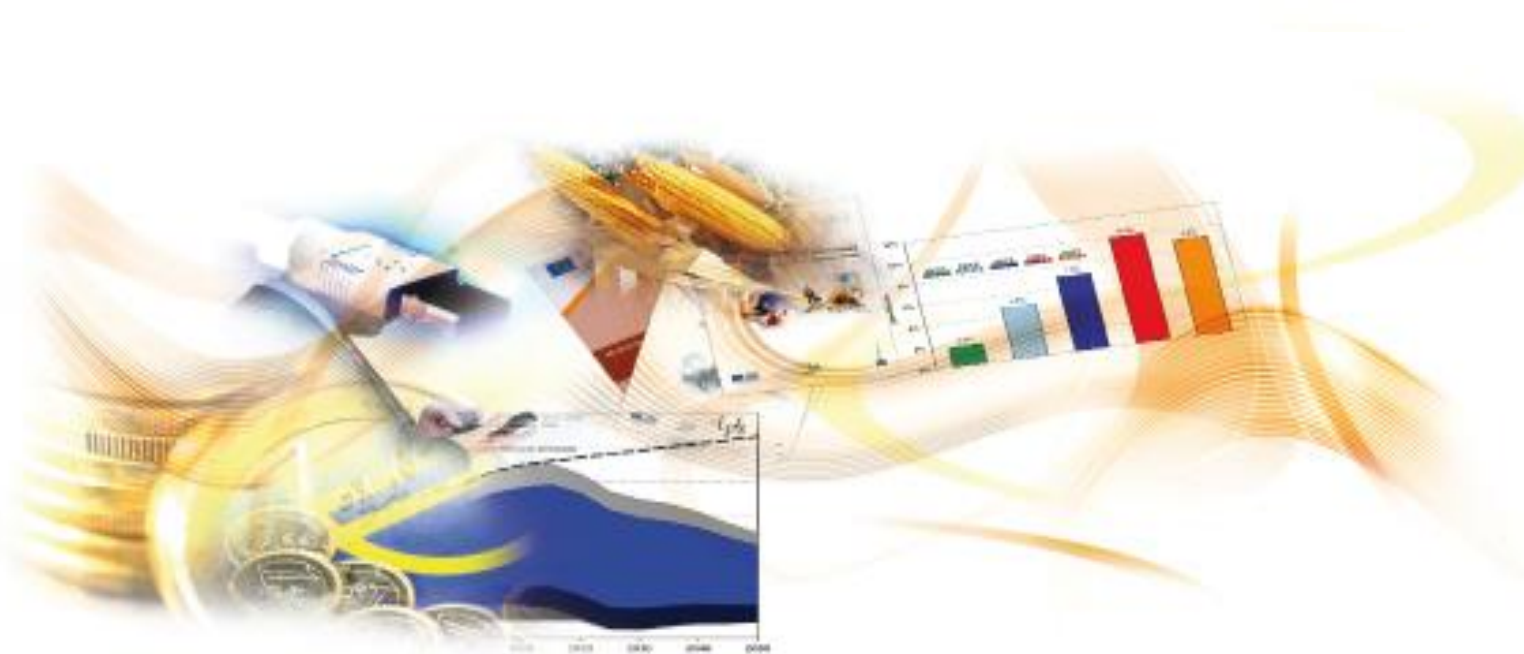
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JRC TECHNICAL REPORTS



*Institute for Prospective Technological Studies
Digital Economy Working Paper 2015/03*

Revenue, New Products, and the Evolution of Music Quality since Napster

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2015

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This publication is a Working Paper by the Joint Research Centre of the European Commission. It results from the Digital Economy Research Programme at the JRC Institute for Prospective Technological Studies, which carries out economic research on information society and EU Digital Agenda policy issues, with a focus on growth, jobs and innovation in the Single Market. The Digital Economy Research Programme is co-financed by the Directorate General Communications Networks, Content and Technology.

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JRC90047

ISSN 1831-9408 (online)

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Abstract

Recorded music revenue has fallen sharply since Napster's appearance, by about 70 percent in North America and Europe, raising a serious question about the viability of continued investment in new recorded music products. The number of new works has risen significantly since 2000; but the number of new products is a poor indicator of the value that society derives from music given the skew in sales distributions. Using comprehensive digital sales data on the US, Canada, and 15 European countries, we infer the evolution of vintage quality from consumption data by time and vintage. We find that quality has increased since 2000 based on both North American and European consumption data. Our detailed data allow various decompositions of the quality index. First, we decompose by geographic origin, and we find that the increase in quality appears in both North American and European-origin music. Second, we decompose sales into the number of songs and sales per song, and we find that most of quality increase stems from growth in the number of songs. We explain the growth in quality despite the collapse of revenue by the fact that costs have fallen more than revenue, allowing strong growth in the number of new products. Moreover, because of the unpredictability of commercial appeal, growth in the number of products is akin to taking more draws from an urn and allowing the discovery of more products with substantial appeal.

Non-Technical Summary

Recorded music revenue has fallen sharply since the appearance of the first file sharing technology (Napster) in 1999. By 2012, it was down by about 70 percent in North America and Europe compared to 1999. Several factors may have contributed to this decline in revenue, including the change from physical CD formats to digital downloading and widespread file sharing. The fall in revenue raises a serious question about the viability of continued investment in new recorded music products, but it is not by itself the only question of interest for public policy. The purpose of copyright is precisely to protect investment in new artwork and give artists and producers a financial incentive to invest in new recordings. If that incentive is no longer strong enough to ensure a steady stream of new high-quality products, there may be a need for policy makers to intervene to reinforce copyright protection in music. From this perspective, the correct barometer for the health of the copyright system is whether creators bring forth valuable new products.

The paper investigates the impact of recent technological change - that one may collectively term “digitization” - on the quantity and quality of music products produced in North America and 15 European countries. The number of new works has risen significantly since 2000; but the number of new products is a poor indicator of the value that society derives from music given the skew in sales distributions. Instead, one should take into account the evolution of the quality of new music products as well.

The evolution of vintage quality can be inferred from consumption data by year and by vintage. In any given year, older music tends (on average) to sell less due to depreciation. Given data on sales by vintage for multiple calendar years, one can ask whether different vintages sell more or less than others, after accounting for depreciation. Using this approach on fragmentary sales data for the US only, [Waldfogel \(2012\)](#) found that the quality of music in the eyes of US consumers has grown sharply since Napster. This paper revisits the question of how vintage quality has evolved using comprehensive digital sales data on the US, Canada, and 15 European countries. It finds that quality has increased since 2000 based on both North American and European consumption data.

Our detailed data allow various decompositions of the quality index. First, we decompose by geographic origin, and we find that the increase in quality appears in both

North American and European-origin music. Second, we decompose sales into the number of songs and sales per song, and we find that most of quality increase stems from growth in the number of songs.

We explain the growth in quality despite the collapse of revenue by the fact that, with digitization of music, production and distribution costs have fallen more than revenue, allowing strong growth in the number of new products. How then does the growth in the number of products translate into an increase in quality? We argue that the growth in benefit that consumers experience from new music would depend on the ex ante predictability of music's appeal at the time of investment. We test two hypotheses. If music quality were perfectly predictable, a reduction in the cost of bringing songs to market would facilitate entry of new songs in the "long tail" of low-appeal songs. The concentration of the sales distribution would fall. This could nevertheless collectively raise consumer surplus, if only modestly. If quality were unpredictable, on the other hand, then cost reduction would enable entry of songs throughout the realized sales distribution. We would see growing success of songs which had low ex ante prospects at release. That is, a growing share of even the top-selling songs would be those released with low ex ante prospects. This would not necessarily reduce the sales concentration and it would generate much larger benefits for consumers. Put differently, because of the unpredictability of quality, growth in the number of products is akin to taking more draws from an urn and allowing the discovery of more products with substantial appeal. Using artists on independent labels as markers of low ex ante prospects, we find substantial growth in the share of products with modest ex ante prospects among the top-sellers. We also find growth in sales concentration even as the number of products available to consumers rises substantially. Hence it appears that the growth in the number of new releases allows consumers to discover additional valuable products that would not have come to market prior to digitization.

From a public policy perspective, our results cast doubt on whether the sales-displacing effect of unpaid consumption through file-sharing creates a problem that requires redress through stronger copyright protection, at least in order to maintain pre-digitization levels of quantity and quality of creative output in the recorded music industry. One could of course argue that stronger copyright protection might have further increased the quantity and quality of music production.

1 Introduction

The advent of digitization over the past few decades has been tumultuous for both the recorded music industry and the copyright system. With the appearance of Napster in 1999, revenue from recorded music began to fall in the US after rising for decades. In 2012 North American recorded music revenue was 75% below its 1998 level in real terms, and revenue in Europe was down by 70%. Industry observers have long viewed file sharing as the cause of the decline in revenue and have sought relief in the form of stronger copyright enforcement, including HADOPI in France as well as attempts to pass SOPA and PIPA in the US, among other reforms ([Wortham and Sengupta, 2012](#); [Pfanner, 2013](#)).

In the research community the advent of file sharing launched a literature devoted to measuring the impact of file sharing on sales.¹ Because of spotty data availability as well as the lack of clean “experiments,” the question is rather difficult to study, so particular studies are generally not dispositive. But after a decade of research, a preponderance of the evidence indicates that file sharing indeed depresses sales. Moreover, it is likely that the sales displacement rate - perhaps 1:4 - in conjunction with large volume of unpaid consumption can explain most of the decline in recorded music revenue ([Liebowitz, 2011](#)).

While the impact of file sharing on revenue is an important question for sellers of recorded music, it is not by itself the only question of interest for public policy. The purpose of copyright is to provide rewards adequate to ensure continued supply of creative products, generating benefits for both producers and consumers. From this perspective, the correct barometer for the health of the copyright system is whether creators bring forth valuable new products. Because of high costs of bringing new products to market, lower revenue could reduce the number of products brought to market, harming both sellers and buyers. Yet, recent technological changes - that one might collectively term “digitization” - have not only made it more difficult to generate revenue from a given set of products, but have also reduced the costs of bringing new products to market. It is therefore not clear a priori whether reduced revenue has undermined the flow of new creative products.

Ascertaining whether a creative economy brings forth the right number of products is, empirically at least, a daunting task. A more feasible if nevertheless challenging question is

¹See [Oberholzer-Gee and Strumpf \(2007\)](#), [Rob and Waldfogel \(2006\)](#), [Zentner \(2006\)](#), [Blackburn \(2004\)](#), among others.

simply whether the flow and quality of new products has declined or increased following digitization.² [Waldfoegel \(2012\)](#) proposes a method for inferring the evolution of music’s appeal using data on the sales of music by calendar year and vintage of original release. In any given year, older music tends to sell less due to depreciation. Given data on sales by vintage (v) for multiple calendar years (t), one can ask whether different vintages sell more or less than others, after accounting for depreciation. That is, by regressing the log of the share of year t sales originally released at vintage v , or $\ln(s_{t,v})$, on age dummies and vintage dummies, one can recover an index of the appeal of each vintage - or “quality” - to consumers from the vintage coefficients. Using this approach on fragmentary sales data and aggregate airplay data for the United States, [Waldfoegel \(2012\)](#) finds that the quality of music in the eyes of US consumers has grown sharply since Napster. This is a provocative result: if correct, it casts significant doubt on whether the sales-displacing effect of unpaid consumption creates a problem that requires redress through stronger intellectual property protection, at least in order to maintain pre-Napster levels of creative output.

This paper offers two contributions. First, we revisit the question of how vintage quality has evolved using comprehensive song-level digital sales data on the US, Canada, and 15 European countries, 2006-2011. While this question has been posed before, it was analyzed using fragmentary data for only the US. Because the answer is potentially important for public policy, an assessment using authoritative and more comprehensive data is valuable. Our analysis confirms the growth in vintage quality documented earlier. In particular, we find that the quality of new vintages has been raising steadily since 2000 and now stands at its highest level since 1975. Our data also allow us to calculate the vintage quality index separately by destination. We find similar patterns using consumption data from North America and Europe, indicating that quality has increased in the eyes of consumers around the world. Our results also show similar patterns for music from different origin regions, indicating that the quality increase arises from new products around the world.

Our second contribution relates to the mechanism driving this substantial quality growth. The detailed nature of our data allows us to disaggregate the vintage share in year t ($s_{t,v}$) into the share per song and the number of songs, revealing that most of the growth in vintage service flow arises from growth in the number of products. Growth in the available number of

²Throughout the text we will refer to music “quality” as whatever determines the appeal of recorded music products and, consequently, the level of demand for such products.

products would be expected to generate additional service flow from recorded music, but we argue that the extent of the growth in benefit that consumers experience would depend on the ex ante predictability of products’ appeal at the time of investment. If product quality were perfectly predictable, a reduction in the cost of bringing products to market would facilitate entry of a “long tail” of low-appeal products which could nevertheless collectively raise consumer surplus. If quality were unpredictable, on the other hand, then cost reduction would enable entry of products throughout the realized sales distribution, generating larger benefits for consumers. Put differently, because of the unpredictability of quality, growth in the number of products is akin to taking more draws from an urn and allowing the discovery of more products with substantial appeal.

These competing explanations have contrasting observable implications. Under ex ante predictability the new songs would appear in the left tail of the realized sales distribution, and sales concentration would fall. Under ex ante unpredictability, by contrast, we would see growing success of songs which had low ex ante prospects at release. That is, a growing share of even the top-selling songs would be those released with low ex ante prospects. Moreover, growth in entry would not necessarily reduce sales concentration since the new products might reside in the right tail of the distribution, attracting substantial sales. We find growth in sales concentration even as the number of products available to consumers rises substantially. We also explore a second implication of ex ante unpredictability, that products with modest ex ante appeal appear among ex post successes. Using artists on independent labels as markers of low ex ante prospects, we find substantial growth in the the share of products with modest ex ante prospects among the top-sellers. The evidence we present on mechanism may provide a reconciliation of the “long tail” perspective of [Brynjolfsson et al. \(2003\)](#) and [Anderson \(2006\)](#), who advance the welfare benefit of many small products, and [Elberse \(2013\)](#), who counters that demand has recently concentrated on blockbusters.

The paper proceeds in 5 sections after the introduction. Section [2](#) reviews a simple framework for analyzing the positive and welfare impacts of digitization on the market for recorded music. Section [3](#) discusses the various data sources we employ. Section [4](#) documents the evolution of worldwide recorded music revenue and presents basic evidence on the number of new songs released by time and country using three distinct data sources. Section [5](#) then turns to the detailed sales data to measure the quality of recorded music across vintages. Section [6](#) explores the mechanisms leading to an increase in music quality. Section [7](#) concludes

and discusses the policy implications of our results.

2 Theoretical Background

This section briefly outlines a theoretical framework for analyzing the impact of technological change on the market for recorded music. We consider both positive and normative implications of technological change on recorded music markets in the short and long run. We then turn to a discussion of the relationship between the number of new products and the quality of these products when the products have unpredictable appeal.

2.1 Static and Dynamic Effects of Technological Change on the Production of New Music

Copyright grants creators monopoly rights over their works, giving rise to a downward-sloping demand curve for protected products. While monopolies are well understood to be harmful in and of themselves, copyright's monopoly grant has a purpose, to provide revenue rewards adequate to give creators incentives to bring new products to market. A simple model illustrates the idea. Consider a recorded music product, say a particular song recording by a particular artist, facing a downward-sloping demand curve. The product is digital but suppose initially that file sharing is not possible, so that the demand curve shows both the consumer's valuation of the product as well as his or her willingness to pay. Given that the product is digital, it is both simple and realistic to assume zero marginal costs. Bringing the product to market has fixed costs, however. The product is sold at a positive price.

Figure 1 depicts this situation. There is a downward-sloping demand curve ($P = 2 - 0.2Q$), and the price of the product is 1. Consumers purchase 5 units, generating revenue of 5. The curved line is the average cost curve, which is here $AC = \frac{FC}{Q}$. With the initial demand curve - and the price of 1 - the price covers average costs, so the product can profitably be offered. Producers obtain surplus of 5, of which 1 is technically profit. Consumers receive surplus of 2.5 (the area between $P = 1$ and the demand curve, between $Q = 0$ and $Q = 5$). There is also deadweight loss (DWL): the consumers valuing the product below 1 do not obtain the

product despite the fact that they value it above its (zero) marginal cost.

File sharing allows consumers to obtain the product without paying. Some do, and others do not. The effect of file sharing on revenue and welfare depends on which individuals choose to consume without paying, and it can be illustrated in Figure 1. If individuals valuing the product below 1 consume without paying, their unpaid consumption has no effect on revenue; instead, their unpaid consumption simply turns deadweight loss into consumer surplus. When consumers valuing the product above 1 - and who would otherwise have purchased the product - consume without paying, their unpaid consumption reduces revenue. A consumer valuing the product at, say, 2 would previously have generated revenue of 1 and CS of 1. When she appropriates the product without paying, total surplus is the same, but it all takes the form of consumer surplus. In the short run - that is, for recorded music products that already exist - unpaid consumption raises welfare. In the extreme case in which all individuals consume the product without paying for it, the area of the diagram that was consumer surplus prior to file-sharing remains surplus for consumers. The area that was revenue for producers (PS) ceases to be revenue and is instead transferred to consumers. The area that was previously deadweight loss becomes consumer surplus.

While short run welfare increases with ubiquitous unpaid consumption, it is important to note that the long run effects can be entirely different. If producers can no longer cover their costs, then new products will not be brought to market, and the copyright's purpose is not being fulfilled. In the next period, there is no product investment; as a result, there is no producer surplus or consumer surplus. In the longer run, technological change threatens to destroy all surplus.

Despite the undermining effect of file sharing on recorded music revenue, other technological changes have reduced the costs of bringing new works to market. Production of recorded music has grown less costly as inexpensive computers and software have grown capable of performing the roles of costly studio equipment. Digital distribution has made it possible for artists' works to be available to millions of consumers with the costs of pressing discs, transporting physical goods, or maintaining inventory in physical retail establishments. Finally, promotion too has become less expensive as Internet radio, social media, and widely available online criticism have supplemented the traditional promotional bottleneck of terrestrial radio.³

³See [Waldfoegel \(2013\)](#) for a discussion of the cost reductions.

The reduction in production costs allowed by digitization can therefore offset the negative effects of file sharing, and the crucial question relevant to whether copyright is functioning properly is whether new products with benefits to society continue to be brought to market. Whether the technological changes would, on balance, increase or decrease the flow of new music is an empirical question.

2.2 New Products and Quality

A simple model reminiscent of [Terviö \(2009\)](#) suggests how predictability interacts with reduced costs of bringing works to market to affect the quality from new music. The basic idea is that the appeal of new music products is difficult to predict at the time of investment.⁴ Suppose that investors form an estimate of the quality of a project as the true quality, plus a random error. Define y as the true quality. They estimate this as $y' = y + \varepsilon$, where y and y' are denominated in expected revenue. Define T as the cost of bringing a product to market. Then investors bring products to market when their guesses about quality exceed the cost threshold: $y' > T$.

Digitization encompasses two effects: revenue falls, but costs fall as well. Costs fall from T to T' ; then entry occurs when $y' > T'$. If costs fall enough, then the net effect is to reduce the cost threshold so that more products are brought to market. And - see below - this appears to be the empirically relevant case. Growth in the available number of products would be expected to generate additional service flow from recorded music, but the extent of the growth in benefit that consumers experience would depend on the ex ante predictability of products' appeal at the time of investment.

If quality were perfectly predictable, then a reduction in the cost of entry from T to T' would elicit entry of songs with expected and realized quality between T and T' , therefore appearing in the left tail of the realized sales distribution. This would raise welfare, albeit only modestly, and it would necessarily decrease sales concentration.

The appeal of most cultural products such as music, movies, and books, is nevertheless difficult to predict at the time investments are made. Screenwriter William Goldman famously remarked that “nobody knows anything” about which movie releases will find success with

⁴See [Caves \(2000\)](#) for discussion of the idea that “nobody knows anything” about which releases will find success with consumers.

consumers (Goldman, 1989), and industry observers indicate that roughly 10 percent of new movies are commercially successful, with similar figures for music and books (Caves, 2000).

In the more realistic case in which quality is not perfectly predictable, then once again the newly entering products would have ex ante quality between T and T' . The products' ex post quality would not be limited to the range T to T' ; instead, the new products would have sales throughout the realized quality distribution. This gives rise to two distinguishing empirical predictions. First, with unpredictability, a reduction in entry costs that gives rise to entry of products with low ex ante appeal also gives rise to growth in the share of ex ante losers among ex post winners. Second, concentration need not decline with the entry of products with low ex ante appeal.

Testing this mechanism requires us to have ways to operationalize ex ante low appeal. We do this using the distinction between major and independent labels. Even before digitization, the recorded music industry had two sorts of entities releasing music, “major” record labels owned by large media firms (Sony, Universal, etc.) and “independent” labels. The independents acted as a “farm system,” releasing works with modest or uncertain commercial prospects, while the majors focused on music with greater or more obvious commercial promise (Southall, 2003; Knopper, 2009).

The considerations above raise a series of questions: First, what has happened to revenue available for recorded music? Second, how has the number of new products evolved? Third, what has happened to the quality of new music across vintages? Fourth, what is the mechanism underlying the changed quality: has sales concentration risen or fallen over time? And what has happened to the share of products with modest ex ante prospects among the commercially successful products? We address these questions below.

3 Data

We have three broad kinds of data from five underlying sources. First, we have data on aggregate recorded music revenue, by country and year. These data are drawn from the Recording Industry in Numbers publication from IFPI. These data include revenue from

physical products and, since 2004, on both physical and digital products.⁵ Second, we have data on the number of new recorded music products released each year, from three distinct sources.

The first of these sources is the MusicBrainz database, an open music encyclopedia that collects music metadata and makes it available to the public.⁶ According to Wikipedia, “as of 3 October 2013, MusicBrainz contained information about roughly 800,000 artists, 1.2 million releases, and 13 million recordings.”⁷ For each song, one can ascertain its year of recording and in most cases the nationality of the band or artist. Hence, it is possible to create time series of production - the number of new songs made available - by country back to the early 1980.⁸

A second source of data on the number of new releases is the Discogs database, which is similar to MusicBrainz. Although its coverage is somewhat different, we can nevertheless use it to corroborate trends. A third source of data on new releases is the Nielsen digital sales database itself (which we describe below).

Our third broad dataset, covering sales, comes from Nielsen and includes the digital sales of recorded music in the US, Canada, and 15 major European countries between 2006 and 2011.⁹ We observe the annual sales of each downloaded track in each destination. For each track, we obtain the original year of release (i.e. the vintage year) from the ISRC code provided by Nielsen.¹⁰ Finally, some countries in our data contain information on the corresponding label for each song.¹¹ We treat recordings with the company code “IND” as independent-label recordings.

⁵Because we were not able to get retail value data for years 2005-2012 directly from these reports, we relied on data coming from Wikipedia, which itself relies on data from the Recording Industry Association of Japan Yearbooks (http://en.wikipedia.org/wiki/Global_music_industry_market_share_data). A shortcoming of this data is that its coverage for the years 2011 and 2012 is limited to the top 20 countries in terms of revenue.

⁶www.musicbrainz.org

⁷See <http://en.wikipedia.org/wiki/MusicBrainz>.

⁸The data actually includes songs with year of recording going back to the early 1900’s. Since coverage is likely to be more complete for recent releases, we decide to focus on releases starting in 1980.

⁹The dataset initially includes the following 16 European countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. However, given that Poland enters the data in 2008 only, we decided to drop it from the analysis.

¹⁰We performed the following exercise in order to verify the validity of this vintage measure. We first selected the top and bottom 150 Nielsen songs in terms of sales for the period 2006-2011. Second, we manually checked their Wikipedia pages for their official release year. We found a correlation of 0.949 between the two vintage distributions, confirming the validity of our original measure.

¹¹The company variable in Nielsen takes on 5 different values: EMI, Sony (SME), Universal (UNI), Warner (WEA), and independent (IND). This variable is available and complete for the U.S. and Canada but unfortunately contains many missing values (close to 50% of the observations) for the remaining countries.

Significant controversy surrounds the measurement and identification of independent record sales (Waldfoegel, 2013). Nielsen identifies independent labels according to the entity distributing a record rather than the entity producing the recording. The American Association of Independent Music (A2IM) claims that the Nielsen methodology understates the importance of independent labels and argues that the ownership of master recordings provides a better indicator of independence than the type of distributor.¹² The latter approach is difficult to implement empirically, so we follow a Nielsen’s definition of independent-label recordings, understanding their possible understatement.

The dataset includes 1,532,095 distinct artists but unfortunately does not include the artists’ country of origin. To overcome this shortcoming of the data, we recovered data on artists’ country of origin from MusicBrainz.¹³ The MusicBrainz database is sufficiently authoritative that the BBC relies on it to support the artist and music information on their music website.¹⁴ Unfortunately, there is no unique identifier that permits a straightforward matching between our data and MusicBrainz. We therefore engaged in a tedious matching procedure based on artists’ names. Because sales are concentrated in top artists - the top 150,000 artists account for over 99 percent of sales - we only attempted to find these artists’ nationalities. Excluding the observations that we could not match, our sample includes 75,235 distinct artists covering over 91 percent of the Nielsen sales. Our data include 3,984,227 distinct tracks and, because a song can appear in multiple countries and years, 50,828,216 observations. Total track sales in the data are 628.2 million in 2006 and rise to 1512.4 million in 2011.¹⁵

Finally, other variables we employ in our analysis include GDP per capita, the percentage of fixed broadband Internet subscribers, and the percentage of mobile cellular subscriptions. These are drawn from the World Bank Open Data.¹⁶

¹²See <http://tinyurl.com/what-exactly-is-an-ind-ependen> (accessed September 11, 2014) and <http://tinyurl.com/a2im-disputes-billboardsoundsc> (accessed September 11, 2014).

¹³Whenever available in MusicBrainz, the country of origin of each artists corresponds to their country of birth.

¹⁴See <http://www.bbc.co.uk/music/brainz/>.

¹⁵Because that dataset includes only artists whose national origins can be determined from MusicBrainz and excludes entries that appear not to be songs, it excludes 44.4 percent of otherwise valid observations while retaining 91 percent of sales. Since part of our analysis does not require the origin of the artist, we verified that our results are unchanged when relying on the full dataset.

¹⁶See <http://data.worldbank.org/>.

4 Revenue and New Products

4.1 The Collapse of Recorded Music Revenue around the World

Figure 2 shows the aggregate recorded music revenue for 3 groups of countries: 1) those countries for which we have revenue available for years 1998-2010, corresponding to a total of more than 43 countries;¹⁷ 2) those countries for which we have revenue available for years 1998-2012, corresponding to a total of 19 countries;¹⁸ and 3) our 17 sample countries.¹⁹ Each of the series show that revenue has fallen drastically over the past decade, from \$53,000 million in 1998 to around \$15,000 million in 2012. Figure 3 breaks out the totals for North America and Europe using our 17 sample countries. North American recorded music revenue has fallen by 75%, while European revenue has fallen by 70% since 1998. These declines raise a credible question about whether revenues remain sufficient to finance continued investment of new products at traditional levels.

While recorded music revenues have fallen, revenues from other sources, such as live performance and streaming, have risen. Revenue from live performance has, for instance, grown at a substantially higher rate since the advent of Napster in late 1999 (Connolly and Krueger, 2006; Mortimer et al., 2012). Likewise, streaming revenues have become an important revenue source in the past years. According to IFPI (2014), revenues from online subscription services exceeded US\$1 billion for the first time in 2013, with the industry deriving 27% of its digital revenues from subscription and ad-supported streaming services, up from 14% in 2011.²⁰ Hence, the drop in recorded music revenue may overstate the decline in rewards available for creating new products.

The collapse of recorded music revenue has nevertheless prompted much understandable concern among industry participants, who argue that because music is an investment-intensive

¹⁷These include countries from Central America as well as the following countries: Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Ecuador, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Turkey, the UK, the US, Uruguay, and Venezuela.

¹⁸These countries are: Australia, Austria, Belgium, Brazil, Canada, France, Germany, India, Italy, Japan, Mexico, Netherlands, Norway, South Korea, Spain, Sweden, Switzerland, the UK, and the US.

¹⁹We miss data for years 2011 and 2012 for 4 out of our 17 sample countries (Denmark, Finland, Ireland, and Portugal). However, these collectively account for only 2.6% of the 17 sample countries total revenues between 1998 and 2010.

²⁰See also <http://tinyurl.com/riaa-revenue> for figures on the growing importance of streaming revenues in the US.

industry, the loss of revenue threatens the continued production of music. For example, the IFPI's report on "investing in music" argues that it costs roughly a million to bring an album by a new artist to market (IFPI, 2012). According to IFPI (2012), "[r]ecorded music is an investment-intensive business. The proportion of revenues invested by record companies in A&R activity remains exceptionally high compared to almost any other industry's investment in R&D. According to data from its members, IFPI estimates that record companies worldwide invested 16 per cent of their revenues in A&R activity in 2011."

Industry representatives implicitly take the view that the costs have not changed while revenue has fallen. This ostensible worry, which goes beyond a narrow concern about their revenue is the prospect of diminished production of new music. As Cary Sherman of the RIAA argued before the House Committee on Energy and Commerce, "Piracy is not just a parochial corporate problem. This is an issue that affects many industries, our economy, our culture, tens of thousands of creative individuals, and most importantly, the consumers who enjoy the music we create."²¹ What has happened to the availability of new products and to the quality of these new products? These are the questions to which we now turn.

4.2 New Recorded Music Products

As a first step it would be quite useful to understand how the number of new recorded music products has evolved over time as revenue has fallen. One source of such information, in principle at least, is the sales database of Nielsen. In those data - discussed in more detail below - one can ascertain the number of new products released each year from records of products actually sold. And indeed, we will offer some time series from such data for 2006-2011. Across our 17 countries, the number of new songs in the Nielsen database rises from about 120,000 in 2006 to 150,000 in 2009. The number then declines in the following two years, reaching about 140,000 in 2011.

A second source of information is some rather authoritative user-generated websites on music, in particular MusicBrainz and Discogs. For each song, one can ascertain its year of recording and in most cases the nationality of the band or artist. Hence, it is possible to create time series of production - the number of new songs made available - by country back at least a

²¹Statement of Cary Sherman, Chairman and CEO, Recording Industry Association of America before the Subcommittee on Communications and Technology, Committee on Energy and Commerce, U.S. House of Representatives on "The Future of Audio," June 6, 2012.

few decades. One might of course be concerned that the coverage varies over time. Because MusicBrainz was created in 1999, it is possible that coverage is more complete for recent than for long-ago releases.

Figure 5 shows the overall evolution of music releases by time from 3 different sources. The long time series based on MusicBrainz and Discogs data show substantial increase in the number of new works produced per year. The MusicBrainz data show a downturn in production since 2005. Because it is user-generated, MusicBrainz may take time for users to add recent releases. Given that we obtained the data extract during 2013, it is possible that the recent apparent downturn in production reflects the timing of data input rather than actual production. Interestingly, the Discogs data, which are also user-generated, do not show a downturn. Hence, we are uncertain about how much of the downturn in the MusicBrainz data reflects diminished activity as opposed to reporting. That the Nielsen data show decline since 2009 suggests some real decline, but the apparent decline is longer and more pronounced in the MusicBrainz data. Figure 6 presents the series separately in scale-appropriate graphs for 17 of the countries in the sample. We should note that our division of products by origin does not produce measures of availability by destination. Many products released in France are also available in Germany.

We are not the first to observe that the number of products has increased in the past decade. Oberholzer-Gee and Strumpf (2010) and Handke (2012) present evidence of growth in the number of products coming to market and labels bringing these products to market. Comparing Figure 2 (4) and Figure 5 (6), we observe that while revenue is declining, the number of new products brought to market has been rising. It appears that cost reduction dominates revenue reduction as far as creative incentives are concerned. Yet, it is still possible that revenue reduction has reduced output relative to what it might have been. Given our panel data on country revenue and production, we can ask whether countries with larger reductions in revenue experience less production relative to what would otherwise have happened. To this end we combine our MusicBrainz and IFPI data and run a regression of log production in each country (the number of new works from the country released in the year) on log revenue in the country, year dummies, and a country fixed effect. That is, we estimate:

$$\ln(n_{ct}) = \mu_c + \theta_t + \rho \ln(Rev_{ct}) + X_{ct}\beta + \varepsilon_{ct}, \quad (1)$$

where n_{ct} is the number of new releases from country c in year t , Rev_{ct} is recorded music revenue in country c in year t , μ_c is a country fixed effect, θ_t is a time effect and ε_{ct} is a country-time error. The vector X_{ct} contains time-specific country variables related to economic conditions. It includes GDP per capita, the percentage of fixed broadband Internet subscribers and the percentage of mobile cellular subscriptions.

We are aware that unobserved demand for music affects both revenue and entry, so this regression is at risk of confounding this endogeneity problem with a causal impact of appropriability on entry conditions. Still, we proceed on the understanding that the change in revenue in this period is driven largely by piracy's negative impact on the appropriability of consumers' willingness to pay in the industry. In that case, the coefficient on log revenue tells us how much revenue less undermines production.

Table 1 presents the results from this exercise. Columns (1)-(4) use all years of data, while columns (5)-(8) use only the data through 2005 (before the MusicBrainz time series tend to turn down). Column 1 omits X_{ct} , and column 2 includes X_{ct} . We see no statistically significant relationship between revenue and the number of new releases. Using only the data through 2005, we find a positive relationship between revenue and the number of new products (that is statistically significant for the whole sample). The coefficients range between 0.097 and 0.159, indicating that a 70 percent reduction in revenue would give rise to a 6-11 percent reduction in the number of new products. We conclude that there is some evidence that reduced revenue has a negative effect on new products. To put this another way, while there has been substantial growth in the number of new products per year in the past few decades, the recent level of musical output appears to be lower than it would have been absent the collapse of revenue.

While the quantity flow of new products has remained robust, this does not guarantee that new creative products continue to generate substantial surplus for market participants. The distribution of recorded music sales across products is enormously skewed. For example, the median digital track released in Germany in 2011 generated 9 sales around the world (about 0.0002% of sales). The median for a US track was 12. For the US new releases in 2011, the bottom 95% of tracks according to 2011 sales collectively generated 3.5% of sales. What

these figures show is that the number of new tracks released, while highly suggestive, is not convincing as evidence on the quality of new music. It is possible that creators are releasing large and growing number of tracks but that this work is unappealing to consumers. What's needed is some method for inferring the evolution of the quality of new music over time.

5 Usage-Based Evidence on the Quality of New Music

Inferring the appeal or quality of new music is challenging. As we have argued, the number of new products is potentially misleading. It is tempting instead to look to the number of products released in each year whose sales surpass a threshold, say 5,000, because such works are economically consequential. However, because of growth in the tendency for people to consume without purchase, the appeal that a song requires to generate 5,000 sales grows over time. Hence, the number of works whose sales surpass any threshold does not provide an intertemporally comparable index of the quality of new music.

[Waldfoegel \(2011, 2012\)](#) presents evidence from two broad approaches on how the quality new music has evolved over time. He transforms multi-year best-of lists, such as Rolling Stone's list of the 500 Best Albums of All Time or Pitchfork Media's 200 best albums of the 1990's, into indices of high quality music. Statistically combining indices from many (88) critics' lists covering 1960-2008, he shows that following 1999 the overall index of high quality music did not decline.

The second approach uses data on usage (sales and airplay) by calendar time and vintage of original release to draw inferences about the evolution of vintage quality from consumer choices of vintages over time. The idea is simple. Older music is used less at any point in time, due to depreciation. But after accounting for depreciation, the question is whether some vintages account for more sales than others. Those that account for more, controlling for depreciation, are those that are inferred to have higher quality. Using fragmentary data on sales and airplay by time and vintage, [Waldfoegel \(2012\)](#) documents that, after accounting for age, the quality of recorded music vintages released since Napster is higher than for vintages originally released earlier. This finding, along with evidence that critics find more outstanding recordings among more recent vintages, stands in contrast to both declining revenue and industry claims that weakened investment incentives will reduce the availability

of valuable new products.

While existing evidence is at least strongly suggestive, it suffers from a few shortcomings. Ideal implementation of the quality approach requires data on sales of music by calendar year and vintage of original release. [Waldfoegel \(2012\)](#) employs only limited data on actual recorded music sales, based on RIAA certifications. Thus, rather than observing the sales of all products, he observes only 19,000 certifications for the biggest-selling products over 40 years, which collectively account for about half of overall sales. He also uses data on airplay based on large numbers of underlying songs, but the data are aggregated to vintage.

Here, by contrast, we employ a comprehensive dataset on sales of digital music in 17 countries, 2006-2011. In this section we revisit the question of how the quality of new music has evolved over time. We have far more complete data on the US as well as equally comprehensive data on 15 European countries as well as Canada. We can ask three questions. First, we revisit the specific question addressed in [Waldfoegel \(2012\)](#): based on US consumption behavior, how has quality evolved over time? Second, we use the broader sample of countries to ask that question more broadly, that is to ask how, based on the preferences of other countries' consumers, the quality of music has evolved over time. Third, we also decompose quality by geographic origin. Finally, because we have product-level data we can decompose the evolution of vintage quality over time into effects due to the number of products and the average quality of products. This allows us to explore the mechanism for the results.

5.1 Inferring Vintage Quality from Sales Data

The basic idea of the vintage quality approach is to ask whether different vintages are more or less popular, after accounting for their age. We can convey some intuition about the approach by examining figures on the share of yearly sales by age. [Figure 7](#) presents the average sales shares by age: on average, current music makes up 18 percent, one-year old music makes up 21, 2-year-old music makes up 9 percent, and so on. We seek to infer whether a vintage is particularly useful from whether it sells more than typical vintages reaching any particular age, and our approach requires multiple calendar years of sales data.

We implement the approach in the following way. Define s_{tv} as the vintage- v share of music sold in calendar year t . Define $age = t - v$. We observe the shares s_{tv} for six calendar years,

2006-2011. We can therefore observe the share of annual sales accounted for by current-year releases for music originally released 2006-2011. This is a rudimentary measure of the quality of music released 2006-2011. Related, we can observe the share of sales accounted for by one-year-old music originally released 2005-2010, providing an index of the quality of music originally released 2005-2010. We can similarly observe the share of k -year-old music originally released between 2006- k and 2011- k . This process gives us overlapping indices of vintage quality covering the period 2006- k to 2011. Essentially, we want to average the overlapping quality indices by vintage.

Regression provides a direct way to calculate the resulting overall index. That is, we estimate the following model for each country's sales data:

$$\ln(s_{tv}) = \gamma_{t-v} + \mu_v + \varepsilon_{tv}, \quad (2)$$

where the parameters γ_{t-v} flexibly allow the music of different ages ($t - v$) to have different shares in calendar year t sales, μ_v are vintage fixed effects, and ε_{tv} is an error term. The parameters μ_v provide the index of vintage quality, according to the time and vintage consumption patterns for consumers in each country.²²

Our approach departs from the standard random utility demand modelling approach (e.g. logit) with consumers making choices of whether to buy music and, if so, which tracks. The changing incidence of piracy over time will undermine estimates of the value of music relative to the outside good (no music purchase). Hence, we rely only on choices among inside goods. Our approach asks, of music marketed in a given calendar year t , what share is from each original-release vintage v ?

Figure 8 provides the index of vintage quality implied by the consumption choices of consumers in all 17 sample countries. Vintage quality is high from 1960 through 1970, then falls to 1990. Quality is flat from 1990-1995, then rises. The index jumps in 1999-2000, then settles to a plateau at roughly 1980 level.

When the vintage shares s_{tv} are calculated using the consumption choices for particular destination countries, the resulting index of μ_v reflects the quality of available music accord-

²²While we do not have price data, it tends to be true that prices are nearly uniform for digital music. Hence, the differences between vintages shares arise from the vintages' appeal rather than price differences.

ing to the preferences of consumers in each of the destination countries. We can explore how music quality evolves according to the preferences of different countries’ consumers by estimating the model separately using country-specific s_{tv} data.

Figure 9 shows vintage quality from the standpoint of US consumers. The US is of interest in part because the results can be compared with existing findings. The US pattern strongly resembles the world pattern, in part because of the size of the US. Figures 10, 11, and 12 reproduces the three quality indices from Waldfogel (2012). The first is based on critics “best-of” lists, while the second are derived using the quality approach from US airplay and sales certification data, respectively. Like the current results, all three show decline from 1970 to the 1990s. Like Figure 9, the two usage-based indices show a recent recovery in quality, although the recovery occurs earlier in the Nielsen data, in 1999 rather than 2003.

Figures 13a and 13b display the vintage quality series for each of the 17 countries individually. The indices are similar across countries, in that they tend to show declines in quality from 1970 to the 1990s, followed by an increase since the mid-1990s. There are exceptions: Spain, Germany and Norway do not appear to show significant recoveries of the index. But when European destinations are aggregated together, in Figure 14, the overall pattern strongly resembles the North American pattern. Our results, then, corroborate earlier findings indicating that despite the significant dropoff in revenue, the quality of new music is high by recent historical standards.

We can see that consumers in most destinations find increased quality from recent vintages. But does the growth in quality reflect new music from various regions? Given the structure of our data, the share of year t consumption originally released in vintage v can be broken into parts with different geographic origins. If we divide the world into two regions, North America (the US and Canada) and the rest (which is mostly European-origin in our data), then $s_{tv} = s_{NA,tv} + s_{non-NA,tv}$. We can draw some inferences about which origin regions are responsible for the changing quality by performing our basic analysis on $s_{NA,tv}$ and $s_{non-NA,tv}$.

Figures 15 and 16 show the vintage quality coefficients for North-American-origin music and the remainder. Both show falling quality for vintages 1960-1990, followed by reversals during the 1990s and higher levels since 2000. It seems clear that the growth in quality arises from growing production of new music in both North America and elsewhere.

6 Exploring Mechanisms

We find increases in music quality in the eyes of consumers in both Europe and North America. Moreover, the increased quality appears to reflect new music from both North America and the rest of the world. This growth in the quality of new music is on its face a puzzle in light of the collapse of revenue. But we have argued that the extent of the benefits that consumers experience from new songs would depend on the ex ante predictability of products' appeal at the time of investment. In particular, if quality were unpredictable, cost reduction would enable entry of songs with low ex ante prospects but possibly important ex post appeal, generating larger benefits for consumers. Put differently, because of the unpredictability of quality, growth in the number of products is akin to taking more draws from an urn and allowing the discovery of more products with substantial appeal. In this section we explore whether this explanation is borne out in the data.

In section 4.2 we documented substantial growth in the number of new releases per year around the world, raising a question about the role of the volume of new releases in resulting quality. We can assess this directly. The share of year- t sales attributable to music originally released in vintage v , s_{tv} , can be decomposed into the average share per song and the number of songs, as follows: $s_{tv} = \left(\frac{s_{tv}}{n_{tv}}\right) n_{tv}$ where n_{tv} is the number of songs originally released in vintage v that are sold in calendar year t . Taking logs leads to $\ln(s_{tv}) = \ln\left(\frac{s_{tv}}{n_{tv}}\right) + \ln(n_{tv})$, so the regression

$$\ln(s_{tv}) = \gamma_{t-v} + \mu_v + \varepsilon_{tv},$$

can be decomposed into separate regressions:

$$\ln\left(\frac{s_{tv}}{n_{tv}}\right) = \gamma'_{t-v} + \mu'_v + \varepsilon'_{tv}, \quad (3)$$

and

$$\ln(n_{tv}) = \gamma''_{t-v} + \mu''_v + \varepsilon''_{tv}, \quad (4)$$

Figures 17 and 18 use entire-world data to estimate the sequences of μ'_v and μ''_v . The series based on n accounts for most of the variation: it falls continuously from 1960 to 1990, rises

slowly to 2000, then more quickly since 2000. The index based on quality per song is steady from 1960 to 1980, then falls continuously until it rebounds after 2005. Because the quality per song index is largely falling, while the index based on the number of songs is rising more sharply, we can say that the recent growth in overall quality is driven by growth in the number of songs. Figure 19 shows that the number of songs has similar effects on both North America and Europe.

That the growth in quality is attributable largely to growth in the number of new products is consistent with two distinct possible mechanisms. The new products brought to market by digitization are those with less ex ante promise than the products brought to market prior to digitization. Hence, the newly available products are those expected to have modest commercial prospects. If many such new products each attract low realized consumption then we will see two things. First, consumption will grow less concentrated; second, the share of products with modest ex ante prospects among those that turn out to be commercially successful will not rise. On the other hand, if some of the products with modest prospects draw substantial consumption realizations, then the growth in new products will cause growth in sales concentration; and the sales share of modest-prospect songs among commercially successful products will rise.

Figure 21 shows that - except for Spain - sales concentration has risen in every country throughout the period 2006-2011. This suggests that taking more draws leads to more products with substantial appeal. Implementing the second part of the test requires the identification of products with low ex ante commercial promise. We take records released by independent labels to be such products, leading to a question of whether these products occupy a growing share of the works that become commercially successful. Figure 22 and 23 shows that, between 2006 and 2011, the independent share of digital sales has grown from 16% to 20% in the US and from 13% to 21% in Canada. Moreover, the independent share of sales among the top 10,000, top 5,000, and even top 50,000 songs has grown. The evidence appears to be consistent with the view that taking more draws yields more products with substantial appeal.

7 Conclusion

Since the spread of file sharing technology, recorded music revenue has fallen substantially in every region of the world, raising legitimate concerns producers would be unable to generate revenue sufficient to cover the costs of continued investment. Yet, the number of new works brought to market has, according to a variety of measures increased substantially since the mid-1990s and, especially, since 2000, although the number of new releases has fallen since 2007. Perhaps more importantly, the quality of new releases has grown since the late 1990s. Quality is a property of how consumers perceive products, and we see that both North American and European consumers assign greater quality to the recent vintages than to earlier vintages. Finally, consumers assign greater quality to new vintages from both North America and Europe. The growth in quality is a worldwide phenomenon on both the demand and supply sides.

We explain the growth in quality despite the collapse of revenue by the fact that costs have fallen more than revenue, allowing strong growth in the number of new products brought to market. Moreover, because of the unpredictability of commercial appeal, growth in the number of products is akin to taking more draws from an urn. By taking more draws, we discover more products with substantial appeal. The data support this explanation. First, most of the growth in quality stems from growth in products. Second, products with low *ex ante* appeal, including independent-label releases, account for a growing share of sales, even among the most commercially successful products. Finally, sales have grown more concentrated between 2006 and 2011.

From a public policy perspective, our results cast significant doubt on whether the sales-displacing effect of unpaid consumption creates a problem that requires redress through stronger intellectual property protection, at least in order to maintain pre-digitization levels of creative output in the recorded music industry. One could of course argue that stronger copyright protection might have further increased the quantity and quality of music production.

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8 Figures and Tables

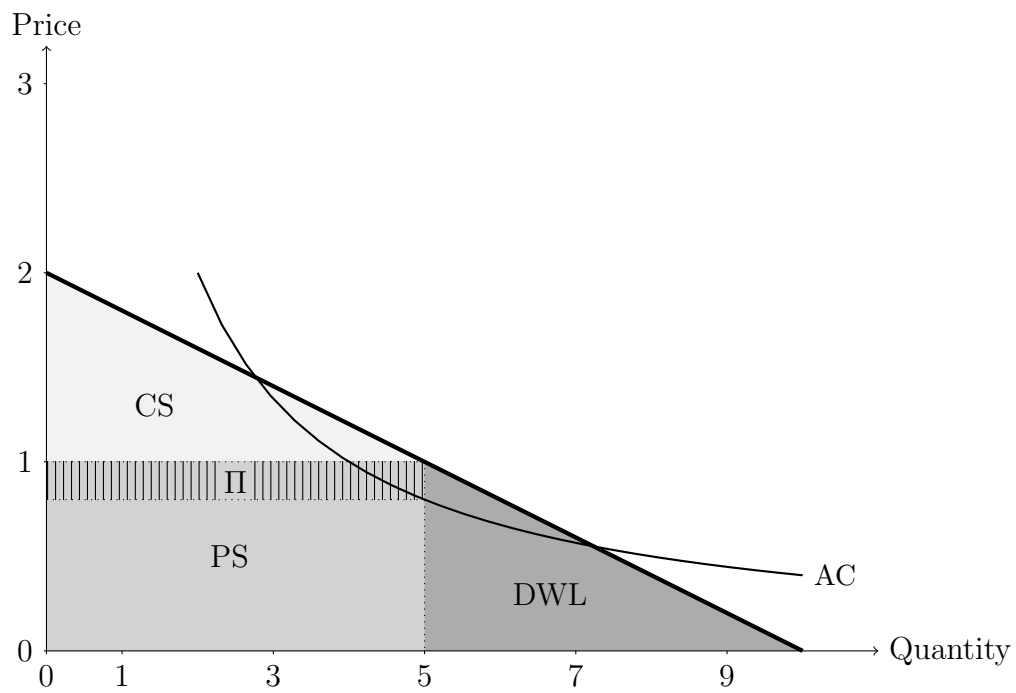


Figure 1: Recorded Music Market

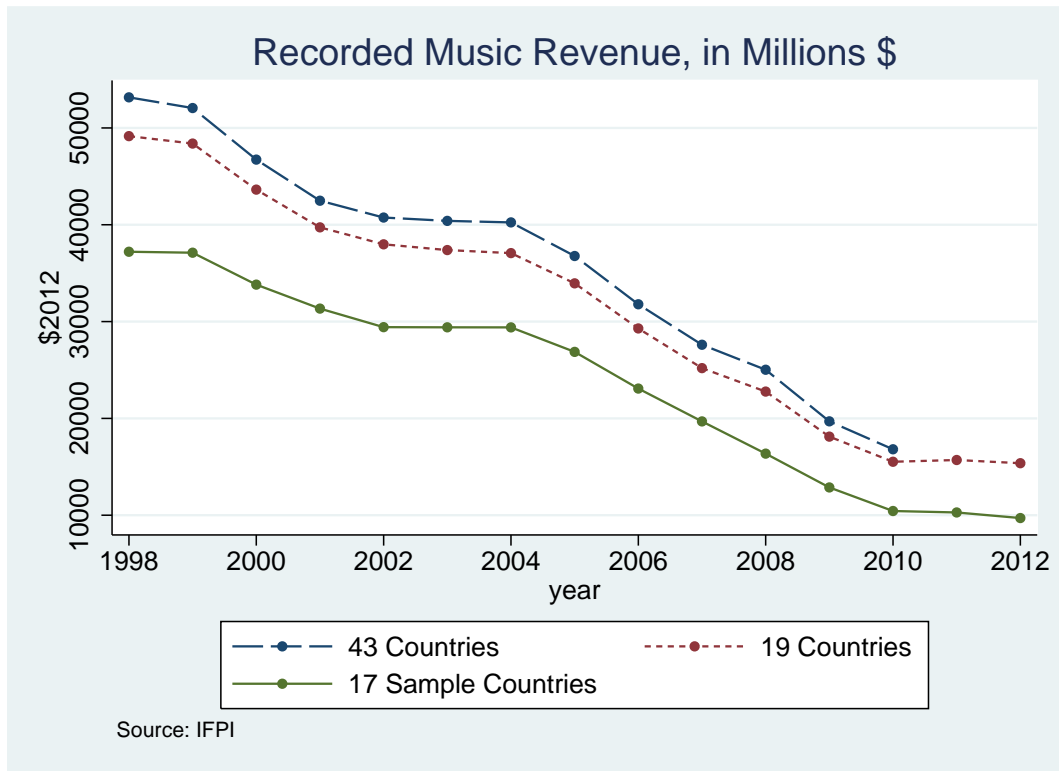


Figure 2: Evolution of Worldwide Music Revenue

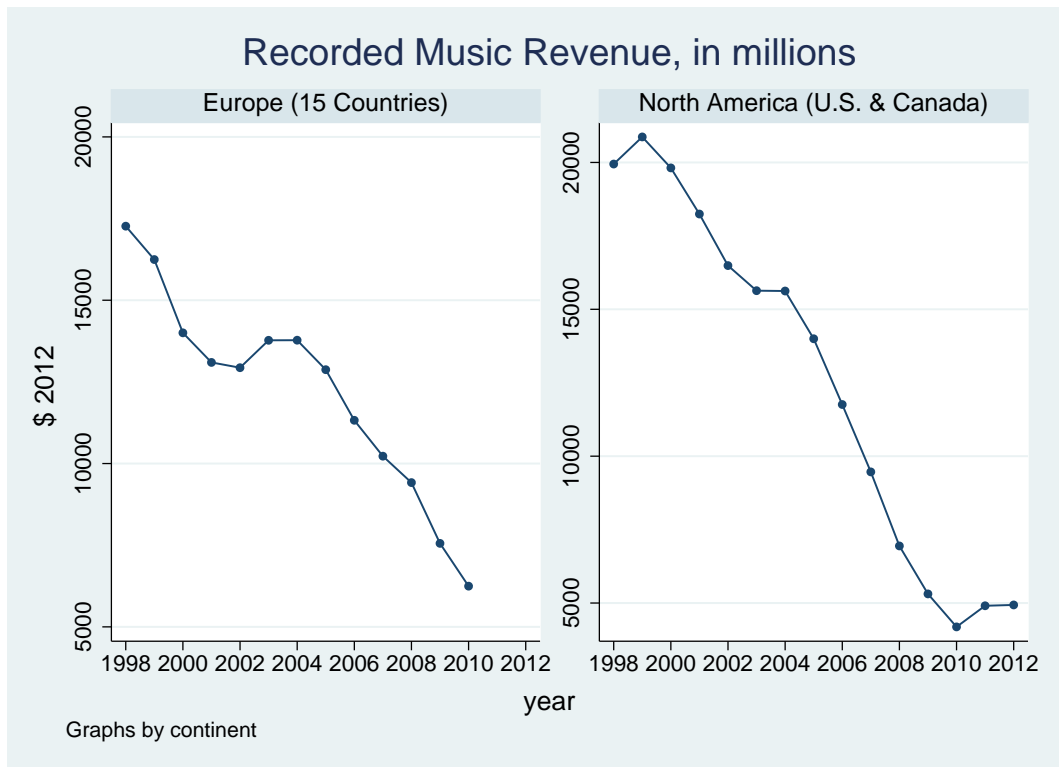


Figure 3: Evolution of Music Revenue: Europe vs North America

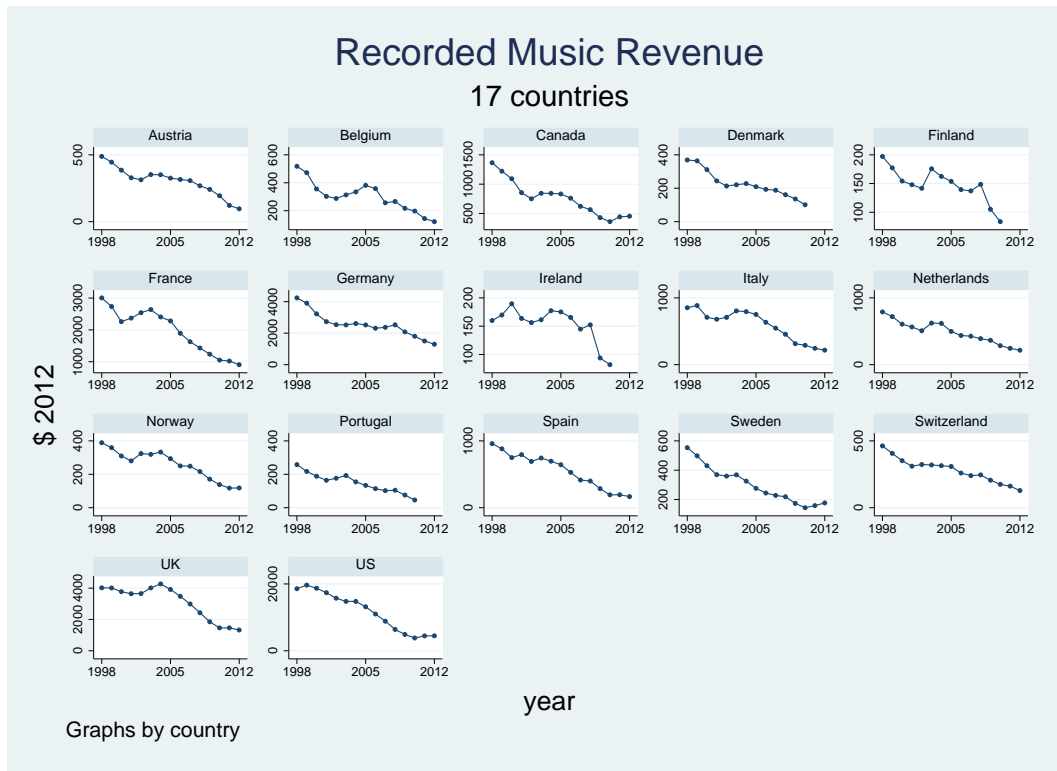


Figure 4: Evolution of Music Revenue by Country

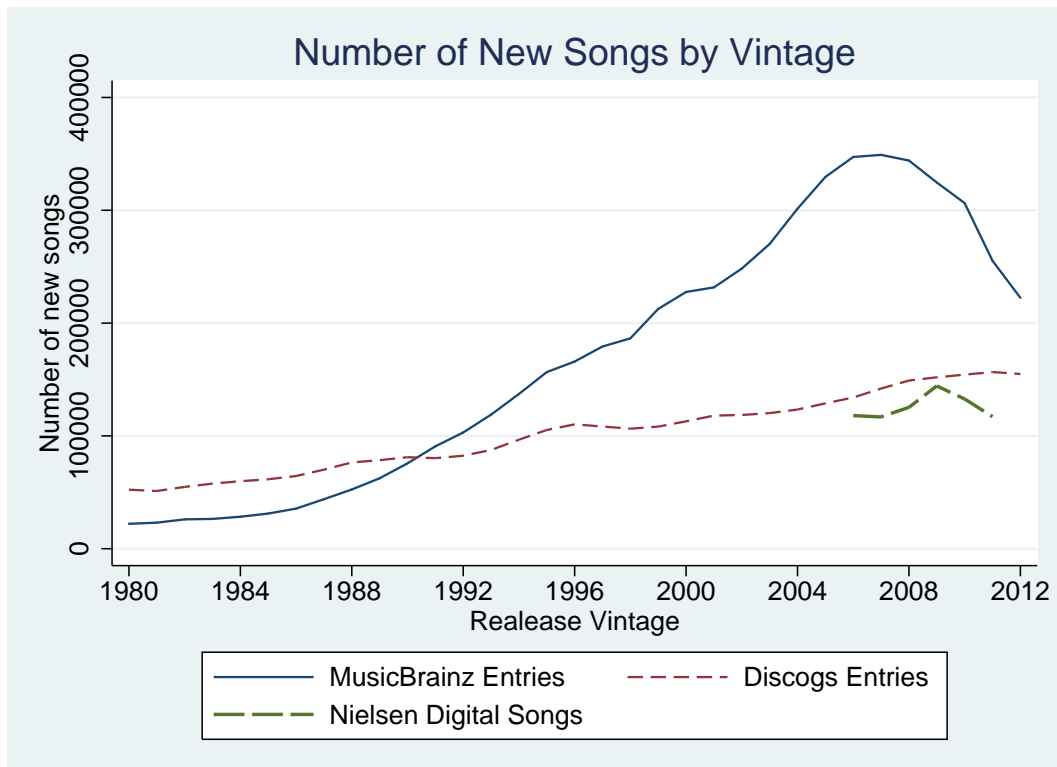


Figure 5: Evolution of the Number of New Songs.

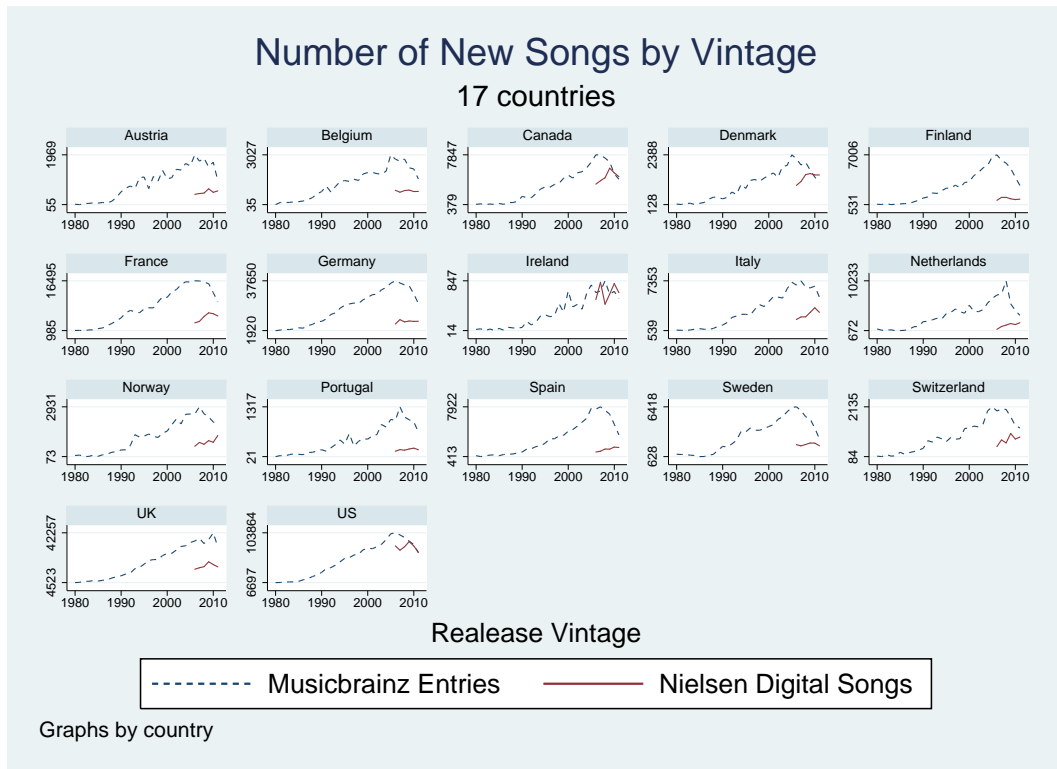


Figure 6: Evolution of the Number of New Songs by Country.

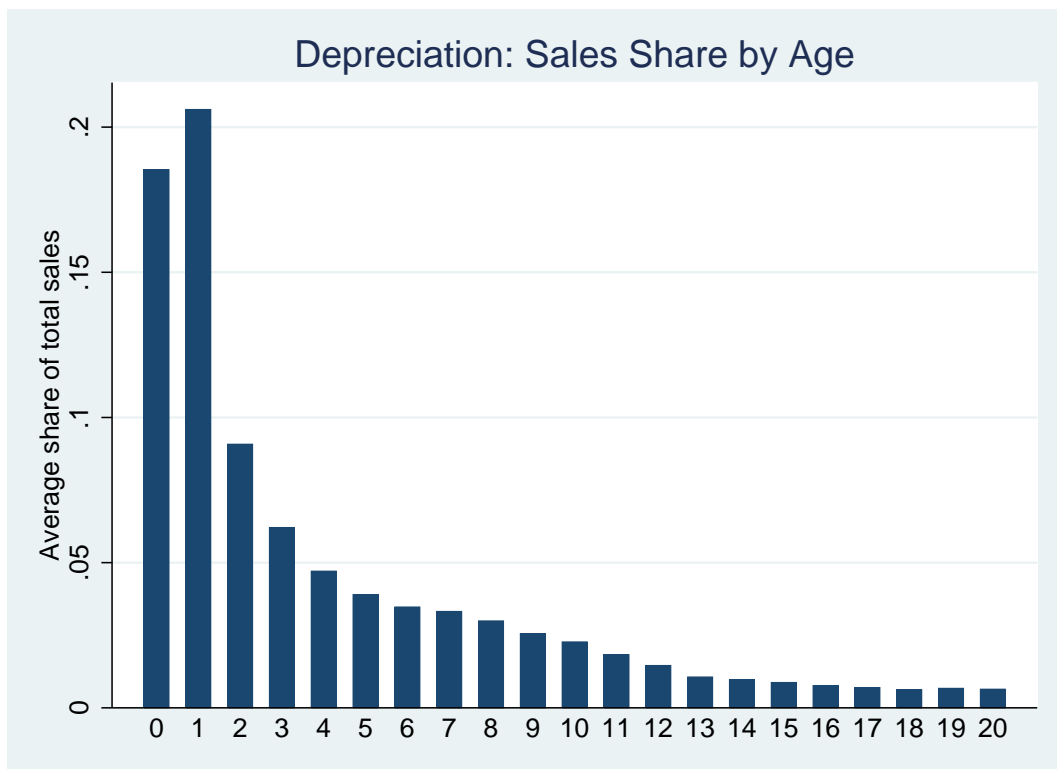


Figure 7: Average Share of Sales by Age

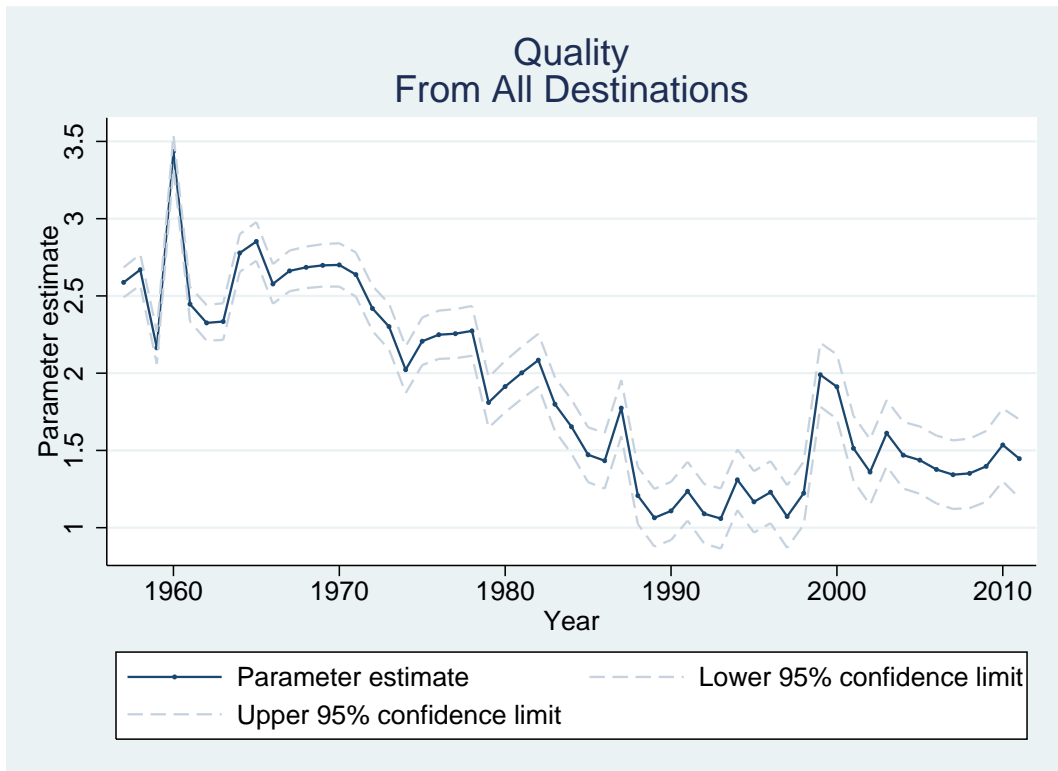


Figure 8: Quality Based on Overall Digital Sales

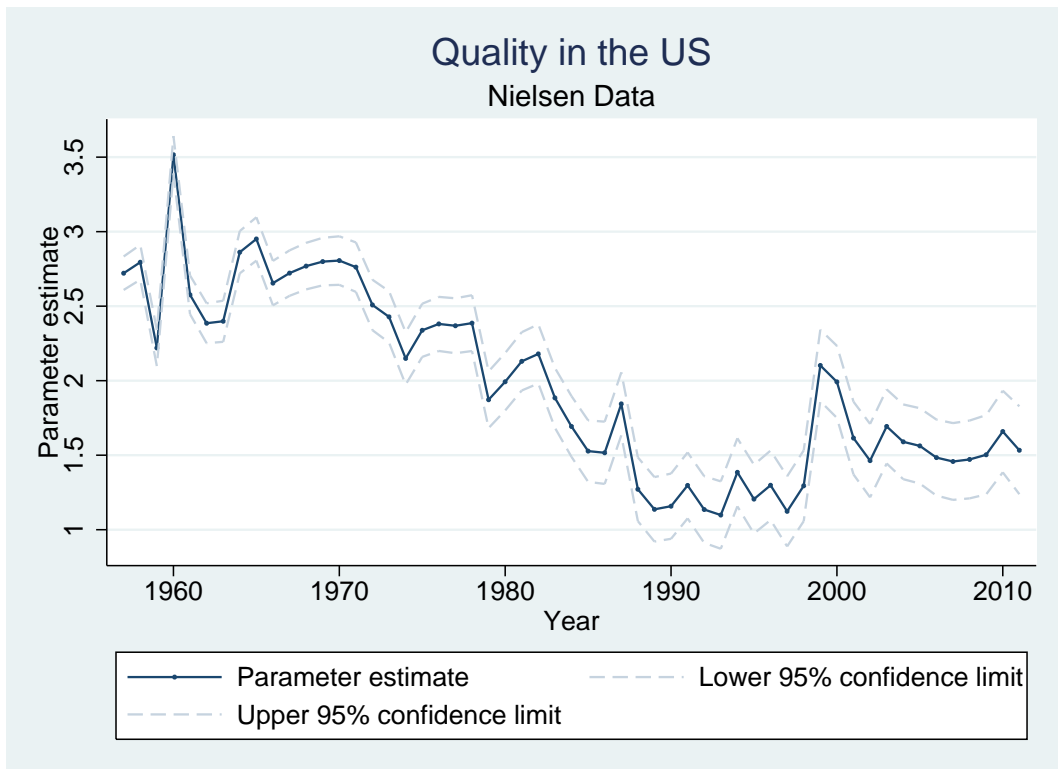


Figure 9: U.S. Quality

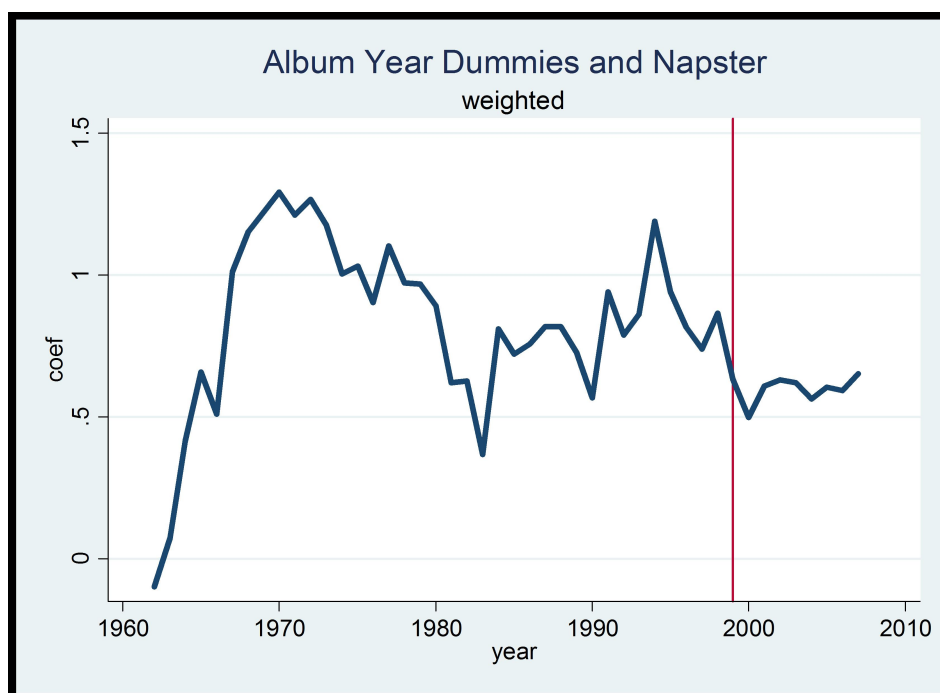


Figure 10: US Critics Index

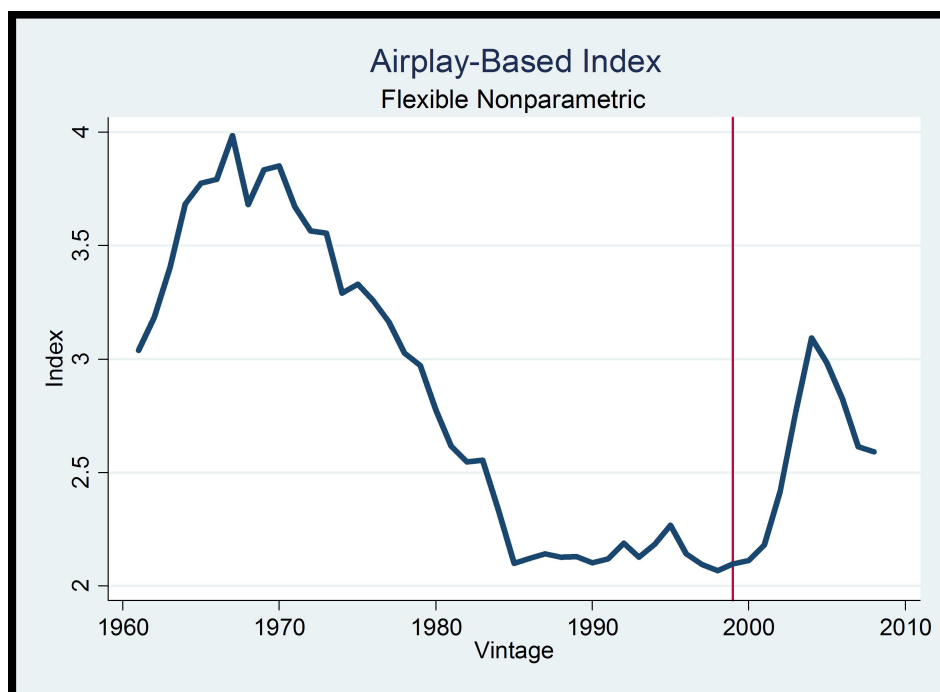


Figure 11: US Airplay Index

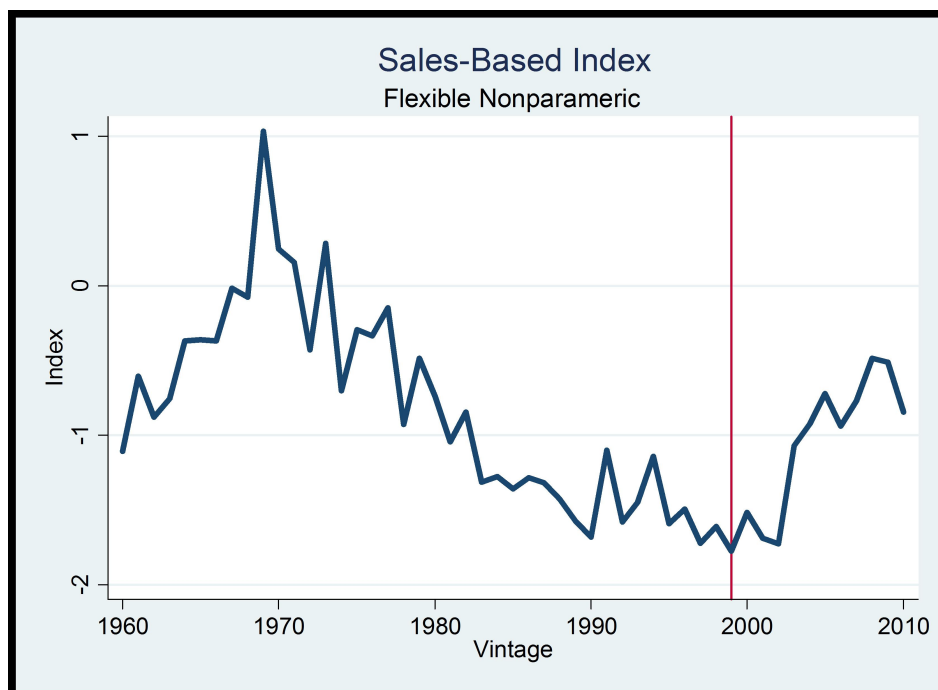


Figure 12: US Certification Index

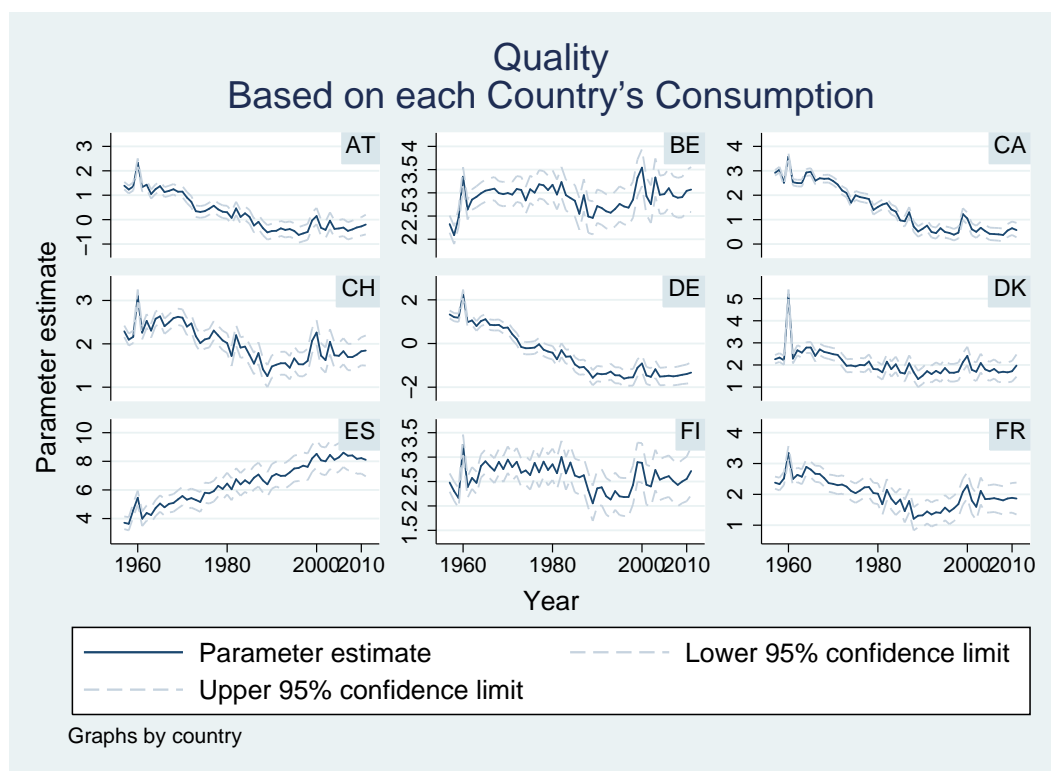


Figure 13a: Quality Based on Each Country's Consumption

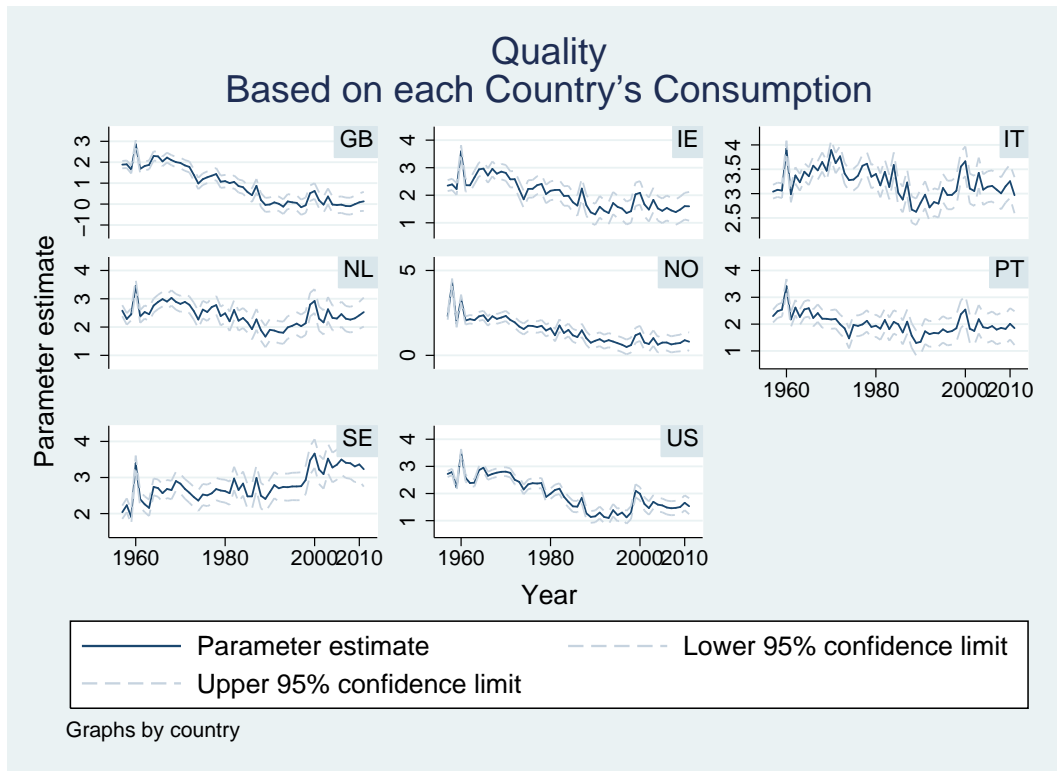


Figure 13b: Quality Based on Each Country's Consumption

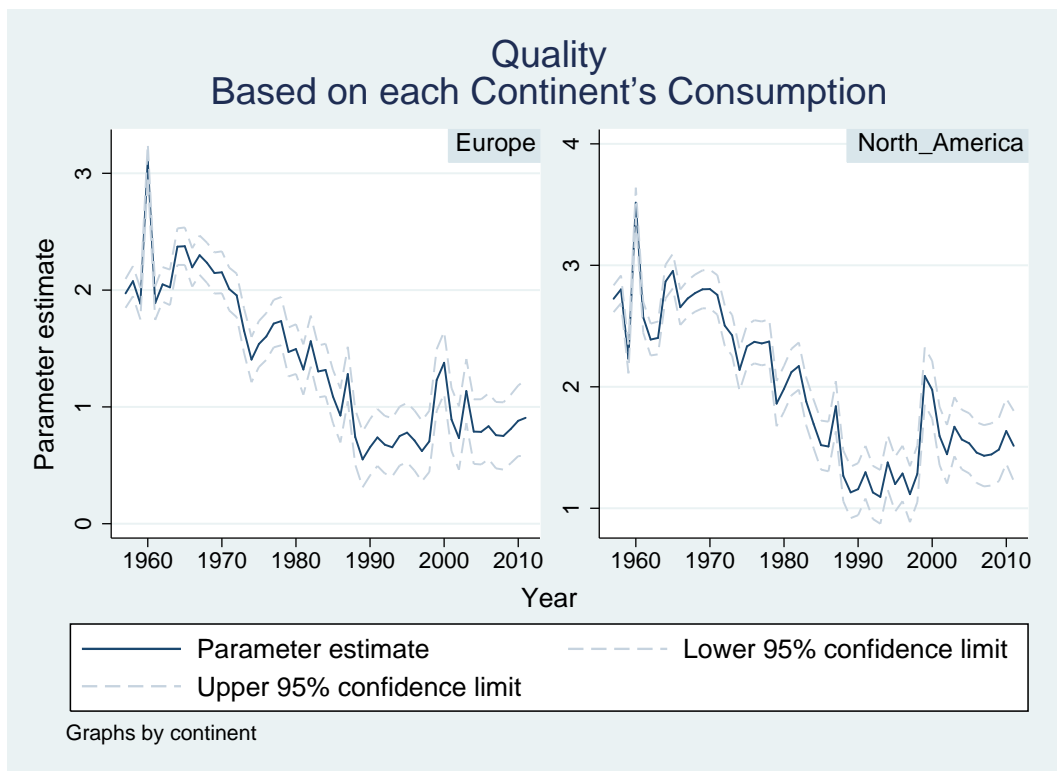


Figure 14: Quality Based on Each Continent's Consumption

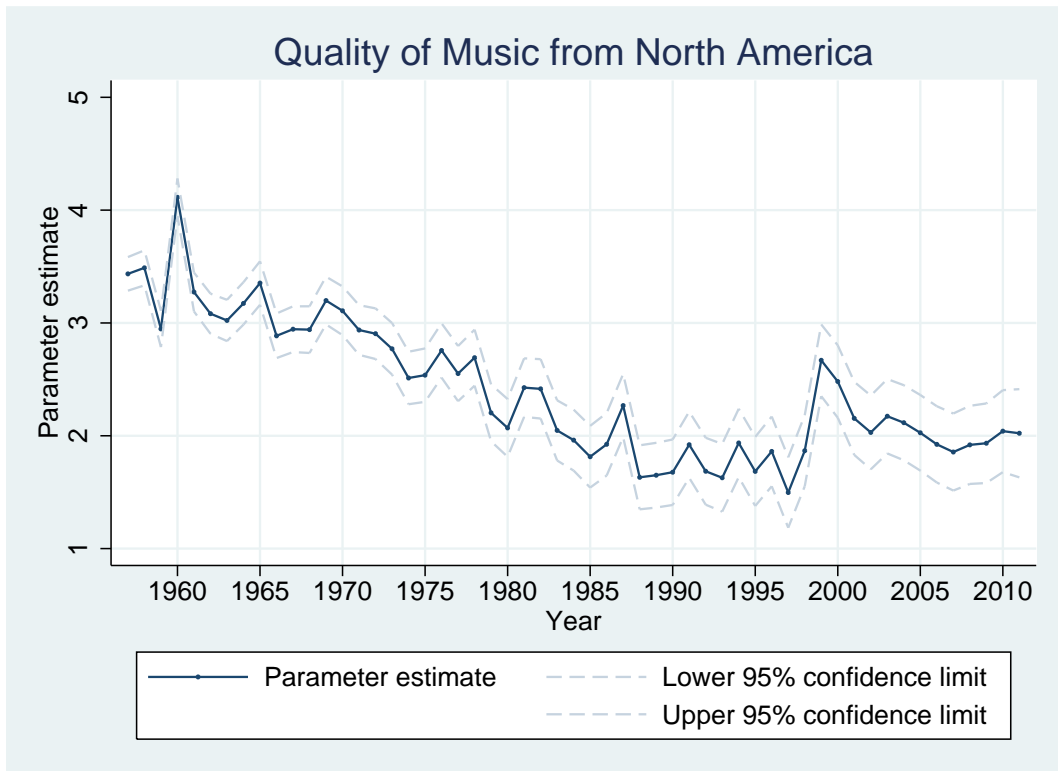


Figure 15: Quality of Music by Geographic Source: North America

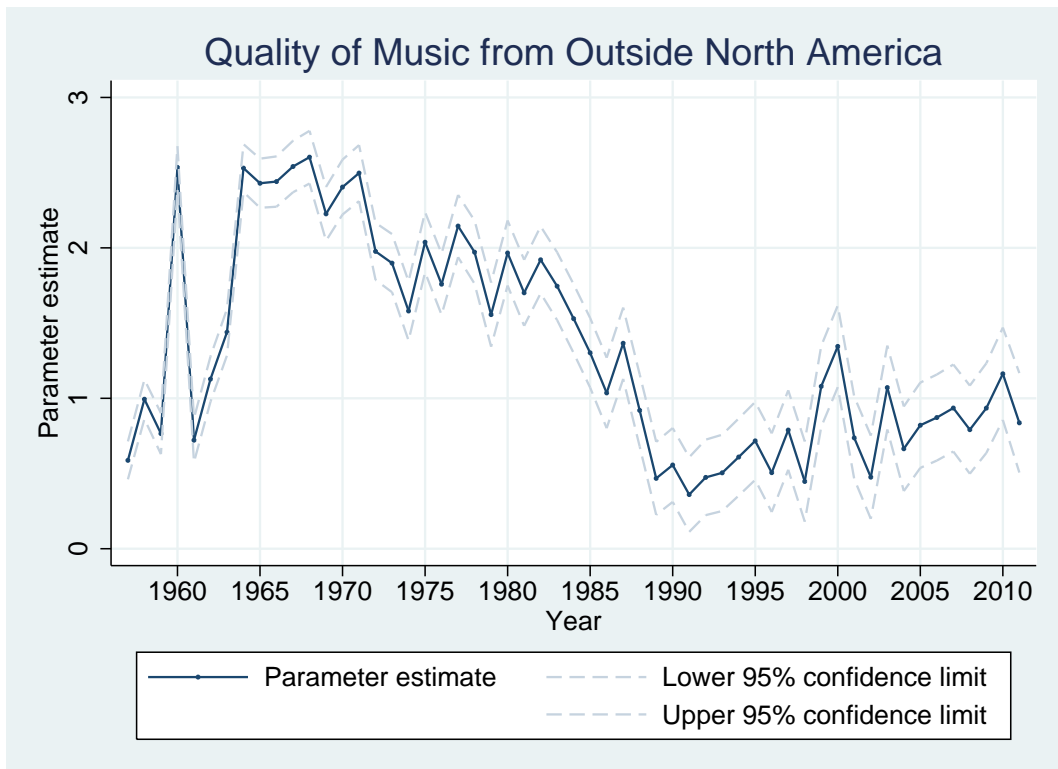


Figure 16: Quality of Music by Geographic Source: Europe

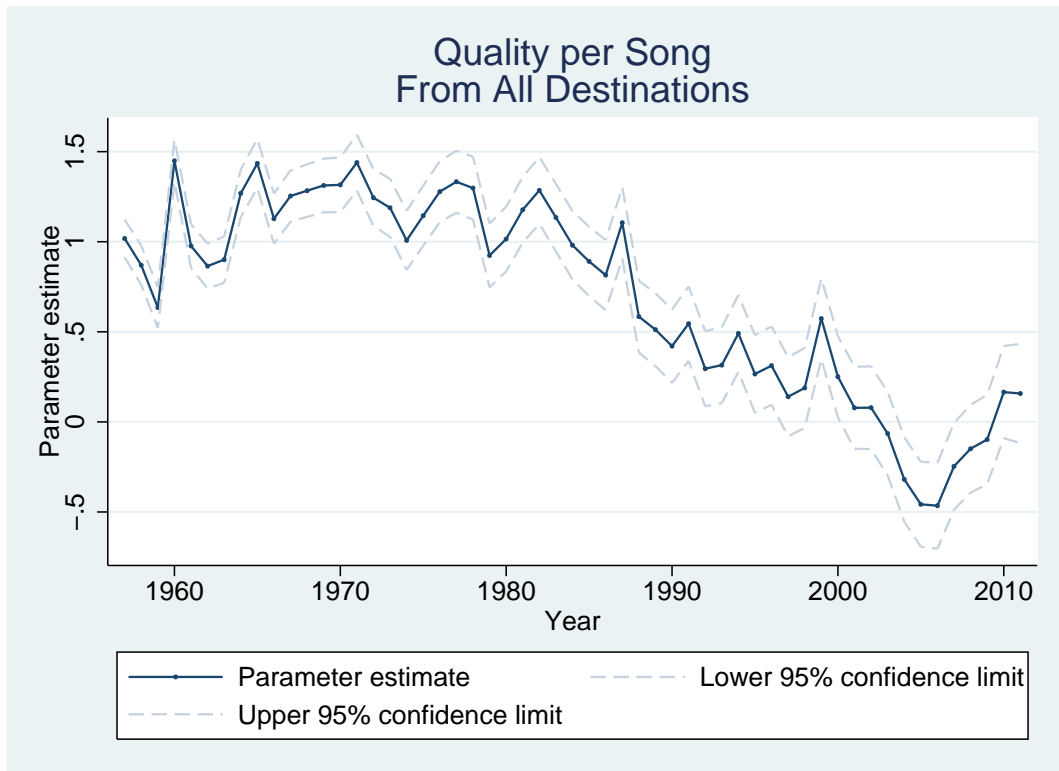


Figure 17: Quality Per Song, Based on Overall Digital Sales

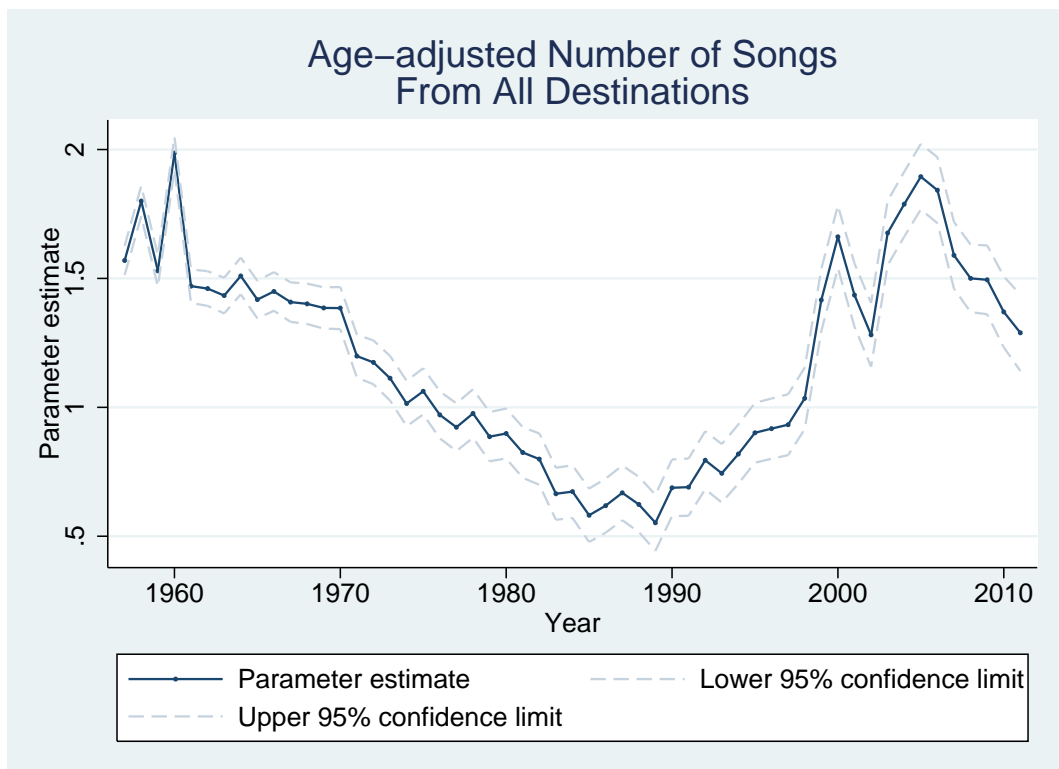


Figure 18: Age-adjusted Number of Songs

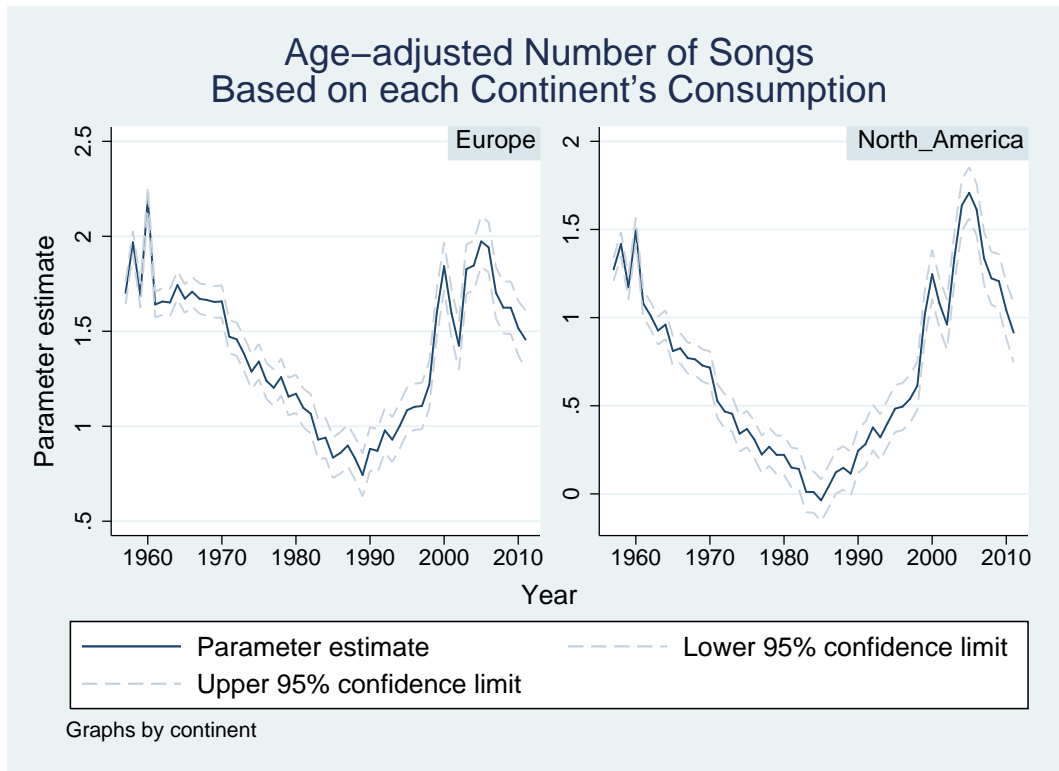


Figure 19: Age-adjusted Number of Songs, by Continent

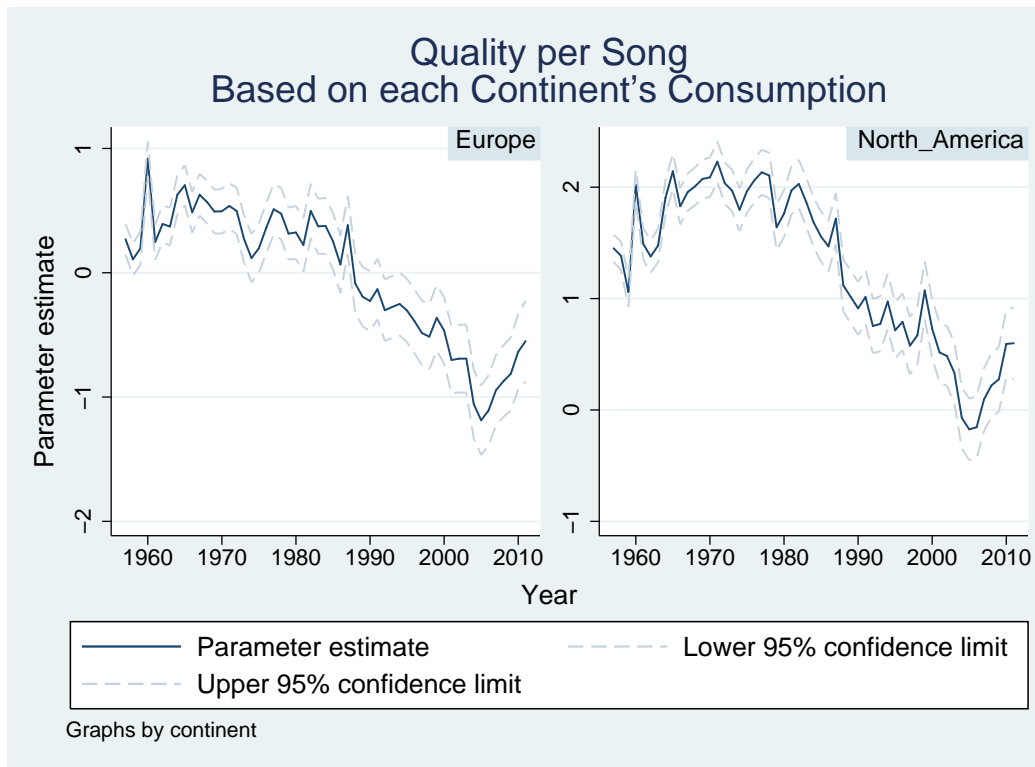


Figure 20: Quality Per Song, by Continent

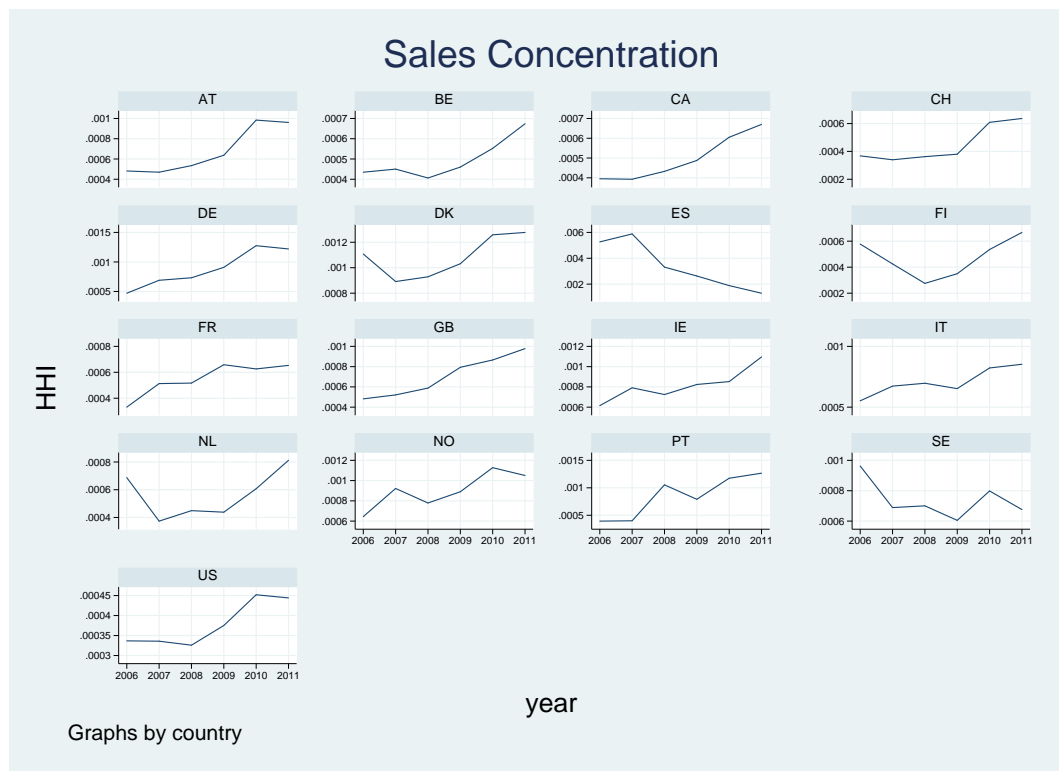


Figure 21: Evolution of Sales Concentration

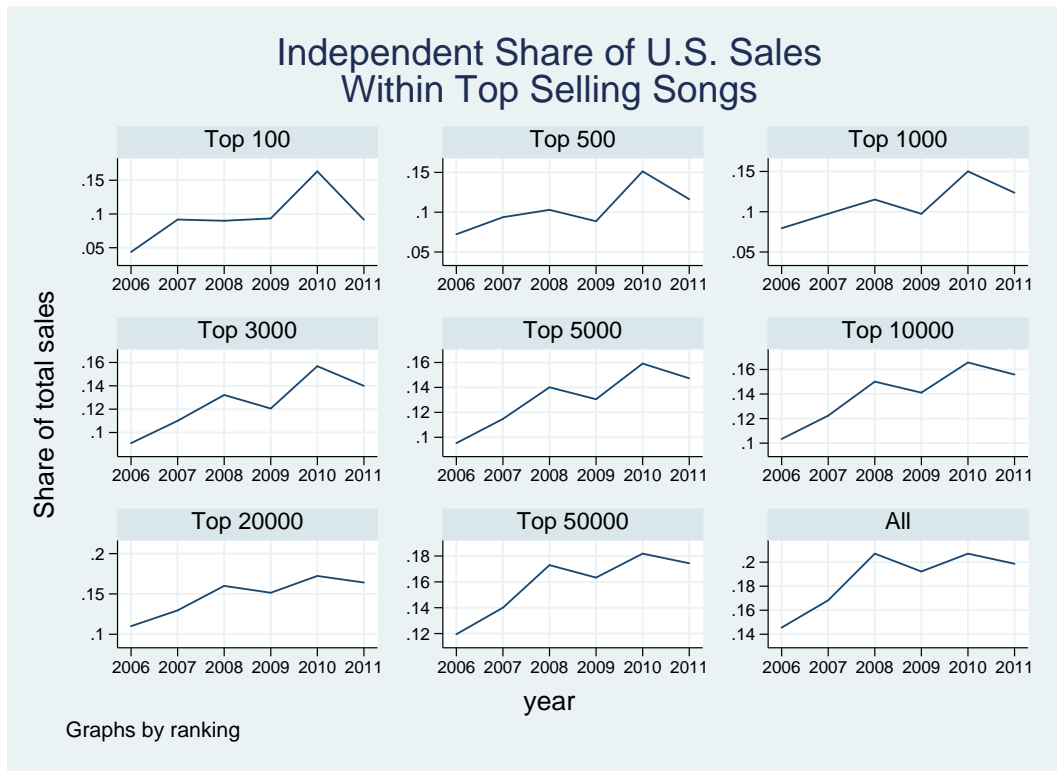


Figure 22: Independent Share of US Sales

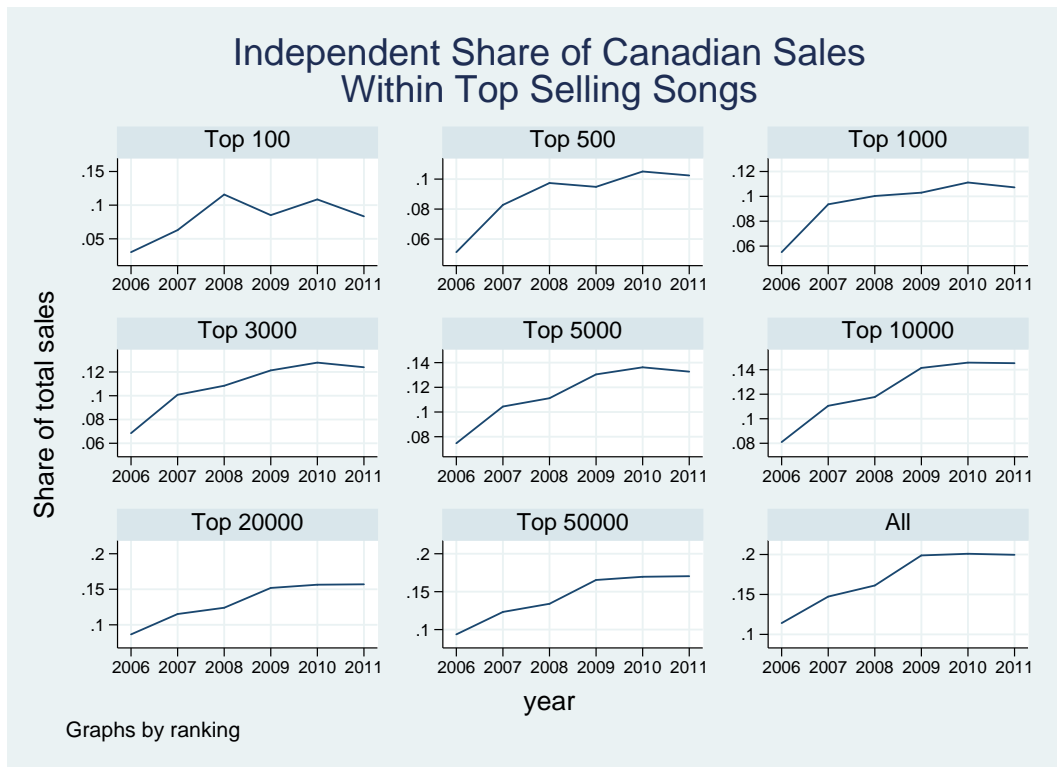


Figure 23: Independent Share of Canadian Sales

Table 1: Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Coef./s.e.	Coef./s.e.	Coef./s.e.	Coef./s.e.	Coef./s.e.	Coef./s.e.	Coef./s.e.	Coef./s.e.
Log(revenue)	-0.020 (0.09)	-0.024 (0.10)	0.043 (0.04)	0.055 (0.05)	0.097 (0.09)	0.132 (0.16)	0.130*** (0.04)	0.163*** (0.06)
Broadband Subscriptions		-0.004 (0.00)		-0.003 (0.00)		0.001 (0.01)		-0.005 (0.01)
Log(GDP per capita)		0.032 (0.24)		-0.071 (0.16)		-0.055 (0.32)		-0.099 (0.24)
Mobile Subscriptions		0.001 (0.00)		-0.002 (0.00)		-0.000 (0.00)		-0.003 (0.00)
Adjusted-R ²	0.776	0.768	0.498	0.498	0.772	0.755	0.468	0.472
No. of Obs.	247	238	654	611	136	127	380	338
No. of Countries	17	17	48	48	17	17	48	48

[†] The dependent variable is the log of the number of new releases from country c in year t . Standard errors in parenthesis and clustered at the country level. Estimations in columns (1), (2), (5), and (6) use the 17 sample countries while columns (3), (4), (7), and (8) use 49 distinct countries. Columns (1)-(4) use all years of data (1998-2012) while columns (5)-(8) use only data through 2005. All specifications include time and country fixed effects. We are missing some years for some countries, so the panels are not balanced.

*** Significant at the 1% level.

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Title: Revenue, New Products and the Evolution of Music Quality since Napster

Authors: Luis Aguiar, Néstor Duch-Brown, and Joel Waldfogel

Spain: European Commission, Joint Research Centre

2015 – 39 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9408 (online)



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