Does Music Matter in “Pop” Music? The Impact of Musical Characteristics on Commercial Success and Critics’ Ratings

Cedric Ceulemans & Lionel Detry

1. Introduction

With the introduction of rock and roll and the 45 rpm record in the 1950's, singles became a key product for the recording industry. A single is a song that is released separately from an album in addition to usually appearing on the album. The recording label typically has the contractual right to choose which songs from the album will be promoted as singles. This decision is crucial because it often drives the economic viability of an album. If a single sells well, it will boost the album's sales, making it a profitable product.

The pattern of a single's life can be summarized in four steps. First, labels present a new single to radio program planners and try to convince them to play it as often as possible. Second, radio stations play the song, and consumers buy the single. Third, (success) charts are compiled based on radio airplay and sales figures. Fourth, radio stations increase or decrease the frequency of airplay according to the charts' rankings. The cycle repeats itself until the market is saturated. Hence, the purpose of a single is to captivate the audience of radio and television musical programs. The question of how to achieve this goal has always puzzled the recording industry: "Can the ability to achieve success be attributed to a more or less innate sixth sense? […] Is success achieved through bribery, through massive 'plugging,' through a dulling of the senses or through conformism, as the ritual claims of the press would have it?" (Hennion, 1983, p.159).

To reduce this uncertainty, labels use several tools: quality and quantity of promotional kits, the label's network and social influence, press gatekeeping, and payola. Payola is defined as "undisclosed payments (or other inducements) which are given to bring about the inclusion of material in broadcast programs" (Coase, 1979). In the music industry, payola is mainly used to boost a single's sales. Since 1960, payola has been illegal in the United States, but the practice still exists. For example, in 2002, Sony gave KHTS-FM a plasma screen television worth $3,325 in exchange for the station to play "Shut Up" by Kelly Osbourne, "Pandemonium" by B2K, and "This is Me…Then" by Jennifer Lopez (Rossman et al., 2008).

Payola is very likely to continue, as current music consumption is dominated by downloaded singles (1.1 billion units) as opposed to CDs (226 million units) and downloaded album (83 million units)[1]

Consumers have access to millions of songs and can preview each song (in 30-second excerpts on iTunes or Amazon, or the entire song on websites such as YouTube, Grooveshark, etc.). Consumers choose which songs they wish to purchase, meaning that consumers are not forced to buy the single or the entire album, as was the case before the digital era. Every song is sold at the same price[2] and is equally easy to download (consumers have the same access to every song). Although such a market could smooth consumption across artists and songs, there are still huge inequalities in the success of different songs. Among the most reasonable explanations are social influence and product characteristics.

Banerjee (1992) developed a model of social influence, known as herd behavior, which explains that people choose a product because other people have chosen it, even if they would not normally choose the product based on their own knowledge. The experiment of Salganik et al. (2006) tested social influence on the inequality and unpredictability of success in an artificial music market. The study revealed that even a weak indication of others' preferences is enough to increase inequality in an artificial market. In other words, participants downloaded songs only because others had downloaded them before.

In the downloadable music market of the "real world," it is nevertheless interesting to analyze the impact of a product's characteristics on sales. Consumers face the same price, packaging, "transportation" costs, and quality [3] for all songs; however, differentiations are found in song characteristics. In this paper, we investigate if success is driven by musical characteristics that can be measured objectively. The next section is devoted

[1]Figures are taken from the R.I.A.A.'s website (http://www.riaa.org) and describe the U.S. market in 2010.

[2]The database used in the paper includes songs released in 2009. At that time, iTunes was by far the largest digital store. All songs were sold at $0.99 until April 2009. Since then, three prices have become available: $0.69, $0.99, and $1.29. In practice, very few songs are sold at $0.69. New releases and popular songs are sold at $1.29, and the majority of other songs at $0.99.

[3]In this case, quality means sound quality. All songs are in an AAC format and compressed at 256 kb/s.

to so-called charts, which are used to measure commercial success. These are essentially rankings based on realized sales. Section 3 describes the unique database that we build and then used to estimate the influence of musical characteristics on various types of charts. Sections 4 and 5 present the results and conclusions of our research, respectively.

2. Charts

The first music chart appeared almost a century ago in the UK. A few years later, in 1934, the Billboard chart appeared in the US and led to a series of radio “Hit Parade” programs (Parker, 1991). In 1958, the accuracy of sales transformed the Billboard charts into the Billboard Hot 100 as we know it today: a ranking of songs’ popularity. Nowadays, Billboard computes dozens of charts, but the Billboard Hot 100 remains by far the most popular chart for the singles’ market. This ranking is obviously very important for the music industry (labels, radio stations, etc.) to know which songs sell and which do not. Not only professionals are interested in the charts; consumers are also obsessed with sales figures and charts (Parker, 1991). Since radio stations and consumers use the charts to decide what is worth airing and listening to, songs from the best-selling artists will continue to sell until the market has been saturated. The music chart can thus be thought of as a product and a mirror of public consumption at the same time (Attali, 1977, p.201).

If a chart is a product, it can be (illegally) purchased. For example, Michael Treacy and Fred Wiersema are suspected to have bought *The New York Times* book chart, (also known as the “Best Sellers” list). As the authors of *The Discipline of Market Leaders*, they were convinced that a high position on this chart would lead to a substantial increase in sales. They secretly bought 50,000 copies of their own book from stores whose sales are monitored for *The New York Times* Best Sellers list. Their book made the Best Sellers list and sold well enough to continue as a bestseller without further intervention by the authors (Bikhchandani et al., 1998). This anecdote suggests that being in the charts “artificially” boosts product sales. The

existence of charts might thus increase the inequality in cultural markets, and contribute to creating superstars.

The study of Salganik et al. (2006) tests this hypothesis. They created an artificial music market and divided participants into three groups. Group 1 had no information about others' preferences. Group 2 had information about the number of previous downloads, with the songs presented in a rectangular grid and the positions of the songs were randomly assigned among participants. Finally, Group 3 had the same information as Group 2, but songs were presented in descending order of popularity (i.e., ranking/chart presentation). The experiment demonstrated that the ranking presentation increased success inequalities. This holds true whether the results of Group 3 are compared with those of Group 1 or of Group 2.

Berns et al. (2010) obtained a similar result: song popularity had a significant effect on the participants' likability ratings of the songs. In other words, participants said they liked a song because the song was popular. The study suggested that the anxiety generated by the mismatch between one's own preferences and the preferences of others is a principal mechanism for how rankings affect consumer choice.

A study by Strobl and Tucker (2000) on chart success of albums in the UK indicated that charts were highly skewed, whether measured by the total number weeks of success per artist or the total number of albums listed per artist. The length of survival on the charts was positively correlated with album type (greatest hits and soundtracks performed better) and initial popularity, while it was negatively correlated with seasonal demand (albums entering the charts during the pre-Christmas period remained in the charts for a shorter period of time).

Charts are so important for music consumers that nearly every specialized magazine or website now provides its own rankings. Those charts are also included in our database, which is described in the next section.

3. Data

We constructed the database in three steps explained in each of the sub-sections. We selected the songs to be included in the dataset based on critics and music lovers' "best songs of the year" lists as well as on billboard charts. We observe that critics' rankings and billboard charts consist of different songs and hence that a song's success might depend on the criteria used to evaluate it. To take this observation into account, we define several measures of success. Finally, we analyze the musical content of each song. This led to a database consisting of 514 songs which makes it possible to analyze the effect of musical characteristics on success.

3.1. Choice of songs included in the database

We looked at several 2009 year-end charts. Songs that appeared in at least one of these charts constitute our database. Three types of charts were taken into account in order to encompass all aspects of the musical market: commercial charts, critics' charts, and music lovers' charts.

Commercial Charts

Commercial charts consist of the top-selling tracks of 2009 in the United States, and four sources were used. The first chart, the Billboard Hot 100, was selected because it is the most famous and one of the oldest music charts. At the end of each year, Billboard releases a list of the top 100 most successful songs during the year. Like their weekly charts, it represents songs with "the greatest airplay and sales gains."[4] The Billboard Hot 100 "indicates sales in the largest recorded music market in the world [and] it also takes into account radio airplay. This is largely because of the greater importance that commercial radio has in promoting records in the US market." (Parker, 1991, p.207).

[4] http://www.billboard.com.

The second chart selected was iTunes, because it is the leading store in the digital music market with approximately 70% of the market share.[5] At the end of every year, a list of the 10 songs that realized the largest number of sales is released.

The third list comes from Amazon, which publishes a list of the 100 best-selling MP3s from their website. Their MP3-selling platform ranks second in the digital music market in the US.[6] The reason for analyzing these digital charts is obvious. Over the last few years, the singles market has been evolving into a fully-digital market. In the US, during 2009, 99.9% of the singles sold were digital files.[7]

Finally, in order to consider the latest trends in musical consumption behavior, we included the chart of Spotify, which is a service that allows users to stream music on the web. It has rapidly become one of the most-used music streaming services and accounts for more than 10 million users across Europe.[8] The chart we used is a list of the top 100 of most-played tracks in 2009.

Critics' Charts

Critics' charts consist of "best songs of the year" lists presented by eight magazines and one radio program: *Pop Matters* (Top 50), *Spinner* (Top 25), *Consequence of Sound* (Top 50), *NME* (Top 50), *Pitchfork* (Top 100), *Rolling Stone* (Top 25), *Slant* (Top 25), *Spin* (Top 20), and NPR ("Song of the Day" Top 10). These magazines/websites were selected due to their fame, prestige, and/or readership. A brief description of each magazine follows, along with the website's traffic ranking in the US (enclosed in parentheses) according to Alexa.com.[9] Alexa.com ranks all websites according to the

[5]According to the NPD Group, "Digital Music Increases Share of Overall Music Sales Volume in the U.S," http://www.npd.com/press/releases/press_090818.html.
[6]According to the NPD Group, "Digital Music Increases Share of Overall Music Sales Volume in the U.S," http://www.npd.com/press/releases/press_090818.html.
[7]According to the R.I.A.A. shipment database, http://www.riaa.com.
[8]http://eu.techcrunch.com/2010/09/15/spotify-10-million/. Although it is a European website, 71 songs ranked in the Spotify Top 100 has been ranked in the Billboard Hot 100.
[9]Ranking retrieved July 4, 2011.

number of page views and average daily visitors over the previous three months. We used this ranking as a rough measure of magazine's popularity.

Pop Matters (3,821) is an online magazine that was launched in 1999. It discusses movies, comics, books, and music in the form of regularly-written reviews, interviews, and academic essays. *Spinner* (2,167) is a blog that discuses only about music but in a much more commercial manner than *Pop Matters*. *Consequence of Sound* (6,901) is an online magazine that was launched in 2007 and has received several awards for its quality.[10] *The New Musical Express* (3,921), better known as *NME*, is the "world's longest-running music weekly."[11] It started publishing in March of 1952, and it was the first British magazine to include a singles chart, in November of 1952. Today, *NME* also provides music news through its website. Even though *NME* is based in the UK, we decided to include it because of its prestige.

Pitchfork (913) is known as the leading media source for independent music in the United States and abroad. It is a website, established in 1995, that publishes music criticism, news and artists' interviews. Since 1967, *Rolling Stone* (641) has been one of the most important music magazines in the world. Although it covers other topics like politics, the magazine is best known for its music critiques and interviews. On the internet, it is also one of the leading websites in the music market. Though less visited, *Slant* (8,272) enjoy a good reputation. For example, *The New York Times* called *Slant* "a repository of passionate and often prickly pop-cultural analysis."[12] *Spin* (3,790) was established in 1985 and rapidly became an alternative to *Rolling Stone*. Since 2008, *Spin* also releases a digital edition of the magazine. National Public Radio (241), also known as NPR, broadcasts through 900 stations in the US. In total, it reaches an audience of more than 25 million listeners each week.[13] NPR's program, "Song of the Day," releases a top 10 list at the end of the year.

[10] http://consequenceofsound.net/advertising.
[11] http://www.nme.com/about.
[12] Scott, A.O., "Say 'Brian De Palma.' Let the Fighting Start," September 17, 2006, The New York Times retrieved online: http://www.nytimes.com/2006/09/17/movies/17scot.html.
[13] http://www.npr.org/about/aboutnpr.

Music Lovers' Charts

Music lovers' charts consist of what listeners like, share, rate, or simply listen to. Three charts were selected based on three criteria: availability of the chart, number of users, and quality of the chart.

The first one, "Last.fm", is a website that enables users to share what they are listening to. In 2008, it reported a figure of 21 million unique users each month.[14] As each track is listened to by a user, it is sent through a widget to the internal server, so charts are updated continuously. At the end of each year, a list of the 40 most-played artists is computed. For each artist, we included the most-played track.

The second chart, "We Are Hunted," includes the top 99 hottest singles. It focuses on how music is spreading rather than how music is selling. Its aim is to "listen to what people are saying about artists and their music on blogs, social networks like Facebook and MySpace, message boards and forums, Twitter and P2P networks to chart the top songs online every day."[15] This process results in a ranking that includes more "alternative" songs than commercially successful ones.

Finally, the third chart is "Rate Your Music," which is a user-driven music database where users can rank and review albums. It contains more than two million releases, 20 million rankings, and 1.3 million reviews. The website offers a continuously-updated users' chart that is based on songs' release dates. We extracted the ranking (top 100 songs released in 2009) at the beginning of 2010.

Though all the selected charts concern the year 2009, some of them include songs released before that year. Older songs would only be listed in the charts because, for instance, they were made popular again by a movie or TV show or because of the "death factor" (when a star dies, we often observe a revival of his or her popularity). This is what happened with the death of Michael Jackson on June 25, 2009. Many people gathered to listen to Jackson's music, and radios aired his music more than ever. The charts from Last.fm show that millions of his songs were played just after his death and in

[14]The *Guardian* : http://www.guardian.co.uk/media/2008/feb/22/digitalmedia1.
[15]http://wearehunted.com/a/#/about/.

the month that followed. That put him well above other artists, with twice as many listeners as the second-ranked artist.[16] Sales of Jackson's songs also increased, which resulted in his higher ranking on the Billboard after his death. We deleted those older songs from our database because the purpose of this paper is to elicit a link between musical characteristics (which is likely to be a function of the spirit of time) and success.

3.2. Measures of success

For the 514 songs in our database, we recorded their highest rank (or peak position) in the Billboard Hot 100 chart and the number of weeks they stayed in that chart. These two variables describe intensity and length of success, and were therefore used to define two variables that measure a song's commercial success in the United States.

A song ranked number one in the Billboard Hot 100 will be given the value 100, and a song ranked 100 will receive the value 1. Songs that are not ranked are given the value of 0. This is for ease of interpretation and to maintain consistency with the other "success" variables, which are ascending. The variable is called "Billboard Rank."

"Survival" is the number of weeks a song remains in the Billboard Hot 100. The information were retrieved until April 2011 so that every song had a complete "singles' cycle" (i.e., enter the charts, reach its peak position, and exit the charts). This late retrieval avoids discrepancies between songs released in the beginning of 2009 and those released at the end of that year.

In addition to these two "commercial success" indicators, we constructed two other "success" variables, one that measures critics recognition, and the other that represents music lovers' preferences. "Critics" is the number of times a song is mentioned in critics' year-end charts.[17] Since there are eight such charts, the variable "critics" takes values 0, 1, …, 8.

[16]See, for instance, the weekly chart that follows his death: http://www.lastfm.fr/charts/artist?charttype=weekly&subtype=artist&range=1245585600-1246190400.

[17]We excluded *NME* because its British origin would make the impact of artists' nationality (one of the control variables that are described later) on "Critics" undetectable.

Finally, “Music Lovers” is the number of times a song is present in “music lovers’” year-end charts. It takes values 0, 1, 2 or 3.

3.3. Musical characteristics and control variables

In order to analyze musical attributes of these songs, we used a tool called *Analyze*, which was developed by *The Echo Nest Corporation* and consists of an application-programming interface (API) that produces an analysis of various song aspects.[18] It is the only musical analysis tool that incorporates music perception principles to produce objective measurements. After uploading a song, *Analyze* delivers results for a variety of attributes that are directly stored in a spreadsheet. For our research, we focus on the following factors delivered by *Analyze*: “Key,” “Duration,” “Mode,” “Tempo,” and “Time Signature.” Although *Analyze* was useful, it made many mistakes for some variables. Moreover, the API did not deliver results for three variables that we wanted to include in the study: “Type of Production,” “Gender,” and “Triplet.” This required us to go through the database again and listen to the songs to correct the mistakes and add the new variables. My co-author analyzed the “harmonic” variables and I took care of the “rhythmic” variables song by song. Our database consists of 514 songs and the average length is 4 minutes and 3 seconds. That is my co-author and I both had to listen to more than 34 hours of music to compile all the necessary information. Table 1 describes the dataset in some detail and gives the number of observations (frequencies) for each variable. This section describes the variables used to measure the musical characteristics of the songs and discuss the information contained in Table 1.

(1) Type of production: each song is classified as “electronic,” “acoustic,” or “mixed.” Vocals were not considered in this differentiation. In an electronic song, one can hear (almost) only electronic sounds: drum machines, synthesizers, etc. An acoustic song is played with acoustic instruments: guitar, piano, bass, drum kit, etc. Guitars may or may not be electric. A mixed song is a blend of acoustic and electronic sounds. Though electronic music is

[18]The API is available for free on The Echo Nest’s website: http://the.echonest.com.

popular since the 1980s, most songs (295 out of 514) in 2009 are still played with acoustic and electric instruments.

(2) Gender: three possibilities can characterize the singer(s): male, female, or duo (i.e., one male and one female lead singer). We did not include in the database instrument-only songs (i.e., songs without a singer). It represents eleven observations, none of which is charted in the Billboard Hot 100. The commercial music industry is known to be dominated by male artists. The data support this statement: male singers (327 songs) outnumber female singers (140 songs).

(3) Tempo: the speed of the song, expressed in beats per minute. The average tempo is 114 beats/minute and the standard deviation is 31.4 beats/minute.

(4) Duration: length of the song expressed in seconds. The average length of a song is 243 seconds and the standard deviation is 71 seconds.

(5) Key: the overall musical key in which the song is written. C is noted Key0; C# is noted Key1,…, B is noted Key11. Table 1 shows that all keys are used by composers but not with the same frequency. D and C are the most common keys as opposed to G# and A#. The data does not make it possible to establish if this is a trend in the commercial music genres or if it is particular to the year 2009.

(6) Mode: the mode is either minor or major. Although many different modes exist, these are the only two used in popular music. Our data indicates that musicians compose evenly in minor and major modes.

(7) Time signature: the overall time signature determines the number of beats in each measure. It is also called a meter. In popular music, most of the songs are in 4/4. In our case 97% of the songs have a “4/4” time signature.

(8) Triplet: when each beat is composed of three sub-beats, it can create a different groove, even though the song may still be in a 4/4 time signature. Only 45 compositions use the “triplet” rhythmic.

Finally, we added three control variables:

(1) Label: we classified the songs into two label groups, major or independent, depending on which label they were signed with at the time of the release. This classification reflects the organization of the actual music industry, which is divided into a large number of small independent labels and four major corporations (Universal, Sony, Warner, EMI) that account for approximately 75% of the market.[19] Our database is even split between musicians signed by majors and Independent labels.

(2) Nationality: a dichotomous variable depending on the US or non-US origin of the artist. Sixty percent of the musicians in our data are American.

(3) Guest: a dichotomous variable signaling the appearance of a guest star in the song. It is common to market a song or an artist by including a well-known singer as being “featured” (or as a guest) in the song. There are nearly as many “duos” as there are “guests” songs in our database suggesting that in order to broaden artists’ audience even more “guest” artists are often from the opposite sex than the “main” artist.

[19]According to *Music & Copyright* (figures for 2009): http://musicandcopyright.wordpress.com/2010/04/21/sony-music-makes-gains-on-dominant-universal-in-2009/

Table 1—Descriptive Statistics

Variable		No. Of observations
Type of production	Acoustic	295
	Electronic	119
	Mixed	100
Gender	Female	140
	Male	327
	Duo	47
Tempo	see text	
Duration (in seconds)	see text	
Key	0 (C)	58
	1 (C#)	30
	2 (D)	80
	3 (D#)	27
	4 (E)	56
	5 (F)	35
	6 (F#)	29
	7 (G)	43
	8 (G#)	22
	9 (A)	56
	10 (A#)	22
	11 (B)	56
Mode	Major	269
	Minor	245
Time Signature	4/4	499
	Non-4/4	15
Triplet	Yes	45
	No	469
Label	Major	263
	Independent	251
Nationality	U.S.A.	315
	Non-U.S.A.	199
Song features a guest	Yes	41
	No	473
Total Number of Observations		514

4. Results

We deal with two sets of variables, summarized in Table 2, one of which contains several measures of success ("Billboard Rank", "Survival", "Critics", "Music Lovers"), while the other contains musical characteristics and control variables. We considered using a statistical technique referred to as canonical correlation (see for example Anderson, 1984), which allows "regressing" one set on the other, in fact finding two linear combinations, one for the success variables the other for the characteristics and controls, such that the correlation between the resulting two linear combinations is the largest possible.[20] We thought that this multivariate technique could shed some light on where the strong correlations would lie. The analysis unfortunately led to results that we were unable to interpret.

Since the results of canonical correlations were difficult to interpret, we turn to regressing each "success" variable on musical characteristics and control variables, distinguishing between commercial success ("Billboard Rank" and "Survival") and success as judged by critics and music lovers.

Before analyzing the results, we should make two preliminary remarks. First, some "Key" coefficients are statistically significant but not reliable because the "Key" variables are not jointly significant, even when the less frequently used keys are deleted from the regression.

Second, observations on songs constitute the database, but one artist might be the author of several songs. This means that we have "groups" or "clusters" in our data and we suspect that intragroup observations are correlated: observations are independent across groups (clusters) but not necessarily within groups. Therefore we always use a robust variance estimator for cluster-correlated data (Williams, 2000 and Rogers, 1993).

[20] In fact, one can compute several such combinations. For details, see e.g. Anderson (1984).

Table 2—Variables' Description

Type of variables	Variables		Description
Success	Billboard Rank		"Inverted" peak position of the song in the Billboard Hot 100 (a number between 0 and 100).
	Survival		Number of weeks a song remained in the Billboard Hot 100 (a number between 0 and 76).
	Critics		Number of times a song is present in critics' year-end charts (a number between 0 and 8).
	Music Lovers		Number of times a song is present in music lovers' year-end charts (a number between 0 and 3).
Musical Characteristics	Type of Production	Electronic	1 if song is electronic; 0 otherwise.
		Mixed	1 if song is a mix of electronic and acoustic; 0 otherwise.
		Acoustic	1 if song is acoustic; 0 otherwise.
	Gender	Male	1 if lead singer is a male; 0 otherwise.
		Female	1 if lead singer is a female; 0 otherwise.
		Duo	1 if lead singers are female and male; 0 otherwise.
	Tempo		Beat Per Minute.
	Duration		Length expressed in seconds.
	Squared Duration		Square of duration.
	Key		Coded as 12 binary variables. One for each key.
	Mode		1 if song is in major mode; 0 otherwise.
	Time Signature		1 if song is in 4/4; 0 otherwise.
	Triplet		1 when each beat is composed of three sub-beat ; 0 otherwise.
Control	Label		1 if song was released by a major; 0 otherwise.
	Nationality		1 if song was made by an American artists; 0 otherwise.
	Guest		1 if guest appearance; 0 otherwise.

4.1. Commercial Success

The "Billboard Rank" variable contains many zeros since many songs did not chart in the Billboard Hot 100. In these cases, we do not observe the level of success (i.e., whether they were totally unsuccessful or very close to enter the Billboard chart). These observations are thus left-"censored" because we do not know whether an observation should take the value zero or be negative. We first ran a tobit regression (see Tobin, 1958). However, the dependent variable "Billboard Rank" is not continuous but rather a ranking (with many ties possible). Consequently, we also used ordered logit and logit models. In the ordered logit case, we grouped the observations in eight

categories according to the billboard rank. Hence, the variable "Billboard Rank" takes the value 0 (for unranked songs), 1, 2…, and 7(for highly ranked songs). In the logit case, "Billboard Rank" is a dichotomous variable that takes value zero for non-ranked songs and one otherwise. The logit regression estimates how musical characteristics influence the probability of entering the Billboard chart. Results are shown in Table 3.

In all three regressions, the coefficients of "Electronic" and "Female" are positive and statistically significantly different from zero at the five and ten percent probability level, respectively. Electronic songs perform better and female singers are more likely to enter the charts. The control variables play an important role: "Nationality" and "Label" are the most significant ones (included in our database) that explain a song's position in the charts. This suggests that payola, mainly used by majors,[21] and other promotional techniques are efficient. Having a "Guest" (a trick used by some important artists) might also boost sales.

There is an optimal duration for a song when the coefficients of "Duration" and "Squared Duration" are positive and negative, respectively. Crain and Tollison (1997) show that the duration of hit songs fluctuates over time. They analyze the average length of number 1 songs and distinguish three periods: 1940-1955, 1956-1964, and 1965-1988 with an average duration of 166 seconds; 146 seconds, and 235 seconds, respectively. Songs were shorter before the 1970s because the best selling format at the time was the 45rpm vinyl disc that could not hold more than three minutes of music. Hence, record labels promoted only songs that fit into that specific format. When the technical restrictions disappeared, the length of hit songs increased up to the "four minutes format" which exists for the last thirty years. For 2009, we estimate the optimal duration of a song to be equal to 246 seconds. The length is likely to be influenced by radio stations since long songs might be excluded from their playlists.[22]

[21]Independent labels do rarely have the financial asset to use payola on a large scale like majors can do.
[22]When a song on an album is too long and that a label wants to promote it as a single, a " Radio edit" (i.e., a shorter version) is often produced.

Table 3—Commercial Success Estimation Results: Billboard Rank

	Tobit		Logit		Ordered Logit	
	Coeff.	t-value	Coeff.	z-value	Coeff.	z-value
Electronic	31.43***	(2.91)	0.93**	(2.31)	1.12***	(3.2)
Mixed	-5.40	(-0.43)	-0.27	(-0.58)	0.11	(0.28)
Female	16.76*	(1.82)	0.57*	(1.65)	0.62**	(2.03)
Duo	4.21	(0.34)	-0.05	(-0.11)	0.50	(1.09)
Tempo	-0.12	(-1.09)	-0.003	(-0.76)	0.00	(-0.9)
Duration	1.58***	(2.8)	0.04**	(2.44)	0.05**	(2.53)
Squared Duration	-0.003***	(-2.83)	-9E-05**	(-2.55)	-10E-05**	(-2.47)
Key1	-18.01	(-1.29)	-0.85	(-1.58)	-0.25	(-0.55)
Key2	-26.36	(-1.56)	-1.36**	(-2.1)	-0.57	(-1.02)
Key3	-16.11	(-0.96)	-0.99	(-1.5)	-0.45	(-0.86)
Key4	-4.46	(-0.33)	-0.32	(-0.6)	0.17	(0.37)
Key5	-16.33	(-1.01)	-0.7	(-1.06)	-0.30	(-0.62)
Key6	-7.61	(-0.45)	-0.63	(-0.9)	0.39	(0.66)
Key7	8.67	(0.62)	0.23	(0.42)	0.55	(1.26)
Key8	-32.68	(-1.61)	-1.35*	(-1.77)	-0.91	(-1.45)
Key9	-17.28	(-1.13)	-0.88	(-1.43)	-0.22	(-0.43)
Key10	-27.07*	(-1.72)	-1.07*	(-1.71)	-0.56	(-1.26)
Key11	-26.16	(-1.64)	-1.31**	(-2.1)	-0.47	(-0.86)
Mode	1.07	(0.12)	0.15	(0.45)	0.05	(0.18)
Time Signature	26.30	(0.54)	1.49	(0.86)	1.29	(0.81)
Triplet	-3.22	(-0.24)	-0.14	(-0.31)	-0.07	(-0.18)
Label	117.47***	(11.57)	3.67***	(7.97)	3.50***	(8.55)
Nationality	59.72***	(5.67)	1.88***	(5.09)	1.80***	(4.7)
Guest	24.29*	(1.88)	1.29**	(2.1)	0.52	(0.97)
Intercept	-332.6***	(-3.89)	-10.5***	(-3.52)	/	/
Intercept (cut)1					11.72697	
Intercept (cut) 2					11.96665	
Intercept (cut) 3					12.13882	
Intercept (cut) 4					12.82398	
Intercept (cut) 5					13.54116	
Intercept (cut) 6					14.12505	
Intercept (cut) 7					14.51874	
Observations						
Left-Censored	353					
Uncensored	161					
Total	514		514		514	

Notes: 1) *, **, *** indicate that the coefficients are different from zero at a 10, 5 and 1% probability level, respectively.

2) Omitted dummy variables are: “Acoustic” for “Type of Production”, “Male” for “Gender”, “Key0” (i.e. Key C) for “Key”, “Minor” for “Mode”, “non-4/4” for “Time Signature”, “no triplet” for the variable “triplet”, “Non-U.S.” for “Nationality”, and “No Guest” for “Guest.”

Our second measure of commercial success is survival in the charts. "Survival" can be thought as a count variable (a song can stay 0, 1, 2, etc. number of weeks in the charts). Therefore we use a count model and because "Survival" exhibits over-dispersion — the variance is much larger than the mean — the negative binomial should perform better than the Poisson model. As shown in Table 4, we estimate "Survival" using a zero-inflated negative binomial regression, since the data include an excess of zeros (i.e. a large number of non-ranked songs).

When we restrict the data to the songs that have been charted, the number of observations falls to 161. In this case, the dependent variable takes only strictly positive values, though zero is a possible outcome. Therefore we use a zero-truncated negative binomial model.[23] Zero-inflated and zero-truncated negative binomial regressions lead to similar results.

They show that electronic songs stay longer in the "Billboard Hot 100" and duration increases survival in the charts up to a certain point, after which it decreases. Contrary to "Billboard Rank", "Survival" does not depend on "Label", "Nationality", or "Guest" appearance. This suggests that major labels can buy — literally for songs that are promoted via payola, though it is prohibited — a song's entry in the charts but not its survival. It could be that once a song enters the "Billboard Hot 100", it has sufficient media attention to compete fairly with all other charted songs. If this is the case, it seems reasonable that being American, promoted by a major label, or having a guest would not significantly improve chart survival.

The coefficient of "Mode" is positive and significantly different from zero at the five percent probability level. "Happy" songs are more likely to stay in the charts. Indeed, the major and minor modes are associated with happiness and sadness, respectively (see e.g. Crowder, 1985). There is no definite explanation for why the association exists but similarities between the spectra of voiced speech uttered in different emotional states and the spectra of particular minor and major intervals have been observed (Bowling et al., 2010). For example, the minor third communicates sadness in speech, mirroring its use in music (Curtis and Bharucha, 2010).

[23]Note that in this case, one song only has a "time signature" different form 4/4. We therefore excluded the variable from the zero-truncated negative binomial regression.

Table 4—Commercial Success Estimation Results: Survival

	Zero-Truncated Negative Binomial		Zero-Inflated Negative Binomial	
	Coeff.	z-value	Coeff.	z-value
Electronic	0.32**	(2.57)	0.30**	(2.34)
Mixed	-0.02	(-0.13)	-0.02	(-0.16)
Female	-0.01	(-0.13)	-0.02	(-0.16)
Duo	0.01	(0.09)	0.01	(0.08)
Tempo	-0.001	(-0.53)	-0.001	(-0.42)
Duration	0.03***	(4.57)	0.03***	(4.30)
Squared Duration	-5E-05***	(-4.72)	-5E-05***	(-4.42)
Key1	0.05	(0.34)	0.04	(0.34)
Key2	0.02	(0.13)	0.02	(0.11)
Key3	-0.04	(-0.29)	-0.04	(-0.28)
Key4	-0.02	(-0.13)	-0.02	(-0.14)
Key5	-0.34**	(-2.35)	-0.35**	(-2.35)
Key6	0.13	(0.67)	0.13	(0.67)
Key7	0.05	(0.25)	0.04	(0.22)
Key8	-0.07	(-0.29)	-0.07	(-0.27)
Key9	-0.03	(-0.18)	-0.03	(-0.20)
Key10	-0.38*	(-1.69)	-0.38*	(-1.68)
Key11	-0.01	(-0.03)	0.02	(0.09)
Mode	0.29**	(2.4)	0.28**	(2.26)
Time Signature	/	/	0.54	(1.55)
Triplet	0.001	(0)	-0.01	(-0.04)
Label	0.20	(0.94)	0.17	(0.77)
Nationality	0.10	(0.74)	0.10	(0.79)
Guest	0.02	(0.15)	0.01	(0.12)
Intercept	-0.84	(-0.99)	-1.21	(-1.53)
Observations				
Zero			353	
Non-Zero			161	
Total	161		514	

Notes: 1) *, **, *** indicate that the coefficients are different from zero at a 10, 5 and 1% probability level, respectively.

2) Omitted dummy variables are: “Acoustic” for “Type of Production”, “Male” for “Gender”, “Key0” (i.e. Key C) for “Key”, “Minor” for “Mode”, “non-4/4” for “Time Signature”, “no triplet” for the variable “triplet”, “Non-U.S.” for “Nationality”, and “No Guest” for “Guest.”

Our results show that there is no magical formula to compose a hit song but that the "spirit of time" and the promotional force of majors can have a significant influence. The stereotype of a hit song in 2009 is sung by a female American artist who is under contract with a major label, sings a four-minute song in major mode with the support of a guest. A perfect example is the American singer Lady Gaga, who is under contract with Interscope (a subsidiary of Universal Music). Her song, "Just Dance" featuring Colby O'Donis (4:02 in length and composed in major mode) was one of the biggest successes of 2009.

4.2. Critics' and Music Lovers' Success

We now analyze how professionals (variable "Critics") and amateurs (variable "Music Lovers") are influenced by musical characteristics. "Critics" is a number between zero and eight and "Music Lovers" a number between zero and three (both numbers represent the number of charts). In both cases, we use the ordered logit estimation method. Very few songs appear in more than two charts, and we decided to aggregate into one group all the songs present in two or more than two charts. We also aggregated in two groups only (0 and positive) and ran logit regressions.

The results, presented in Table 5, show that musical characteristics and control variables have a different impact on Critics charts than on Billboard charts (in Table 3) We might have expected this result for three reasons: (1) critics are professionals and listen to much more music than the "average consumer." This should have an effect on music preferences, (2) critics target "music lovers" who are a sub-sample of music consumers, and (3) critics are not "corrupted" by payola.

The coefficients picked up by "Mixed", "Duo", and "Nationality" are positive and statistically significantly different from zero at the five percent probability level for the first one and at the ten percent probability for the other two variables. These results suggest that critics might pay attention not to hurt their potential readerships. Indeed with "Mixed" songs, critics favor electronic and acoustic sounds at the same time; the same argument holds for "Duo" (one female and one male lead singer). Online magazines have mostly an

American readership. This might explain their tendency to favor American artists. Finally, the negative sign of the coefficient picked by the "Label" variable might be seen as a signal sent to readers that magazines are independent with respect to majors. However, the hypothesis that critics are influenced by their potential readership can unfortunately not be tested with our data.

Critics prefer songs composed in major mode. As a significant part of their job is to listen to music, critics might be biased in favor of "happy" songs.

Table 5—Critics and Music Lovers Estimation

	Panel A. Critics				Panel B. Music Lovers			
	Logit		Ordered Logit		Logit		Ordered Logit	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Electronic	0.09	(0.33)	0.07	(0.27)	-0.71**	(-2.31)	-0.70**	(-2.34)
Mixed	0.72**	(2.57)	0.71***	(2.8)	-0.07	(-0.26)	0.004	(0.02)
Female	0.10	(0.45)	0.06	(0.25)	0.23	(1.03)	0.30	(1.37)
Duo	0.62*	(1.79)	0.59*	(1.77)	-0.08	(-0.23)	-0.15	(-0.46)
Tempo	0.002	(0.59)	0.002	(0.68)	0.004	(1.10)	0.003	(0.99)
Duration	0.007	(1.08)	0.005	(1.13)	0.003	(0.57)	0.003	(0.54)
Squared Duration	-3E-06	(-0.23)	-7E-07	(-0.13)	-7E-06	(-0.91)	-7E-06	(-0.91)
Key1	-0.28	(-0.52)	-0.28	(-0.52)	-0.27	(-0.51)	-0.37	(-0.7)
Key2	0.03	(0.07)	0.04	(0.09)	0.19	(0.49)	0.12	(0.31)
Key3	0.41	(0.76)	0.10	(0.22)	-0.12	(-0.23)	-0.14	(-0.25)
Key4	-0.10	(-0.24)	-0.14	(-0.35)	-0.13	(-0.33)	-0.21	(-0.53)
Key5	0.74	(1.58)	0.46	(1.07)	0.46	(0.99)	0.56	(1.15)
Key6	0.21	(0.37)	0.24	(0.46)	0.04	(0.08)	-0.09	(-0.18)
Key7	-0.82	(-1.59)	-0.83*	(-1.77)	0.52	(1.14)	0.49	(1.09)
Key8	0.82	(1.52)	0.82	(1.45)	0.01	(0.01)	0.06	(0.09)
Key9	0.49	(1.07)	0.52	(1.24)	0.17	(0.42)	0.18	(0.44)
Key10	-0.33	(-0.58)	-0.48	(-0.94)	-0.14	(-0.23)	-0.26	(-0.44)
Key11	0.13	(0.28)	0.03	(0.08)	0.62	(1.47)	0.50	(1.21)
Mode	0.42*	(1.90)	0.37*	(1.82)	-0.34	(-1.50)	-0.32	(-1.47)
Time signature	0.22	(0.30)	0.04	(0.05)	-0.47	(-0.76)	-0.33	(-0.62)
Triplet	-0.29	(-0.82)	-0.27	(-0.78)	0.49	(1.52)	0.45	(1.47)
Label	-1.25***	(-5.51)	-1.06***	(-4.74)	-0.82***	(-3.89)	-0.75***	(-3.56)
Nationality	0.41*	(1.88)	0.42*	(1.94)	-0.62***	(-2.94)	-0.60***	(-2.87)
Guest	-0.43	(-0.94)	-0.38	(-0.85)	-1.51**	(-2.39)	-1.52**	(-2.44)
Intercept	-2.51*	(-1.85)			0.21	(0.17)		
Intercept (cut) 1			1.87				-0.13	
Intercept (cut) 2			4.06				2.67	
Observations	514		514		514		514	

Notes: 1) *, **, *** indicate that the coefficients are different from zero at a 10, 5 and 1% probability level, respectively.

2) Omitted dummy variables are: "Acoustic" for "Type of Production", "Male" for "Gender", "Key0" (i.e. Key C) for "Key", "Minor" for "Mode", "non-4/4" for "Time Signature", "no triplet" for the variable "triplet", "Non-U.S." for "Nationality", and "No Guest" for "Guest."

For “Music Lovers,” the coefficients of “Electronic,” “Label,” “Guest,” and “Nationality” are negatively signed and statistically significantly different from zero at the five percent probability level. Since our “Music Lovers” ranking is made by Internet users from around the world, the “Nationality” coefficient is less relevant for our analysis. The coefficients have the opposite sign of those obtained for the “Billboard Rank” regression. This might be contradictory because music lovers are also music consumers. But music lovers seem to represent a too small fraction of the music consumers’ population to have a significant impact on the Billboard charts.

5. Discussion and Conclusion

Several experiments in the field of psychology (for reviews, see Juslin and Laukka, 2003) have demonstrated that objective properties of music have an impact on listener responses. For example, tempo has an effect on arousal and pleasure (Kellaris and Kent, 1993). The present study evaluates whether such musical characteristics are also correlated with consumption behavior and critic ratings. Our results suggest that only the mode impacts songs’ survival in the commercial charts as well as critics’ rankings. The influence of the other characteristics depends on the population sample (specialists versus non-specialists), suggesting that public and critics’ tastes are different.

Comparing the three logit regressions (“Billboard Rank”, “Critics”, and “Music Lovers”), one can observe that the “Label” coefficient is always statistically significantly different from zero at the one percent probability level but it is positive with “Billboard Rank” and negative otherwise. This difference may be due to payola, which hides the musical content to non-specialists. In other words, non-specialists are more likely to pay attention to the media hype and specialists to the music itself. This hypothesis is supported by an experiment on the influence of popularity on ratings of music: “Conformists [participants who are heavily influenced by other’s preferences, like the non-specialists] had lower activity across the whole song period relative to non-conformists, indicating that their sensitivity to popularity was also related to the degree to which they may have paid attention to the musical semantics of

the song itself, which includes chord progressions, rhythm and lyrics." (Berns et al., 2010, p. 2695).

To be commercially successful, a song must be largely promoted and be in the "spirit of time," that is being a formatted product. Crain and Tollison (1997) show that duration and tempo of popular songs have changed over time. Further research could include expanding the scope of our analysis to incorporate additional years in order to measure the possible shifts in musical characteristics over time.

Finally, our analysis of the musical content of songs is of course incomplete. Variables that describe melodic complexity, content of the lyrics, etc. are not included. Finding a method to measure them objectively might be another way to extend the present research.

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