# Let the Music Play?
# Free Streaming, Product Discovery, and Digital Music Consumption*

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**Abstract**

Music streaming services have grown tremendously in recent years, raising questions about their effects on digital music sales and piracy. Theoretical considerations suggest that these effects may differ according to the streaming services' functionality. Premium subscriptions offer consumers unconstrained access to music, providing little incentives to acquire music through alternative channels. Free services offer very limited mobility in their usage. If streaming allows for the discovery of new products, and if consumers value mobility, then free services may stimulate the use of channels that offer the possibility of mobile consumption. We rely on individual-level clickstream data to analyze how free streaming affects music purchasing and piracy behavior. We exploit the introduction of a listening cap by the platform *Deezer* to identify this causal effect in a difference-in-differences setting. Our results show that free streaming stimulates alternative channels that offer mobility. We find that users of *Deezer*'s free services visited licensed and unlicensed downloading websites 2.9% and 2% less than they would have had the restriction not been introduced, respectively. Our findings are indicative of music streaming serving as a channel for the discovery of new products.

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# 1 Introduction

Interactive music streaming services have recently gained in popularity and generated heated debates around their effects on the recorded music industry. At the heart of the issue lies the potential of these services to curb music piracy and, to a larger extent, the fear that they may negatively affect recorded music sales, and therefore decrease revenues to music right holders. These concerns have lead some artists - claiming relatively low levels of streaming royalties - to remove their products from online streaming services altogether.[1]

In the wake of digitization, analyzing the effects of music streaming on alternative consumption channels is crucial to understand the tumultuous transformation of the recorded music industry. On the one hand, streaming services are often described as product discovery tools, which could potentially stimulate digital music sales. According to *Spotify*, for instance, their service "makes it easier than ever to discover, manage and share music [...]"[2] Likewise, *Deezer* describe themselves as "music lovers at heart, on a mission to help you discover artists that rock your world."[3] On the other hand, streaming could also serve as a substitute to alternative consumption channels, decreasing both music sales and piracy. Because the settlement of music streaming royalties also evolves around the effect of streaming on alternative consumption channels, a good understanding of these relationships is crucial for the various actors involved in the settlement of royalty rates.

Despite the importance of this issue, the empirical evidence on the effects of music streaming is scarce. Additionally, and perhaps more importantly, the debates surrounding this question often fail to distinguish between the various functionalities of music streaming services. They often do not, for instance, differentiate between interactive and non-interactive platforms, or between free and premium subscriptions services when considering their effects on alternative music consumption channels. Economic theory does not provide any clear predictions on the effects of these functionalities; each one of them could a priori serve as either a substitute or a complement to alternative means of consumption such as digital sales and piracy. Yet there are reasons to believe that not all types of streaming would have the same effects on these alternatives.

Consider, for instance, the services offered by a *premium* subscription to an interactive music

[1] See for instance Taylor Swift's decision to pull her music away from Spotify in November 2014. http://uk.businessinsider.com/taylor-swift-explains-why-she-left-spotify-2014-11?r=US&IR=T.

[2] https://press.spotify.com/us/2013/05/29/hello-music-discovery-spotify-here/.

[3] http://www.deezer.com/features.

streaming platform.[4] These would typically provide users with on-demand, advertisement-free listening on fixed and mobile devices. For a monthly fixed-fee, premium subscribers can therefore have access to the complete platform's repertoire whenever and wherever they want. In that case, it seems natural to expect that consumers will have little incentives to acquire digital music via other channels such as licensed or unlicensed downloading. Put differently, interactive premium streaming would a priori be likely to displace both digital sales and piracy. Recent industry trends indeed show that as the usage of streaming services increased, revenues from licensed downloads have been decreasing.[5] Likewise, Aguiar and Waldfogel (2015) make use of the growth in Spotify between 2013 and 2015 - coinciding with an important increase in premium subscribers - to show a displacement effect of Spotify on digital music sales and piracy.

Alternatively, consider the case of *free* interactive streaming. These advertisement-supported services naturally offer a more limited access to music. First, consumer listening is interrupted by advertisement. Second, and most importantly, on-demand streaming mobility is not accessible or drastically restricted.[6] While free streaming services allow consumers to discover and learn more about new products, they still lack the benefits of fully interactive mobile consumption offered by licensed and unlicensed downloading.[7] It follows that if streaming allows for the discovery of new music, and if consumers want to add mobility to their music listening, then *free* streaming may well stimulate consumption through both of these alternative channels. These considerations suggest that while it is easy to imagine a circumstance in which *premium* streaming would displace digital sales and piracy, the effects of *free* streaming are - a priori - less clear.[8]

[4] Online streaming services can broadly be divided into two distinct categories: interactive and non-interactive platforms. The non-interactive platforms (such as *Pandora* or *iHeartRadio*) offer services that are similar to a radio broadcast in that the end user is offered a pre-programmed set of songs, and consumers cannot select the songs they want to listen to or even observe the order of the tracks to be played. This is in contrast with interactive platforms (such as *Deezer* or *Spotify*), which offer consumers the liberty to pick the songs they want to listen to. Our analysis will focus exclusively on interactive music streaming services. For simplicity and ease of exposition, we therefore refer to these services simply as "music streaming service" in the remainder of the text.

[5] Christman, Ed. "Nielsen SoundScan Mid-Year Report: Digital Album and Single Sales Slow." Billboard, July 3, 2013. http://www.billboard.com/biz/articles/news/1568871/nielsen-soundscan-mid-year-report-digital-album-and-single-sales-slow. Christman, Ed. "Digital Music Sales Decrease For First Time in 2013." Billboard, January 3, 2014. http://www.billboard.com/biz/articles/news/digital-and-mobile/5855162/digital-music-sales-decrease-for-first-time-in-2013.

[6] The recent introduction of mobile apps for free users has made free mobile streaming available, but the limited on-demand listening capabilities that are typically offered (e.g. limited repeated listening, no ability to skip tracks within playlists, imposition of shuffle mode) are still preventing free users from flexibly accessing music everywhere. In that respect, mobile apps offered by free interactive streaming platforms resemble the services provided by non-interactive platforms.

[7] Presumably any MP3 file obtained via either a licensed or unlicensed provider can be played on any mobile device.

[8] A similar theoretical argument would lead to the same conclusions when considering the effects of non-interactive music streaming services, where users do not have full control over the songs they can listen to.

The limited data availability on music streaming, together with a lack of clean experimental settings, has naturally lead to scarce empirical evidence on this issue. The objective of this paper is to fill this important gap and analyze the effect of *free* streaming on the usage of licensed and unlicensed music downloading platforms. Our analysis focuses on the French leading streaming platform *Deezer* and relies on Internet clickstream data. Our data allow us to observe a representative sample of 5,000 French Internet users during the year 2011 and to precisely follow their behavior on a large set of websites, including licensed and unlicensed digital music consumption websites. Our empirical approach exploits *Deezer*'s introduction of a listening cap on June 6, 2011 and relies on a difference-in-differences strategy to identify the causal effect of free streaming on music purchasing and piracy behavior.

Our empirical analysis shows a negative effect of the imposition of a free streaming cap on both licensed downloading and music piracy websites' visits. In particular, we find that following the imposition of the streaming cap, individuals who are users of *Deezer*'s free streaming services visit licensed downloading websites up to 2.9% less than they would have had the restriction not been introduced. Similarly, they decrease their visits to unlicensed downloading websites by as much as 2%. Taken at face value, our results therefore show a positive effect of free streaming on these alternative channels of music consumption.

Our paper is, to our knowledge, the first one to provide evidence on the causal effect of free music streaming on music purchasing and piracy behavior. Our study contributes to the growing debate surrounding the effects of music streaming and to the empirical literature on the effects of digitization in the recorded music industry. It has several implications. First, our results show how online music streaming can serve as an information channel for consumers to discover and learn about new products they would otherwise not have been aware of. Second, our results indicate that *free* streaming - because it only allows for very limited mobility in consumption - can lead to a stimulation in alternative digital music consumption channels that offer mobility, such a licensed and unlicensed downloading. Finally, our study highlights the importance of taking the specific functionality of each streaming service into account when analyzing its effects on alternative consumption channels. In particular, our results should not be extrapolated to other types of streaming services providing users with alternative functionalities, such as services offering full mobility of consumption (i.e. premium subscriptions) or non-interactive streaming services. From that perspective, our study serves as a first step toward understanding the heterogeneity of effects that streaming platforms may have on the rapidly changing recorded music industry.

The remainder of the paper is composed of 6 sections organized as follows. Section 2 presents the various existing types of online music streaming services as well as a simple theoretical argument on their potential effects on alternative music consumption channels. It also presents related literature and some descriptive facts about the French music streaming market and *Deezer*. Section 3 presents the data for the study, while Section 4 presents our empirical approach and identification strategy. Section 5 presents the results of our estimations of the effects of online streaming on licensed and unlicensed downloading. Section 6 concludes and discusses the implications of our results.

# 2 Background

## 2.1 Online Music Streaming

In the past few years, the introduction of online music streaming services has importantly expanded music consumption opportunities, making music ubiquitously available for many consumers. Simply defined, online streaming services allow consumers to listen to music without the need to download the corresponding audio file. In recent years, online music streaming services have clearly become an increasingly important segment of the recorded music industry. According to IFPI (2014), they accounted for 27% of overall digital revenues in 2013 - up from 14% in 2011 - and global revenues from subscription and ad-supported streaming services grew by 51.3% in 2013, exceeding US$1 billion for the first time.

Interactive streaming platforms usually offer two types of services. The first one is a *free* service which offers unlimited streaming and is supported by advertisement. The free service is typically offered with further restrictions, particularly with respect to the mobility of access. The second type of services is often referred to as *premium* subscription, which offers users additional benefits for a monthly flat-rate fee. In particular, it typically provides full mobility of access (i.e. mobile as well as offline listening), higher quality of sound, and advertisement-free listening.

We now briefly describe how online interactive music streaming could potentially affect digital sales or piracy. It puts a particular emphasis on the effects that different streaming functionalities - in particular the ones offered by *free* vs *premium* services - could have on these alternative channels of consumption.

## 2.2 How Could Streaming Affect Alternative Music Consumption Channels?

Economic theory does not provide an unambiguous prediction on the effect of interactive music streaming on digital sales and piracy. Because music is an experienced good (Nelson, 1970), online streaming can, in theory, either act as a substitute or as a complement for other modes of music consumption. While some consumers may use online streaming as a way to listen to songs they would otherwise have bought or illegally downloaded, others may use it to sample new products before deciding to acquire them from alternative sources. In that process, they may also discover new products that they like and that they did not previously know about. Finally, it is also possible for consumers to use streaming as a way to listen to songs they would otherwise never have bought or unlawfully acquired. In that case streaming would have no effect on these alternative channels.

The distinct characteristics of services offered by streaming platforms - in particular free vs premium - suggest the possibility of different effects according to their functionalities. Take, for instance, *premium* subscriptions. By offering both online and offline advertisement-free listening, these streaming services have rendered music ubiquitously available for their users. For a monthly fixed-fee, a premium subscriber can have access to the complete service's repertoire whenever and wherever she wants. Unless some songs are not provided by the platform, it therefore seems natural to expect that premium consumers have little incentives to acquire digital music via other channels. In this case, a consumer who used to consume digital music via licensed or even unlicensed providers would potentially stop doing so. For premium consumers, music streaming therefore appears likely to be used as a substitute to other means of consumption.

*Free* streaming services, on the other hand, naturally offer access to music in a more limited way. On top of advertisement's interruptions, free users' mobility of usage is importantly restricted. Until recently, consumers were typically only offered the possibility to freely stream from a fixed device - such as a PC - as no mobile access was available. The recent introduction of mobile apps for free users has somehow changed this situation, but the limited on-demand listening capabilities that they offer (e.g. limited repeated listening, no ability to skip tracks within playlists, imposition of shuffle mode) are still preventing free users from flexibly accessing music everywhere.[9] If free streaming allows sampling and the discovery of new products, then it may well stimulate both licensed and unlicensed downloading for users who want to add mobility to

[9] See, for instance http://tinyurl.com/Deezer-free-mobile for the case of *Deezer*'s mobile app and http://tinyurl.com/Spotify-free-mobile for the case of *Spotify*'s mobile app.

their music consumption.[10]

These considerations suggest an important distinction between the effects of free and premium streaming on alternative music consumption channels. While one can easily imagine a circumstance in which premium streaming displaces both digital sales and piracy, the effect of free streaming are - a priori - less clear. Whether free streaming displaces or stimulates music consumption through these alternative channels therefore remains an empirical question.

Despite the growing importance of online streaming platforms in the music market, little empirical research analyzes their effects on other digital music consumption channels. This is mainly due to limited data availability as well as a lack of clean "experiments" necessary for the identification of such effects. Some recent papers have analyzed the effects of music consumption on *YouTube* on digital sales of music.[11] Exploiting the removal of Warner Music content from *YouTube* between January and October of 2009, Hiller (2015) finds a substantial sales displacement effect of *YouTube* consumption on the best-selling albums. His results also show that this effect diminishes quickly with the album's ranking. In particular, he finds no evidence of sales displacement when focusing on the albums below the top 50. Kretschmer and Peukert (2014) also analyze the effect of *YouTube* music consumption on digital music sales. They take advantage of a royalty dispute between *YouTube* and the German collecting society and performance rights organization *GEMA* which has led to the blocking of music videos in Germany. Comparing sales in Germany to sales in nine other countries where music videos are not restricted, they find no evidence of sales displacement from free sampling on *YouTube*. More specifically, they find that online music videos trigger sales of album, but have no effect on the the sales performance of individual songs. Some other papers rely on individual level data. Aguiar and Martens (2013) use Internet clickstream data on a sample of more than 16,000 individuals to look at the relationship between different music consumption channels. Using a host of variables to control for many forms of unobserved individual heterogeneity such as music preferences, they find a positive effect of online music streaming on visits to licensed downloading websites. Their analysis does not, however, distinguish between the various types of streaming services. Nguyen et al. (2013) rely on survey data from 2,000 French individuals

[10] See Shapiro and Varian (1999); Peitz and Waelbroeck (2006a,b); Dewan and Ramaprasad (2012); Zhang (2013) for various accounts of how sampling and reduced search costs could stimulate demand. There is now increasing evidence showing that consumers indeed value mobility in their music consumption. *Spotify*, for instance, announced that mobile consumption now accounts for the majority of listening (http://techcrunch.com/2015/01/10/music-is-a-mobile-linchpin/). Empirical evidence in Leung (2015) also shows that pirated music files are complements to mobile devices such as the iPod, indicating that music consumers indeed value mobility in their digital music consumption.

[11] *YouTube* offers a different music consumption experience than interactive streaming services like *Deezer* or *Spotify*. However, it allows users to access music in an almost unrestricted way, making this service rather similar to the premium subscriptions offered by fully interactive streaming services.

to look at the relationship between online and offline music consumption. While they do not consider sales of digital music, their results show a positive effect of free music streaming on live music attendance, and no significant effect on CD sales.

Finally, recent research also shows how interactive and non-interactive streaming services can differently affect music sales. Danaher (2014) argues that while interactive services can serve as perfect substitutes for music purchases, non-interactive services can act as a complement to paid digital downloads by exposing individuals to songs they would otherwise not have heard or by allowing sampling of music. Using data from an Internet consumer panel tracking company, he shows that the use of non-interactive webcasting services has a significantly more positive impact on digital song purchases than interactive webcasting services. In a similar vein, McBride (2014) looks at the effect of *Pandora* on sales of songs. By manipulating the availability of certain songs in certain geographical locations, he shows that *Pandora* increases music sales by around 2%, providing evidence that non-interactive music streaming services can stimulate sales.

### 2.3 The French Market and *Deezer*

Online streaming has developed rapidly in France in recent years. According to the French National Syndicate of Phonographic Publishing (SNEP), the share of France's digital revenues coming from streaming (subscription and advertisement-based combined) grew from 36% in 2011 to 53% in the first semester of 2014.[12] These figures have made France the second largest market in terms of streaming in 2013, far behind Sweden (with a 94% of its digital revenue coming from streaming).

Within this growing market, *Deezer* is undoubtedly the major online streaming platform in France. In 2011, *Deezer* accounted for nearly 70% of overall streaming revenues. This share declined slightly in 2012 and 2013 but remained stable at around 65 percent.[13] In 2013, about two thirds of French streaming revenues came from premium subscriptions, and one third from advertisement. Until the end of 2011, *Deezer* was only available in France, Belgium and the United Kingdom. The platform basically offered three types of services at that time: one for free users and two for premium subscribers. Free users initially had access to unlimited streaming - interrupted by advertisement - on their PC, but had no access to mobile streaming. At the same time, two premium subscription plans were available. For €4.99 a month, users could get rid of advertisement and keep enjoying unlimited streaming on their desktop exclusively. The

[12] See http://tinyurl.com/snep-shares-2011 and http://tinyurl.com/snep-shares-2014-pdf.
[13] See http://tinyurl.com/snep-market-2014-pdf.

second subscription plan added unlimited mobile streaming for €9.99 a month.[14]

As in the case of most streaming services providers, *Deezer*'s customer base is mainly composed of free users. In a July 2011 press release, *Deezer* claimed to have more than a million premium users for a total of 20 million members and the share of premium users did not reach 10% as of June 2012.[15] The number of paying users has nevertheless been growing importantly in recent years. In November 2013, *Deezer* announced that they had multiplied their subscriber base by 2.5 in one year, reaching 5 million subscribers.[16] In January 2015, they claimed to have 16 million monthly active users and 6 million paid subscribers worldwide.[17]

While *Deezer* naturally serves as a music consumption platform, many of its characteristics can also define it as a powerful product discovery tool. In particular, users (free or premium) are given personalized music recommendations, information about musical events and new artists, all of which may spur their interest into acquiring more music. In this paper, we exploit the imposition of a free streaming restriction introduced on June 6, 2011. While unlimited before this change, the restriction imposed a monthly 5-hours limit on free streaming, providing us with the opportunity to identify the causal effect of free streaming on licensed and unlicensed downloading of music.

## 3 Data

The basic data for this study come from Nielsen NetView - Nielsen's Internet audience measurement service - which monitors the online activity of representative panels of Internet users and tracks their usage across websites. Our sample includes 5,000 French individuals who are voluntarily followed over the period going from January 1, 2011 to December 31, 2011, providing us with detailed information on their website visits. The data also reports demographic information on the users, such as gender, age, household income, and education.

For each visit made by an individual in our sample, we observe the precise URL of the webpage visited, the time at which it was visited, and the duration spent on that specific URL. Nielsen

[14] Since 2014, *Deezer* dropped its €4.99 subscription plan. *Deezer* has also expanded internationally and is now available in 182 countries.

[15] See "Dossier de Presse Deezer: Juillet 2011", July 2011. http://www.slideshare.net/deezer_com/le-dossier-de-presse-deezer-juillet2011. And see Pichevin, Aymeric. "Deezer CFO/COO Simon Baldeyrou on Music Streaming Service's Global Expansion, Spotify, Avoiding The U.S." Billboard, June 12, 2012. http://www.billboard.com/biz/articles/news/1093736/deezer-cfocoo-simon-baldeyrou-on-music-streaming-services-global-expansion.

[16] See http://tinyurl.com/guardian-deezer-5m-subscribers.

[17] See http://tinyurl.com/blog-deezer-com-paidsubscriber.

also classifies webpages in one of 15 different categories (themseleves divided into 83 subcategories) according to their content. This allows us to identify specific types of websites within these different categories. Because we are interested in the effects of online music streaming on other digital music consumption channels, we identify all major music streaming websites, websites that (legitimately) sell digital music, and piracy websites that provide access to unlicensed downloading of music. It is worth noting that contrary to studies that rely on individual surveys to measure individual-level music consumption, our data is based on actual usage patterns rather than subjective assessment from Internet users.[18] We also highlight that since our data is composed of a representative sample of Internet users (in terms of gender and age), the results from our analysis need not be restricted to a particular subset of the population. We note at the outset that our data only allows us to observe the number of clicks on a given URL, but does not allow us to observe the precise individual's behavior on the URL. This implies that we cannot perfectly measure digital music consumption per se. Rather than measuring actual streams as well as licensed and unlicensed downloads, our data therefore gives a proxy for the actual consumption of digital music through these different channels. The identification of music consumption websites was performed by manually checking each of the top 1,500 websites registered in the music category. We classified each website into one of three distinct groups according to their purpose: music streaming websites, licensed downloading websites, and digital music piracy websites.[19]

Because *Deezer* is a streaming service that is used within the web browser, our data provides an excellent measure of its usage.[20] For each of the 5,000 individuals in our sample, we can observe the number of weekly visits made to the *Deezer* webpage, providing us with a proxy for music streaming consumption on this platform.[21] Figure 1 shows the average weekly visits for all the music streaming websites that we identified in our data. It clearly shows that *Deezer* was the dominant music streaming platform in France at that time, with almost 4 times as

[18] See, for instance Rob and Waldfogel (2006) and Waldfogel (2010), which rely on surveys of college students to identify the effect of piracy on music sales.

[19] We define the set of licensed webpages as the websites that allow for downloading of digital music files. While these naturally include in-browser digital music stores, they also include licensed websites that allow free downloading. An example is the now gone French ad-supported download store *Beezik*, which offered users the possibility to download digital songs in exchange for the visioning of video advertisement.

[20] The fact that the Nielsen NetView application only captures traffic within the browser imposes some limitations to our analysis. In particular, we cannot observe purchases on *iTunes* given that it is a standalone software. We are therefore only able to observe the visits to the *iTunes* webpage, which is nevertheless an individual proxy for signing up to the service making later purchases.

[21] The data also includes the duration of each domain's visit, but we are reluctant to use it in our analysis. Because Nielsen's measurement tool only records the time spent on websites that are in focus, the duration will clearly underestimate the time spent on *Deezer* if the the individual is streaming music in the background while focusing on another website.

many average visits as the second most visited domain, *Vevo on YouTube*.[22] Note that *Deezer* maintained its leading position after its free streaming restriction was imposed. Figures 2 and 3 show the set of websites that make up our categories of licensed and unlicensed downloading websites, respectively.

Our final sample consists of an individual-level panel dataset of 5,000 French Internet users and their weekly visits to *Deezer* as well as licensed and unlicensed music consumption websites throughout 2011. A total of 1,408 individuals (28% of the sample) were users of *Deezer* before the free listening cap was introduced.

# 4 Empirical Strategy

Our main interest is to identify the effect of free streaming on digital music purchasing and piracy behavior. For a given individual, we would ideally like to compare her music consumption on through digital purchases and piracy when she has access to online streaming services with her music consumption in the hypothetical case in which she has no access to these services. However, since we only observe individuals when they have access to online streaming, we have obviously no way of knowing how they would have behaved in this counterfactual state. In a world where consumers all have access to online streaming services, an ideal experiment would consist in removing access to streaming services to a set of randomly chosen individuals. The effect of online free music streaming on digital purchases and piracy would then be identified as the change in purchases and piracy for the individuals who were denied access compared to the individuals whose use of streaming platforms remained unchanged. Because this type of experimental design is often not feasible, one needs to rely on alternative sources of variation in the consumers' ability to use online streaming services.

Our empirical approach relies on the introduction of a 5-hours free listening cap introduced by *Deezer* on June 6, 2011. This change resulted in a very large restriction for free users of the service, who were allowed unlimited free listening prior to this date. Figure 4 shows the overall evolution of clicks and duration of visits to *Deezer* for the 1,408 individuals who were using *Deezer* before the cap was imposed. The graph shows that, on average, the free streaming restriction had a clear impact on usage, with an average decrease in clicks of more than 40 percent.[23] We can exploit this policy change as a source of exogenous variation in the ability

[22] This numbers are in accordance with the figures provided by the SNEP in their 2012 annual report on the French musical market. See http://tinyurl.com/french-market-snep-2012.

[23] Note also that, as mention above, our measure of duration seems to strongly underestimate the true time

of individuals to use *Deezer*'s free streaming services.[24] In particular, we follow a difference-in-differences strategy and compare how the group of *Deezer* users changed their use of alternative music consumption channels as a results of the cap imposition, compared to individuals that were not users of *Deezer*'s free streaming services.[25] Our empirical strategy therefore consists in estimating the following difference-in-differences equation:

$$\ln(Clicks_{it}^{A} + 1) = \alpha + \beta\,(Deezer_i * Cap_t) + \gamma X_{it} + \mu_i + \nu_t + \varepsilon_{it}, \tag{1}$$

where $Clicks_{it}^{A}$ measures the sum of clicks to the set of alternative consumption websites $A$ for individual $i$ in week $t$, with $A \in \{Licensed\ Downloading,\ Piracy\}$. We use the logarithm of the number of clicks to account for the fact that our individual-level clickstream data tends to be dispersed and because we are interested in relative changes.[26] The variable $Deezer_i$ is an indicator variable equal to 1 if individual $i$ visited *Deezer* before the free streaming cap was imposed, and $Cap_t$ is a dummy variable taking value 1 during the weeks that follow the listening cap restriction. We include a vector of individual fixed effects $\mu_i$ to control for variation in alternative consumption across individuals that is constant over time, resulting for instance from time-invariant differences in musical tastes. The set of week fixed effects $\nu_t$ controls for variation in alternative consumption that is common to all individuals, $X_{it}$ includes individual and time specific control variables (such as visits to other types of websites and user-specific time trends), and $\varepsilon_{it}$ is an individual and time specific error term. Under the assumption that changes in alternative consumption would have been similar for users and non-users of *Deezer* absent the imposition of the listening cap, the coefficient $\beta$ estimates the effect of free *Deezer* streaming on alternative consumption channel $A$.[27] We estimate (1) using OLS and cluster standard errors at the individual level since the error term $\varepsilon_{it}$ is likely to be correlated over time within individuals.

usage of the website (see footnote 21).

[24] Our data unfortunately does not provide information on whether a given individual that uses *Deezer* does so through a free or premium account. We can nevertheless learn more about the type of subscription that individuals were using by looking more closely into their *Deezer* usage. We do so in Appendix B and show that we can be confident in the fact that we are dealing with free users in our sample.

[25] We also performed several robustness checks by looking at alternative control groups. First, we constructed an alternative control group composed of non-users of *Deezer* that are similar to *Deezer* users in terms of observable demographic characteristics (income, education, gender, and age). We constructed this control group using a one-to-one Propensity Score Matching (PSM) approach. Second, we considered as a control group the set of individuals who did not use *Deezer* before the cap was imposed, but removed from the sample all individuals who did not visit any music consumption related website during the sample period. The results from using any of these two alternative control groups lead us to quantitatively similar results as the ones presented in Section 5 below.

[26] Because we often do not observe a user visiting an alternative music consumption website in a given week, we follow the prior literature and take the log over $Clicks_{it} + 1$.

[27] More precisely, the effect of free *Deezer* streaming on alternative consumption channel $A$ is given by $e^{\beta} - 1$.

### 4.1 Identification Assumption

Our identification strategy assumes that being a user of *Deezer* is uncorrelated with the usage of alternative channels of music consumption. In other words, it relies on the assumption that usage of alternative channels for both users and non-users of *Deezer* would have followed similar trends had the listening cap not been introduced.[28] One may worry that individuals that decide to use *Deezer* form an inherently different group than individuals who decide not to, possibly casting doubt on our identification assumption. Table 1 presents the demographic characteristics for these two groups of individuals in our final sample. Among the 5,000 individuals in our sample, 1,408 (28%) have been users of *Deezer* before the free streaming cap was imposed, and we observe only minor differences in demographic characteristics across these two groups. The largest difference is in terms of education, with users of *Deezer* having a larger proportion of individuals with tertiary education. Compared to non-users, a larger share of the users are employed or students, and they are also slightly younger on average.[29] Finally, there are no discernible differences in terms of income across the two groups. In any case, our panel data allows us to control for all of these demographic factors as well as for any other time-invariant unobservables by introducing individual fixed effects in our analysis.

Our data also allows us to partially test our identification assumption by looking at the trends in alternative channels of consumption in the period before the restriction was introduced. We can estimate the following model to test whether trends in the usage of alternative consumption websites are statistically different for users and non-users of *Deezer*:

$$\ln(Clicks_{it}^{A} + 1) = \alpha_0 + \alpha_1^t Week_t + \alpha_2^t \left(Week_t * Deezer_i\right) + \mu_i + \varepsilon_{it}, \tag{2}$$

where, as above, the dependent variable measures the logarithm of the number of visits to the set of alternative music consumption websites $A$ for individual $i$ in week $t$, with $A \in \{Licensed\ Downloading,\ Piracy\}$. $Week_t$ is a vector of week dummy variables for weeks $t = 3, \ldots, 51$, $Deezer_i$ is again an indicator variable equal to 1 if individual $i$ visited *Deezer* before the free streaming cap was imposed, $\mu_i$ is an individual fixed effect, and $\varepsilon_{it}$ is an error term. We estimate (2) using ordinary least squares (OLS) and cluster standard errors at the individual level since the error term $\varepsilon_{it}$ is likely to be correlated over time for a given individual.

[28] This assumption requires the absence of other shocks contemporaneous to the listening cap imposition that may have affected alternative consumption channels for *Deezer* users exclusively.

[29] The average age is 38 for the users of *Deezer* and 42 for the non-users in our sample.

In equation (2), the $\alpha_2^t$ coefficients reflect the difference in the trends in visits to the corresponding set of alternative websites between users and non-users of *Deezer*. If we expect the listening cap to have had a positive effect on the visits to alternative consumption websites - reflecting a negative effect of *Deezer* free streaming on these channels - then we should expect $\alpha_2^t > 0$. On the other hand, we should observe $\alpha_2^t < 0$ if there are complementarities between *Deezer* free streaming and alternative channels of consumption.

Figure 6 plots the resulting $\alpha_2^t$ coefficients after estimating equation (2) using the logarithm of visits to licensed downloading music websites as a dependant variable. The coefficients are presented along with their 90% and 95% confidence intervals, and the black vertical line indicates the week in which the listening cap was introduced (week 23). The coefficients appear to be statistically indistinguishable from zero before the cap was imposed. This indicates that users and non-users of *Deezer* follow identical trends in the period preceding the introduction of the restriction, giving support to our identification strategy. The figure also shows that the coefficients start decreasing after the listening cap is imposed. While they are not always statistically significant, all the coefficients remain below zero until the end of the sample period, suggesting a negative effect of the listening cap on visits to licensed downloading websites.

We repeat this exercise and estimate equation (2) again, using now the logarithm of visits to music piracy websites as a dependent variable. Figure 7 plots the resulting $\alpha_2^t$ coefficients along with their 90% and 95% confidence intervals. While the coefficients also appear to be statistically indistinguishable from zero before the listening cap was introduced, the overall picture is not as clear. In particular, it seems that relative to non users of *Deezer*, visits to music piracy websites were trending upwards for users of the service during the period preceeding the restriction. The picture nevertheless shows that this upward trend stops by the time the listening cap is introduced and remains relatively flat afterwards. These potential differences in music piracy trends may pose a threat to identification. We will therefore also relax our identification assumption in our analysis below and include *Deezer* user specific trends in our specifications, asking whether users of *Deezer* deviate from their pre-restriction trend more so than non users of *Deezer*.

# 5 Results

## 5.1 Online Streaming, Licensed Downloading, and Piracy

Table 2 presents the results of estimating (1) using the logarithm of visits to licensed downloading websites as a dependent variable. Because users of *Deezer* may decide to switch to alternative music streaming services after the listening cap was imposed, we include as a control variable the logarithm of visits to alternative streaming websites. The websites included in this category are the ones listed in Figure 1, excluding *Deezer*. Columns (1) and (2) show that imposing a free streaming cap leads to a statistically significant 1.8% decrease in visits to licensed downloading webpages. Column (3) and (4) replicate the exercise by adding *Deezer* user specific time trends and present very similar results. These figures indicate that free music streaming has a positive effect on digital music purchasing behavior.

Table 3 presents the results of estimating (1) using the logarithm of visits to music piracy websites as a dependent variable. Columns (1) and (2) show no significant effect of streaming on online music piracy. Figure 7 showed, however, that visits to piracy websites were trending upwards for users of *Deezer* compared to non-users before the listening cap was imposed, casting doubt on the common trend assumption between these two groups of individuals.[30] To account for this potential discrepancy in pre-restriction trends, we introduce *Deezer* user specific time trends in specifications (3) and (4). Relaxing the common trends assumption reveals that the introduction of a free listening-cap leads to a statistically significant decrease of 1.3% in the visits to music piracy websites.

Overall, our estimation results show a negative effect of the free streaming cap on visits to both licensed downloading and music piracy websites. These findings therefore indicate a stimulating effect of free music streaming on these alternative channels of music consumption.

## 5.2 Intensity of *Deezer* Usage

Our results have shown that the cap on free streaming imposed by *Deezer* had a negative and significant impact on both music purchasing and piracy behavior. In fact, the only individuals affected by the restriction are the ones that were freely streaming more than 5 hours a month prior to June 6, 2011. Free users who were using the service for less than 5 hours a month before

[30] Note that this trends differential will bias our results toward finding a positive effect of the listening cap on piracy consumption, i.e. toward finding a displacement effect of piracy by free music streaming.

the restriction should not have been affected. Figure 5 presents the evolution of *Deezer* visits by splitting the set of users between high and low users according to their overall usage before the listening cap was imposed.[31] Not surprisingly, it clearly shows how low intensity users were not affected by the listening cap and that there was an important effect on high intensity users.

If our results are effectively driven by the listening cap imposed by *Deezer*, then we should see no effect of the restriction on the users who had lower levels of usage. To test this implication, we modify specification (1) above to account for differences in pre-restriction *Deezer* intensity of usage and estimate the following equation:

$$\ln(Clicks_{it}^{A}+1) = \alpha + \beta_H \left(Deezer_i^H * Cap_t\right) + \beta_L \left(Deezer_i^L * Cap_t\right) + \gamma X_{it} + \mu_i + \nu_t + \varepsilon_{it}, \quad (3)$$

where $Deezer_i^H$ is an indicator variable equal to 1 if individual $i$ was a high intensity user of *Deezer* before the free streaming cap was imposed. Similarly, $Deezer_i^L$ is equal to 1 if individual $i$ was a low intensity user. We again estimate (3) using OLS and cluster standard errors at the individual level to account for the fact that the error term is likely to be correlated over time within individuals.

Table 4 presents the results of estimating (3) using the logarithm of visits to licensed downloading websites as a dependent variable. Columns (1) and (2) of the table confirm that the effect of the listening cap is indeed strongest for individuals with a high intensity usage of *Deezer*, with a statistically significant 2.9% decrease in visits to licensed downloading websites. Columns (3) and (4) add group specific linear time trends (i.e. trends for high, low, and non-users of *Deezer*) to specifications (1) and (2) respectively, although the results remain very similar.

We again replicate our exercise in Table 5 where we estimate equation (3) using now the logarithm of visits to music piracy websites as a dependent variable. The first two columns show no effect of the listening cap on either type of users. When we include group specific linear time trends in specifications (3) and (4) to relax our common trend assumption, the results show that the decrease in visits previously observed in Table 3 is indeed driven by high intensity users. In particular, the results show that the imposition of a free streaming cap leads to a 2% decrease in visits to music piracy websites for individuals with a high intensity usage of *Deezer*.

While they provide access to vast amounts of new musical products, free online music streaming

[31] We define high and low intensity users by looking at the distribution of the users' total number of *Deezer* visits before the restriction was imposed. High (low) intensity users are then defined as individuals whose total number of visits fall above (below) the median of the distribution. This leaves us with a comparable number of users in each of these groups.

services lack an important feature of digital music consumption: mobility. If free streaming services allow sampling and the discovery of new products, and if consumers value mobility in their music consumption, then we can expect a positive effect of these services on alternative music channels that allow for mobile consumption. The evidence presented above is consistent with this mechanism. According to our results, *Deezer*'s free streaming services stimulate digital music consumption through licensed and unlicensed downloading.

# 6 Conclusion

The popularity and usage of music streaming services has dramatically increased in recent years, generating heated debates around their contribution to the transformation of the recorded music industry. Despite the importance of this issue, there is very scarce evidence on the effects of music streaming services. Perhaps most importantly, current debates seem to overlook the fact that the effects of music streaming platforms may differ according to their functionality. While interactive services offering full mobility in consumption leave users with little incentives to purchase or unlawfully download music, the effects of services that restrict mobility may affect music sales and piracy differently. Understanding how these distinct services may affect alternative channels of music consumption is crucial to understand the overall impact of streaming on the music industry.

The objective of this paper is to identify the effects of *free* and *interactive* music streaming on music purchasing and piracy behavior. Our analysis focuses on the French leading streaming platform *Deezer*, exploiting the introduction of a listening cap to identify the effect of free streaming on the usage of licensed and unlicensed music downloading platforms. Our findings present a negative effect of the free streaming cap on both licensed downloading and music piracy websites' visits. In particular, we find that following the imposition of the streaming restriction, individuals who are users of *Deezer*'s free streaming services visit licensed downloading websites as much as 2.9% less than they would have had the restriction not been introduced. Similarly, they decrease their visits to unlicensed downloading websites by as much as 2%. Taken at face value, our results therefore show a positive effect of free streaming on these alternative channels of music consumption.

Our study contributes to the important debate around the effects of music streaming and to the empirical literature on the effects of digitization in the recorded music industry. It has several implications. First, our results show that music streaming services can serve as a channel of

music discovery. Second, we show that free streaming services - because they do not offer users full mobility in their music consumption - can lead to a stimulation in alternative music consumption channels that offer mobility, such as licensed and unlicensed downloading. While our results are consistent with this mechanism, we highlight that they should not be extrapolated to streaming services that offer alternative functionalities. In particular, our results do not imply a positive effect of premium subscription services - which offer full mobility in consumption - on digital sales or piracy. From that perspective, our study serves as a first step toward understanding the heterogeneity of effects that distinct streaming platforms - interactive, non-interactive, free, premium - may have on the recorded music industry.

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# A Figures and Tables

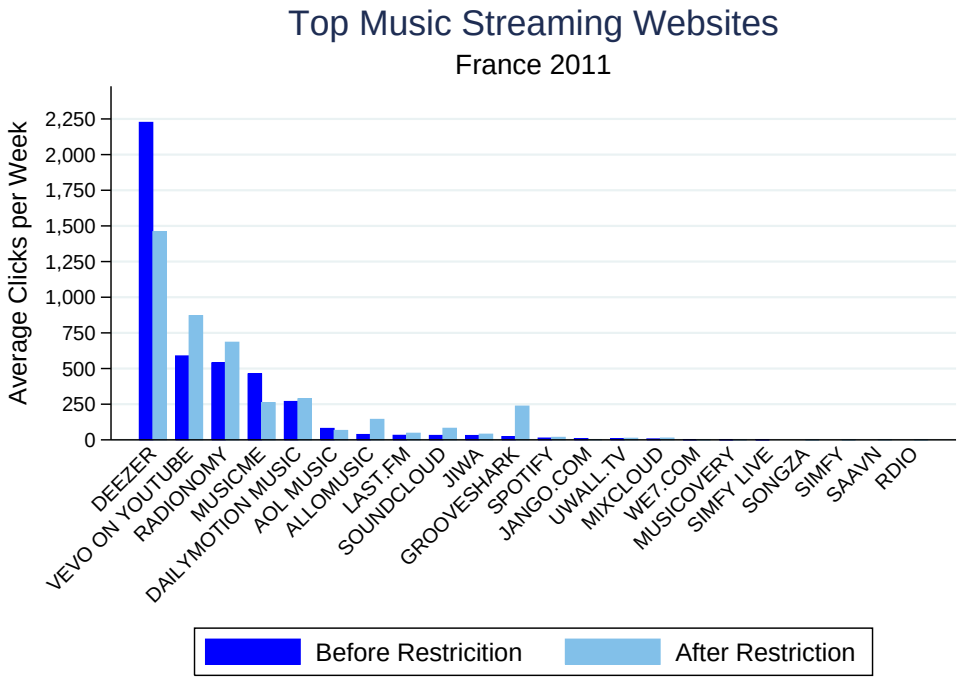



Figure 1: Top Streaming Websites in France, 2011.

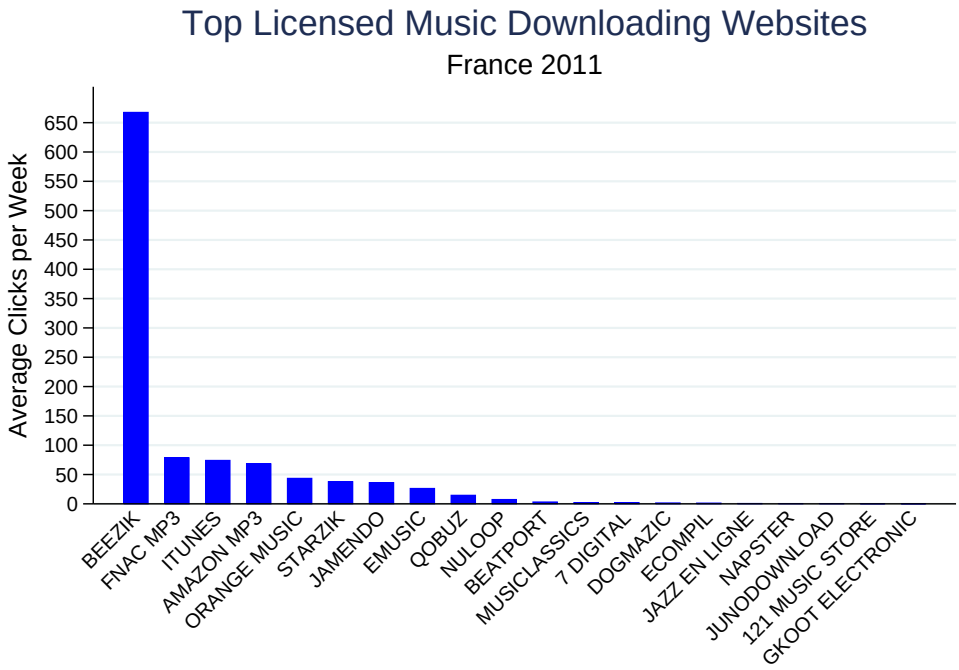



Figure 2: Top Licensed Music Downloading Websites in France, 2011.

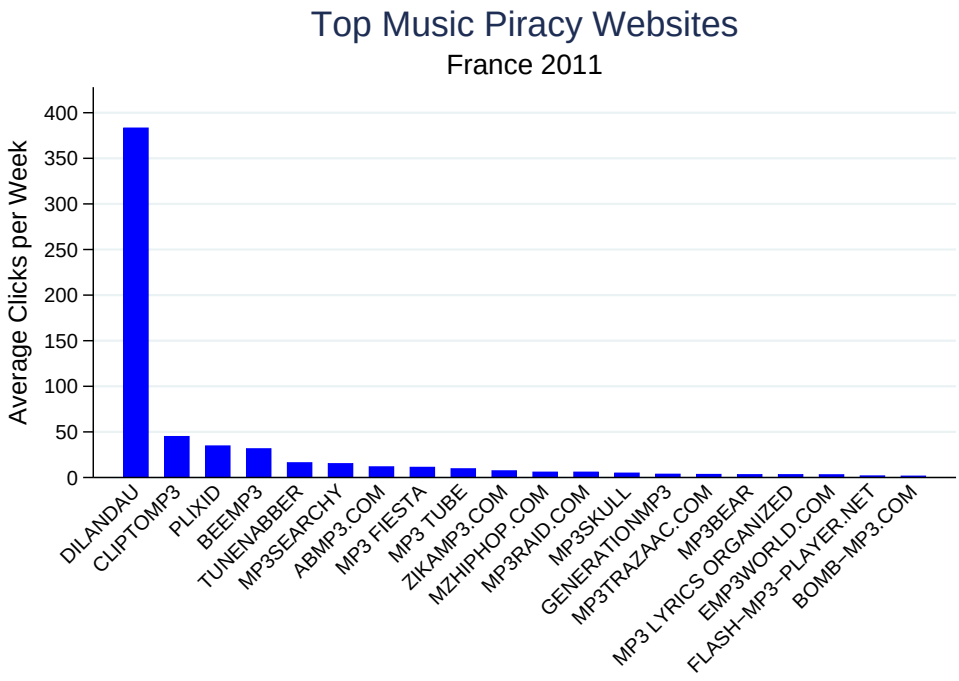
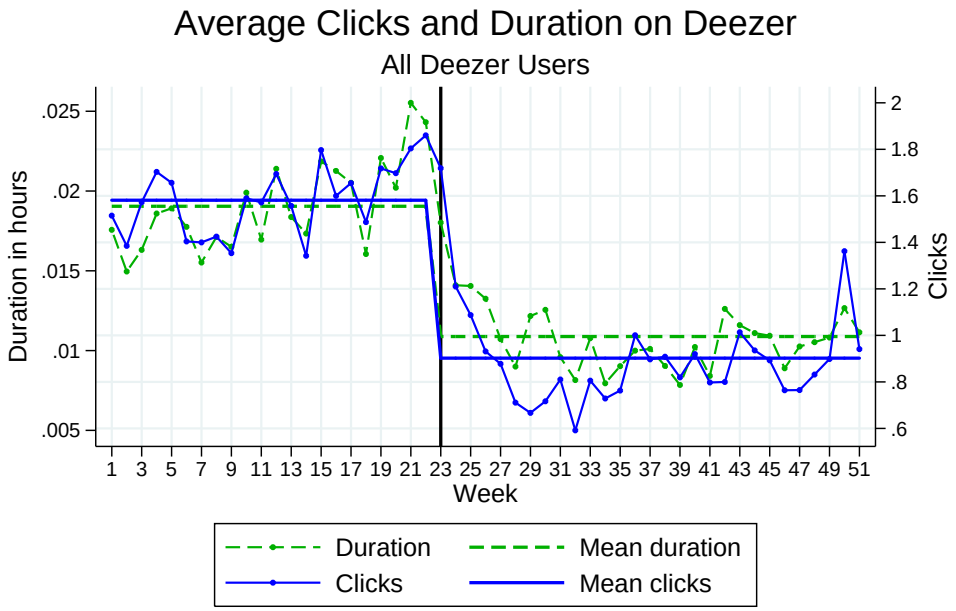
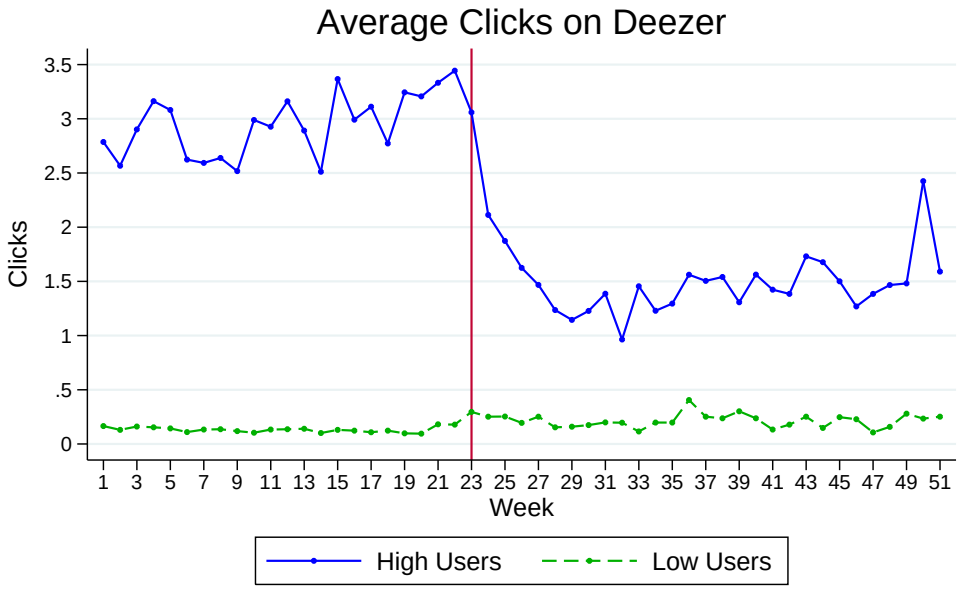



Figure 3: Top Unlicensed Music Downloading Websites in France, 2011.




Note: Deezer Users are defined as individuals who visited Deezer at least once before the free streaming cap was imposed.

Figure 4: Evolution of Average Deezer Visits.




Note: High (low) users are defined as users with a total number of clicks on Deezer above (below) the median of total clicks on Deezer before the free streaming cap was imposed. High users: 725 individuals. Low users: 683 individuals.

Figure 5: Evolution of Average Deezer Visits, by Intensity of Usage.

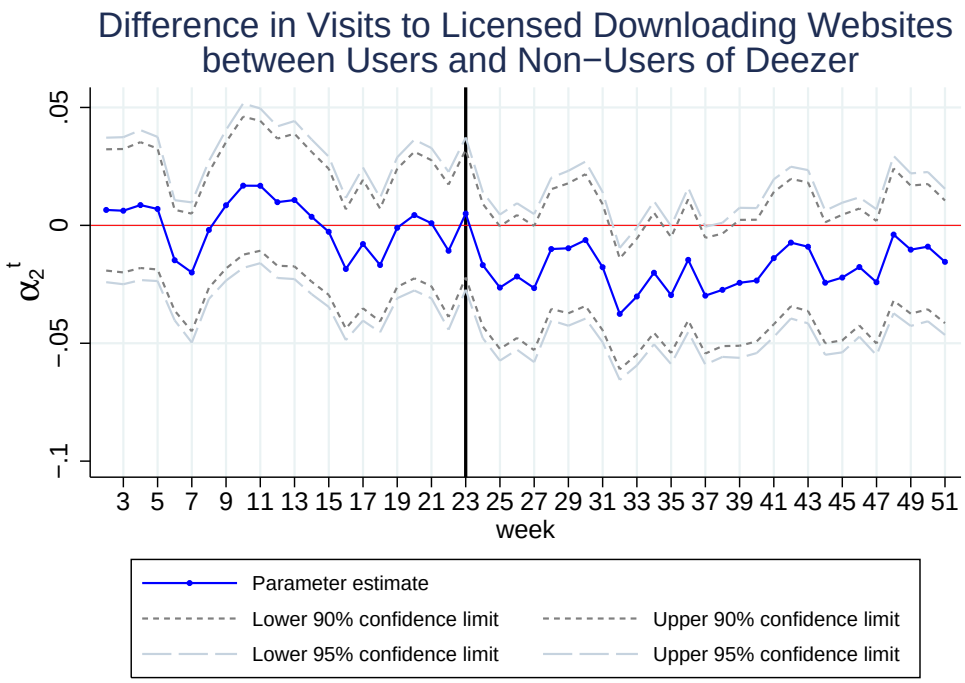



Figure 6: Difference in Visits to Licensed Music Downloading Websites: Users vs Non-Users of Deezer.

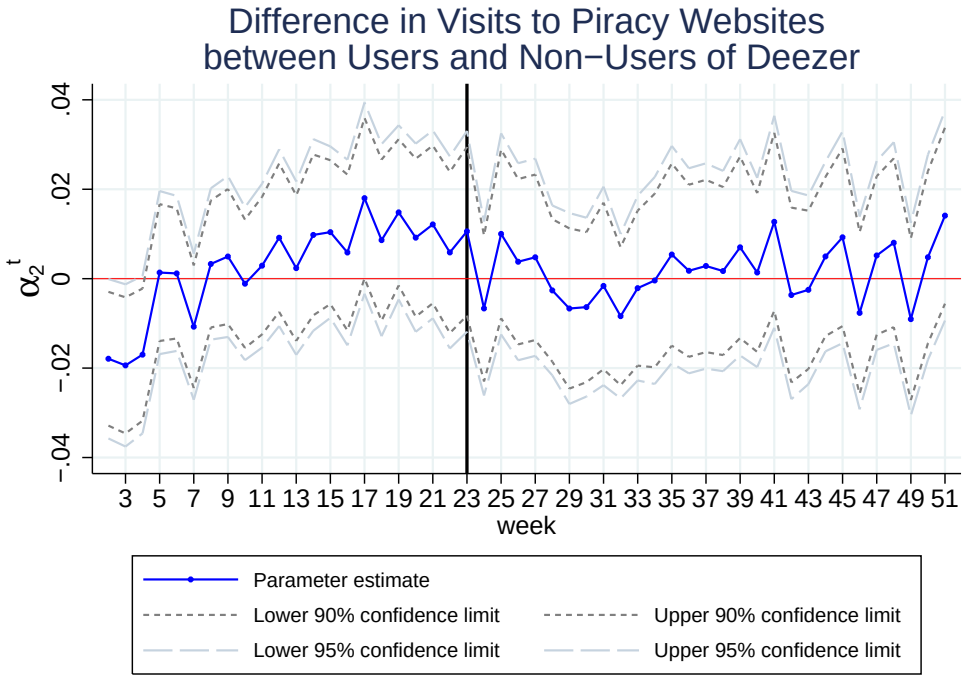



Figure 7: Difference in Visits to Unlicensed Music Downloading Websites: Users vs Non-Users of Deezer.

Table 1: Sample Composition.[†]

| | **Non-Users Deezer** | | **Users Deezer** | | **Total** | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| **Gender** | | | | | | |
| Female | 1773 | 49.4 | 756 | 53.7 | 2529 | 50.6 |
| Male | 1819 | 50.6 | 652 | 46.3 | 2471 | 49.4 |
| **Total** | 3592 | 100.0 | 1408 | 100.0 | 5000 | 100.0 |
| **Education** | | | | | | |
| Primary | 1214 | 34.0 | 361 | 25.7 | 1575 | 31.7 |
| Secondary | 473 | 13.2 | 167 | 11.9 | 640 | 12.9 |
| Tertiary | 1886 | 52.8 | 875 | 62.4 | 2761 | 55.5 |
| **Total** | 3573 | 100.0 | 1403 | 100.0 | 4976 | 100.0 |
| **Income** | | | | | | |
| Low | 1027 | 29.5 | 408 | 29.6 | 1435 | 29.5 |
| Medium | 1672 | 48.0 | 659 | 47.8 | 2331 | 47.9 |
| High | 785 | 22.5 | 312 | 22.6 | 1097 | 22.6 |
| **Total** | 3484 | 100.0 | 1379 | 100.0 | 4863 | 100.0 |
| **Age Category** | | | | | | |
| <15 | 355 | 9.9 | 112 | 8.0 | 467 | 9.3 |
| 15-24 | 259 | 7.2 | 155 | 11.0 | 414 | 8.3 |
| 25-34 | 437 | 12.2 | 258 | 18.3 | 695 | 13.9 |
| 35-50 | 1322 | 36.8 | 587 | 41.7 | 1909 | 38.2 |
| >50 | 1219 | 33.9 | 296 | 21.0 | 1515 | 30.3 |
| **Total** | 3592 | 100.0 | 1408 | 100.0 | 5000 | 100.0 |
| **Employment** | | | | | | |
| Employed | 2050 | 57.5 | 874 | 62.7 | 2924 | 58.9 |
| Out of Labor Force | 1044 | 29.3 | 298 | 21.4 | 1342 | 27.0 |
| Self Employed | 98 | 2.7 | 43 | 3.1 | 141 | 2.8 |
| Student | 185 | 5.2 | 109 | 7.8 | 294 | 5.9 |
| Unemployed | 190 | 5.3 | 71 | 5.1 | 261 | 5.3 |
| **Total** | 3567 | 100.0 | 1395 | 100.0 | 4962 | 100.0 |

[†] Users of Deezer are defined as indivisuals who visited *Deezer* at least once before the free streaming cap was imposed.

Table 2: Licensed Music Downloading Websites

| | (1) Coef./s.e. | (2) Coef./s.e. | (3) Coef./s.e. | (4) Coef./s.e. |
|---|---|---|---|---|
| *Deezer* × Cap | -0.0183*** | -0.0184*** | -0.0166*** | -0.0169*** |
| | (0.005) | (0.005) | (0.006) | (0.006) |
| Log(Alternative Music Streaming) | | 0.0534*** | | 0.0534*** |
| | | (0.004) | | (0.004) |
| Constant | 0.0462*** | 0.0417*** | 0.0461*** | 0.0416*** |
| | (0.004) | (0.004) | (0.005) | (0.004) |
| Week Fixed Effects | ✓ | ✓ | ✓ | ✓ |
| Linear Group Trend | ✗ | ✗ | ✓ | ✓ |
| Adjusted-$R^2$ | 0.137 | 0.142 | 0.137 | 0.142 |
| No. of Individuals | 5000 | 5000 | 5000 | 5000 |
| No. of Observations | 255000 | 255000 | 255000 | 255000 |

† Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table 3: Unlicensed Music Downloading Websites

| | (1) Coef./s.e. | (2) Coef./s.e. | (3) Coef./s.e. | (4) Coef./s.e. |
|---|---|---|---|---|
| *Deezer* × Cap | -0.0007 | -0.0007 | -0.0126** | -0.0128** |
| | (0.004) | (0.004) | (0.006) | (0.006) |
| Log(Alternative Music Streaming) | | 0.0483*** | | 0.0483*** |
| | | (0.004) | | (0.004) |
| Constant | 0.0177*** | 0.0136*** | 0.0174*** | 0.0133*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| Week Fixed Effects | ✓ | ✓ | ✓ | ✓ |
| Linear Group Trend | ✗ | ✗ | ✓ | ✓ |
| Adjusted-$R^2$ | 0.244 | 0.251 | 0.244 | 0.251 |
| No. of Individuals | 5000 | 5000 | 5000 | 5000 |
| No. of Observations | 255000 | 255000 | 255000 | 255000 |

† Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table 4: Licensed Music Downloading Websites, by Intensity of *Deezer* Usage.[†]

| | (1) Coef./s.e. | (2) Coef./s.e. | (3) Coef./s.e. | (4) Coef./s.e. |
|---|---|---|---|---|
| *Deezer* High × Cap | -0.0279*** | -0.0289*** | -0.0246*** | -0.0262*** |
| | (0.008) | (0.008) | (0.009) | (0.009) |
| *Deezer* Low × Cap | -0.0082* | -0.0071 | -0.0080 | -0.0069 |
| | (0.005) | (0.005) | (0.008) | (0.008) |
| Log(Alternative Music Streaming) | | 0.0535*** | | 0.0535*** |
| | | (0.004) | | (0.004) |
| Constant | 0.0462*** | 0.0417*** | 0.0461*** | 0.0416*** |
| | (0.004) | (0.004) | (0.005) | (0.004) |
| Week Fixed Effects | ✓ | ✓ | ✓ | ✓ |
| Linear Group Trend | ✗ | ✗ | ✓ | ✓ |
| Adjusted-$R^2$ | 0.137 | 0.142 | 0.137 | 0.142 |
| No. of Individuals | 5000 | 5000 | 5000 | 5000 |
| No. of Observations | 255000 | 255000 | 255000 | 255000 |

[†] Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table 5: Unlicensed Music Downloading Websites, by Intensity of *Deezer* Usage.[†]

| | (1) Coef./s.e. | (2) Coef./s.e. | (3) Coef./s.e. | (4) Coef./s.e. |
|---|---|---|---|---|
| *Deezer* High × Cap | -0.0022 | -0.0032 | -0.0190** | -0.0205** |
| | (0.007) | (0.006) | (0.008) | (0.008) |
| *Deezer* Low × Cap | 0.0009 | 0.0019 | -0.0057 | -0.0047 |
| | (0.004) | (0.004) | (0.007) | (0.007) |
| Log(Alternative Music Streaming) | | 0.0484*** | | 0.0484*** |
| | | (0.004) | | (0.004) |
| Constant | 0.0177*** | 0.0136*** | 0.0174*** | 0.0133*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| Week Fixed Effects | ✓ | ✓ | ✓ | ✓ |
| Linear Group Trend | ✗ | ✗ | ✓ | ✓ |
| Adjusted-$R^2$ | 0.244 | 0.251 | 0.244 | 0.251 |
| No. of Individuals | 5000 | 5000 | 5000 | 5000 |
| No. of Observations | 255000 | 255000 | 255000 | 255000 |

[†] Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

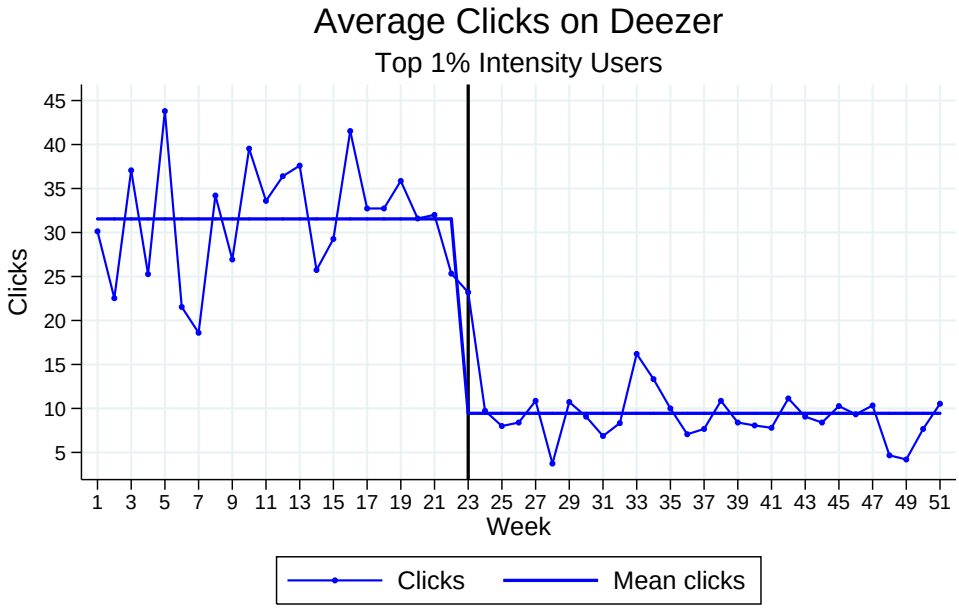
# B Free vs Premium Accounts

Our data unfortunately does not provide information on whether a given individual that uses *Deezer* does so through a free or premium account. The fact that the share of Deezer premium users was rather low in 2011 suggests that the users in our sample are more likely to be free users. Likewise, Figure 4 already showed how the free streaming restriction had a clear impact on usage, with an average decrease in clicks of more than 40 percent, suggesting that a large share of the *Deezer* users in our sample were in fact free users. While these observations are reassuring, they do not allow us to rule out that some of the users in our sample were in fact subscribed to a premium account. We can, however, learn more about the type of service that individuals were using by looking closely into their *Deezer* usage.

Premium users were - by definition - not affected by the streaming cap. Under the assumption that premium subscribers use *Deezer* on their PC to a larger extent than free users, we can look at the streaming consumption evolution of the highest intensity users to identify potential premium subscribers.[32] If a high intensity user does not decrease its consumption after the listening cap is imposed, we can safely assume that the individual was a premium subscriber before the restriction was set. Figure B.8 presents the evolution of average weekly visits for the top 1% of individuals in terms of pre-restriction usage. The picture clearly shows how they decreased their consumption by more than 70%, suggesting that all of them were free users.

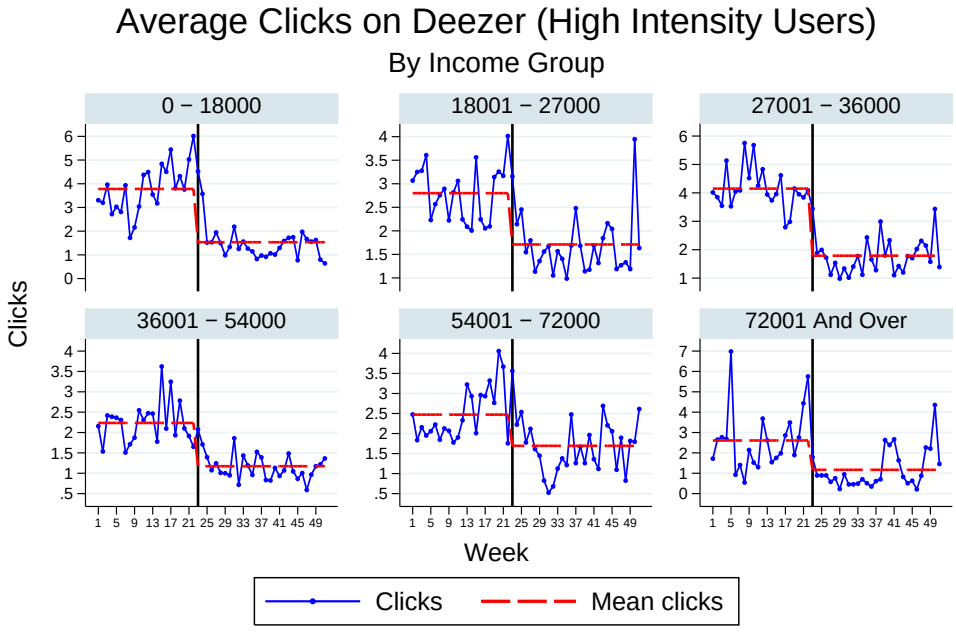
Finally, one may worry that some of the free users decided to subscribe to a premium account after the restriction was imposed, which would potentially bias our estimation results. If we believe that the individuals in our sample all are and remain free users throughout the sample period, then their usage of *Deezer* should naturally have remained lower after the listening cap was imposed. While this was already highlighted in Figure B.8, we can use alternative decompositions of our data to add further evidence to that fact. In particular, since income levels are most likely to affect individuals' decisions to subscribe to a premium account as a response to the cap imposition, we check whether individuals in specific income groups maintain or increase their post-restriction level of *Deezer* usage. Figure B.9 shows that, for all incomes, *Deezer* usage decreases and does not go back to the pre-cap levels. This suggests no change toward premium accounts, further confirming that we are dealing with free users in our sample.

[32] While our assumption is reasonable, we cannot rule out that some premium users in our sample are using *Deezer* mostly on mobile devices, which would reflect in a small PC consumption. Following a random sample of 4,000 *Deezer* users during 5 months in 2014, Maillard (2015) finds that premium subscribers use their mobile device to a larger extent than their PC to listen to music. However, premium users still spend about 25% of their listening time on their mobile devices.




Note: Includes the top 1% of users in terms of Deezer intensity of use (total clicks) before the cap was imposed. Number of individuals is 15.

Figure B.8: Evolution of Average Deezer Visits for the Top 1% of Users in Terms of Deezer Intensity.




Graphs by Income Groups (in euros). High intensity users are defined as users with a total number of clicks on Deezer above the median of total clicks on Deezer before the free streaming cap was imposed.

Figure B.9: Evolution of Average Deezer Visits, by Income Category.