



**HAL**  
open science

## Music consumption in a changing ecosystem

Dandan Niu

► **To cite this version:**

Dandan Niu. Music consumption in a changing ecosystem. Economics and Finance. Université Paris sciences et lettres, 2018. English. NNT : 2018PSLEM008 . tel-01848731

**HAL Id: tel-01848731**

**<https://pastel.hal.science/tel-01848731>**

Submitted on 25 Jul 2018

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# THÈSE DE DOCTORAT

de l'Université de recherche Paris Sciences et Lettres  
PSL Research University

Préparée à MINES ParisTech

La consommation de musique dans un écosystème

Music consumption in a changing ecosystem

**École doctorale n°396**

ÉCONOMIE, ORGANISATION, SOCIÉTÉ

**Spécialité** ÉCONOMIE ET FINANCE

Soutenue par Dandan NIU  
le 27 Juin 2018

Dirigée par **Olivier BOMSEL**

## COMPOSITION DU JURY :

M. Marc BOURREAU  
Telecom ParisTech  
Rapporteur

M. Thomas PARIS  
HEC Paris  
Rapporteur

Mme. Margaret KYLE  
Mines ParisTech  
Présidente

M. Olivier BOMSEL  
Mines ParisTech  
Directeur de thèse





---

## Acknowledgment

---

### **Acknowledgment**

This thesis was conducted under the direction of Professor Olivier Bomsel at Mines ParisTech, I want to thank him for giving me the opportunity to carry out this thesis in such an insightful environment, and for introducing me to the fascinating topic of the economics of the music industry. I also want to thank him for instilling in me the encouragement and of research and the skills to do it well.

I would also like to thank Professor Margaret Kyle, for joining this PhD journey. I'm grateful for her patience and her guidance. Her expertise has been extremely valuable for this thesis.

I wish to thank the seniors of the Center for Industrial Economics, Cerna at Mines ParisTech, in particular, Professor Pierre Fleckinger and Petyo Bonev for their valuable suggestions and comments during the past years.

I thank Professor Shenle Pan from CGS, Mines ParisTech for his helpful advice, and his words of encouragement during the last few months of this thesis. I am also grateful to Professor Xitong Li from HEC for his constructive advice.

At Cerna, I have benefited from a pleasant and stimulating work environment. I thank my fellow PhD colleagues: Charlène Cosandier, Btissam EL Bahraoui, Philippe Frocrain, Paul-Hervé Tamokoué Kamga, Romain Bizet, Sabine Bair, Guillaume Dupéret, Victor Lavialle, and Ekaterina Dukhanina for their useful comments and the entertaining times we had together

during my stay. A special thanks goes to Damien Dussaux, Connie Lee, and Laurie Ciaramella for their thoughtful suggestions during the last months of this thesis. Also, I thank Maddalena Agnoli for the “bittersweet” time spent together looking for a solution to econometric models. I thank Sésaria Ferreira for her administrative help, and for her persistence in encouraging me to speak French.

I have been working in Paris since September 2014, I have thoroughly enjoyed three wonderful years in this beautiful city. I am deeply touched by the people who supported me while completing this thesis, and I would like to thank them sincerely.

I am thankful to all my friends in France and China who helped and supported me, especially those to whom I’ve grown closer over these years: Jiayuan Zhao, Yake Wang, Shaoyi Zhang, Dongyang Huang, Hao Jiang, Fei Ye, Yubing Li, Yanhui He, Shihao Yuan, Xin Gao, Yanyan Yang, Bin Qiao, Bin Fang and Jingwen Zhao. I wish to thank Li You for her encouragement and support, and for having been pleasant hosts every time I needed them. Particularly, I want to thank my Yi Yu and Wei You for accompanying me during this journey. Last, my thanks to my beloved family, for their thorough concern and great confidence in me all through these years.

The Chaire ParisTech d’Economie des Médias et des Marques financed this research. I thank Yacast for providing the radio data used in the analysis. I also thank Universal Music for providing the datasets of streaming services and physical album sales.

Finally, I would like to give a special acknowledgment to the China Scholarship Council for giving me a three-year fellowship in Paris. Financial funding from the Fondation Mines ParisTech through the Chaire ParisTech d’Economie des Médias et des Marques is also gratefully acknowledged.

## Preface

This PhD thesis was funded by the China Scholarship Council and Fondation Mines ParisTech, and was carried out in the Centre for Industrial Economics, CERNA in Ecole des Mines. It consists of three articles which have been presented by myself at several conferences and seminars. Some of them are currently under revision.

The first chapter of this thesis empirically examines the strategic responses of French radio stations to quota regulations. The second chapter of the thesis tackles the challenges involved in the construction of an integrated database between multiple music channels. The third chapter analyzes how consumption of music on streaming services compares to that of radio, as well as how new talent fares on streaming platforms. In the above three chapters, I use empirical methods taken from the economic literature to develop new tools for the analysis of the media industry, to derive new results regarding the regulation, and to propose policy guidance for further improvements of regulation in the music ecosystem.

I presented the first paper, **Strategic responses to cultural quotas: evidence from French radio** at EARIE (European Association for Research in Industrial Economics), in Maastricht Holland in August 2017; at IAAE (International Association for Applied Econometrics) in Sapporo Japan in June 2017; at AFSE (The French Economic Association) in Nice France in June 2017; at Lancaster Conference on Auctions, Regulation and Public Policy in UK in May

2017; at Doctoral workshop of CERNA in Paris France in March 2016; at SERCI (The Society for Economic Research on Copyright Issues) in Chicago USA in June 2016.

The second paper is **Music consumption in France: A database linking streaming services and radio stations.**

The third paper is **Music Streaming: Effects on Variety and Types of Music Consumption.**

<b>Acknowledgment</b>	<b>i</b>
<b>Preface</b>	<b>iii</b>
<b>List of Figures</b>	<b>vii</b>
<b>List of Tables</b>	<b>ix</b>
<b>Introduction</b>	<b>1</b>
<b>1 Strategic responses to cultural quotas: evidence from French radio</b>	<b>17</b>
1.1 Introduction	21
1.2 Literature review	22
1.3 Institutional environment of cultural quotas in France	24
1.3.1 Quota regulation in France	24
1.3.2 Quotas and competition between broadcasters	25
1.4 Data and summary statistics	26
1.4.1 Compliance with quotas	27
1.5 Estimation and results	29
1.5.1 Do stations select shorter Francophone songs?	30
1.5.2 Do stations shift Francophone play?	32
1.6 The importance of each strategic response	35
1.7 Conclusion and future extensions	36
1.8 Main part of paper	38
Appendix A	61
Appendix B	65
<b>2 Music consumption in France: A database linking streaming services and radio stations</b>	<b>73</b>
2.1 Introduction	75

2.2	Literature	77
2.3	Data	78
2.3.1	Data sources	79
2.3.2	Novelty of the data	79
2.3.3	Radio	79
2.3.4	Streaming	80
2.3.4.1	Spotify, Deezer, Napster, Google	80
2.3.4.2	Meta data	81
2.3.5	Other data: physical album sales	82
2.3.6	Challenges	82
2.3.6.1	Geographic representativeness of consumers	83
2.4	Matching	84
2.4.1	Match messy data within streaming dataset	84
2.4.2	Unify song and artist name between streaming services and radio	85
2.5	Aggregate data	87
2.5.1	Aggregate data to weekly level	87
2.5.2	Aggregate data between streaming and radio	87
2.5.3	Sample restrictions	88
2.6	Conclusion	89
	Appendix	90
<b>3</b>	<b>Music Streaming: Effects on Variety and Types of Music Consumption</b>	<b>95</b>
3.1	Introduction	97
3.2	Literature	98
3.3	The French music market	100
3.3.1	Major music services in France	100
3.3.2	Regulatory barriers	102
3.4	Descriptive statistics	102
3.4.1	Overview of streaming services and radio	104
3.4.2	Streaming services play more gold songs, radio stations play more new music	104
3.4.3	Song concentration is higher in radio than streaming	105
3.4.4	Artist concentration is higher in streaming than radio	105
3.4.5	Consumers from streaming services listen to more music produced from France	106
3.4.6	Radio and streaming services share similarity in playing hit songs	108
3.4.7	Summary: How artists distribute music content to different music channels	110
3.5	Conclusion	111
3.6	Main part of paper	113
	Appendix	127
	<b>Conclusion</b>	<b>129</b>
	<b>References</b>	<b>142</b>

---

## List of Figures

---

1.1	Compliance with 35% quota for Francophone music	41
1.2	Compliance with 40% quota for Francophone music	41
1.3	Compliance with 50-60% quota for Francophone music	42
1.4	Compliance of public stations with 50% quota for Francophone music	42
1.5	Compliance with 20% quota level for new music	43
1.6	Compliance with 25% quota for new music	43
1.7	Private stations: Exposure of Francophone music	44
1.8	Public stations: Exposure of Francophone music	44
1.9	Private stations: Exposure of New Francophone music	45
1.10	Public stations: Exposure of New Francophone music	45
1.11	Length of song in seconds, by year of release between Anglophone and Francophone songs	46
1.12	Average length of Francophone song and Anglophone song: one observation per song	47
1.13	Average length of Francophone song and Anglophone song: one observation per diffusion	47
1.14	Average audience by hour of the day	52
1.15	Average audience by month of the year	52
1.16	Percent difference in audience for each station between 2013 Q1 and 2016 Q1	56
1.17	Simulation comparison between AB, stations with 35% quota	57
1.18	Simulation comparison between AC, stations with 35% quota	57
1.19	Simulation comparison between AD, stations with 35% quota	57
1.20	Simulation comparison between AB, stations with 40% quota	57
1.21	Simulation comparison between AC, stations with 40% quota	57
1.22	Simulation comparison between AD, stations with 40% quota	57
1.23	Simulation comparison between AB, stations with 50% quota	58
1.24	Simulation comparison between AC, stations with 50% quota	58
1.25	Simulation comparison between AD, stations with 50% quota	58
1.26	Simulation comparison between AB, public stations with 50% quota	58

1.27	Simulation comparison between AC, public stations with 50% quota	58
1.28	Simulation comparison between AD, public stations with 50% quota	58
1.29	Simulation comparison between AB, stations with 60% quota	59
1.30	Simulation comparison between AC, stations with 60% quota	59
1.31	Simulation comparison between AD, stations with 60% quota	59
1.32	Francophone play by hour, Fun Radio	61
1.33	New music play by hour, Fun Radio	61
1.34	Exposure of Francophone, stations with 35% quota	67
1.35	Exposure of Francophone, stations with 40% quota	67
1.36	Exposure of Francophone, stations with 50% quota	68
1.37	Exposure of Francophone, public stations with 50% quota	68
1.38	Exposure of Francophone, stations with 60% quota	69
3.1	Evolution of streaming and radio, by week by year 2016	114
3.2	Diffusion of music age of streaming by types of consumptions in 2016	115
3.3	Diffusion of music age of radio by types of consumptions in 2016	116
3.4	Number of distinct diffusion of streaming services in 2016	117
3.5	Distribution patterns for top songs of streaming in 2016	118
3.6	Distribution patterns for top songs of radio in 2016	119
3.7	Distribution patterns for top artists of streaming services in 2016	120
3.8	Distribution patterns for top artists of radio in 2016	121
3.9	Diffusion of Francophone music of streaming and radio in 2016	122
3.10	Diffusion of Francophone music of streaming and radio by music age in 2016	123
3.11	Top 30 songs played from matched data between Spotify and radio in 2016	124
3.12	Top 30 songs played from matched data between Spotify(lean forward) and radio in 2016	125

---

## List of Tables

---

1.1	Quota category from 2014 to 2016	38
1.2	Skyrock on March 30, 2015 from 10-11 AM (source: Yacast)	39
1.3	Summary statistics	40
1.4	Summary statistics	47
1.5	Negative binomial estimates, full sample	48
1.6	Negative binomial estimates by quota level	49
1.7	Negative binomial estimates, by Anglophone and Francophone	50
1.8	Negative binomial estimates, by station demographics	51
1.9	OLS and IV estimates for Francophone	53
1.10	IV estimates for Francophone, Anglophone and Non-music minutes	53
1.11	IV estimates with language interactions	54
1.12	IV estimates with language and age interactions	55
1.13	IV estimates by Gain/Loss group	56
1.14	Summary statistics of simulation for all stations	59
1.15	Sanctions	62
1.16	Sanctions (continue)	63
1.17	Changes in quotas from 2001 to 2014	64
1.18	IV estimates of music genre by Weekday	65
1.19	IV estimates of music genre by Weekend	65
1.20	IV estimates with age interactions	66
1.21	Summary statistics of simulation for each station	70
1.22	Summary statistics of simulation for each station	71
2.1	Fun Radio on March 31, 2016 from 12-13 AM (source: Yacast)	91
2.2	Spotify on March 31, 2016 (source: Universal Music)	92
2.3	Variable Definition of Spotify dataset, for year 2016	93
2.4	Summary statistics of Spotify by song-day level, on January 2016	93
2.5	Matching procedure	94

3.1	Summary statistics of No. distinct artists, and No. distinct titles between radio and streaming services in 2016	117
3.2	A comparison of purchase model between major streaming services in France	127

### Introduction

Le terme écosystème est principalement utilisé en biologie pour désigner une communauté d'organismes vivants (plantes, animaux et microbes) et leur interaction avec les éléments non vivants de leur environnement (des choses comme l'air, l'eau et le sol minéral). [Willis \(1997\)](#) définit les écosystèmes comme le réseau d'interactions entre organismes et entre organismes et leur environnement. Par analogie, un écosystème d'entreprise s'applique à une communauté d'agents économiques interagissant pour l'équilibre de tous, dans un cadre favorable aux externalités ([Teece \(2007\)](#) ).

Les technologies numériques apportent de nouveaux médias à tous les écosystèmes. En effet, un écosystème médiatique reflète l'état de la technologie ([Bomsel \(2016\)](#)). Au cours de la période phonographique, la musique a été enregistrée sur des disques et médiatisée à travers des pochettes de disques, des stations de radio, des concerts, des magazines, des clips vidéo et des magasins de disques. Les stations de radio ont dû reconnaître et annoncer la publication des enregistrements afin de commencer à créer un buzz. Les nouvelles technologies ont perturbé l'écosystème phonographique des médias et de la distribution. Du côté des médias, les plateformes de diffusion peuvent créer et amplifier un buzz produit auparavant par la radio. Du côté de la distribution, les téléchargements de musique et, de plus en plus, les services de streaming

remplacent les ventes de CD.

La nouveauté des écosystèmes numériques est que la médiatisation devient floue avec la distribution. La consommation de musique dans un écosystème numérique (voir [Sonnac \(2013\)](#)), ajoute de nouveaux éléments, et appelle donc de nouvelles méthodes numériques. La numérisation fait de la distribution de contenus musicaux un cas particulier de médiatisation. La médiatisation, selon [Bomsel and Nègre \(2012\)](#), consiste à «faire connaître l'artiste et son œuvre au public». La médiatisation inclut également la publicité.<sup>1</sup> Le contenu musical peut être annoncé en donnant des versions gratuites, et un écosystème peut consister en un média fournissant une version gratuite ou un teaser, alors que d'autres médias vendent des versions payantes. Avec la numérisation, les médias payants continuent à bénéficier des externalités des médias libres. Une plate-forme audio taquine gratuitement jusqu'à ce que le spectateur décide de payer pour un service. La multiplicité des canaux médiatiques et les différences dans leurs schémas de tarification soulignent l'importance des effets externes.

Cette pratique existait déjà lorsque, par exemple, les stations de radio devaient payer des droits de licence pour médiatiser la musique. Mais avec les écosystèmes numériques, une telle pratique est répandue et en expansion continue. Par exemple, les plateformes de streaming comme Spotify ou YouTube permettent aux consommateurs de créer leur propre playlist gratuitement ou de payer un petit abonnement. Avec l'augmentation continue et le déploiement de nouveaux médias, l'écosystème de la musique devient de plus en plus dense, ce qui rend les stratégies d'internalisation plus ouvertes et plus souples que par le passé.

La consommation de contenu culturel a des externalités de réseau ([Rauch and Trindade \(2009\)](#)). Les œuvres culturelles protégées par le droit d'auteur génèrent des types spécifiques d'externalité, à la fois positifs et négatifs [Bomsel \(2013\)](#). La consommation de contenu musical affecte non seulement les futures distributions culturelles, mais favorise également l'innovation et la créativité qui améliorent les performances économiques futures ([Bernier \(2003\)](#)). Cependant, l'existence de l'externalité est insaisissable, difficile à vérifier et difficile à mesurer ([Bomsel \(2016\)](#)). Les difficultés résident dans l'identification et la mise en œuvre d'une réglementation efficace de la protection culturelle ([Lee and Bae \(2004\)](#)). Dans l'industrie des médias, les protec-

---

<sup>1</sup>Voir les détails de [Bomsel and Nègre \(2012\)](#), page 115. La médiatisation, c'est faire connaître l'artiste et sa production. Le faire connaître, c'est lancer le buzz de l'artiste sur Internet, créer une communauté, faire, peu à peu, les gens qui incitent à découvrir son clip sur YouTube ou Dailymotion, obtenir une programmation à la radio, des passages à la télévision, susciter des articles de presse. C'est aussi la publicité.

tions sont souvent critiquées pour mener à la production sans valeur externe ([Gasher \(2000\)](#)).

La protection du contenu culturel peut prendre plusieurs formes: tarifs, subventions ou réglementation des quotas. Les quotas réglementaires ont été utilisés principalement dans le commerce international ([Ray \(1981\)](#), [Aw and Roberts \(1986\)](#), et [Anderson and Neary \(1992\)](#)). Dans le secteur des médias, la réglementation des quotas exige qu'un certain pourcentage de contenu soit d'origine nationale ([Helpman and Krugman \(1985\)](#)), un nombre minimum de jours ou de temps consacrés aux programmes domestiques ou une proportion maximale de temps consacrée aux programmes importés ([Bernier \(2004\)](#)). La France a imposé des quotas pour la musique francophone depuis 1996.<sup>2</sup>

Malgré leur utilisation répandue, la littérature sur les quotas culturels est relativement éparse et se concentre principalement sur la diversité des contenus et le bien-être des consommateurs ([Epstein \(1998\)](#), [Sweeting \(2007\)](#) et [Ryan \(2012\)](#)). [cite ren2011protective](#) présente des preuves que les restrictions de quotas et d'investissement augmentent la diversité du contenu local et conclut que les quotas sont un moyen efficace de contrer la domination du contenu culturel étranger. Cependant, [Spence \(1976\)](#) pense que les réglementations culturelles sont conçues pour protéger les consommateurs ayant des goûts spécifiques. Si les entreprises ne sont pas des discriminateurs de prix parfaits, le marché peut ne pas offrir des produits pour les petits groupes avec des préférences intenses. ([Richardson \(2006\)](#)) soutient que les quotas laissent les consommateurs avec des produits moins variés ou plus coûteux. Certains auteurs affirment que les quotas conduisent souvent à une production de faible qualité avec de faibles valeurs culturelles et externes ([Hoskins and McFadyen \(1991\)](#), [Marvasti \(1994\)](#)). [Ulf-Møller \(2001\)](#) étudie les quotas d'écran français et constate que les quotas n'augmentent pas le contenu national.

La question reste ouverte quant aux mécanismes qu'un régulateur devrait utiliser pour mettre en place une réglementation des quotas afin de favoriser la diversité musicale et l'exposition des chansons françaises lorsque seules les stations de radio sont réglementées. L'intégration technologique croissante rend la réglementation des quotas de plus en plus difficile ([Hoskins et al. \(1989\)](#), [Hoskins et al. \(2004\)](#)). Par exemple, [Raboy et al. \(1994\)](#) pense que la mondialisation économique a remis en question la base traditionnelle de l'intervention dans la sphère culturelle. La réglementation des quotas peut ne pas fonctionner lorsque les consommateurs peuvent accéder

---

<sup>2</sup>Voir la loi du 1<sup>er</sup> février 2004, qui a remplacé une loi antérieure sur les quotas, pour plus de détails.

aux médias en utilisant plusieurs canaux et technologies ([Middleton \(2002\)](#), [Bruner \(2007\)](#)). Avec un contenu musical de plus en plus disponible à travers les services de streaming, les difficultés de suivi des transactions augmentent.

Cette thèse contribue à la littérature empirique sur les marchés numériques et tente d'étudier certains aspects de la réglementation pour les marchés numériques qui ont été négligés. Il met en évidence les différentes réponses stratégiques entre les stations de radio et fournit des preuves originales sur leur portée et leur dynamique. Parce que la compréhension de l'écosystème changeant de la musique est essentielle, j'explore également les différences de consommation et de variété musicales entre les services de radio et de streaming. Les résultats de cette thèse concernant la réglementation des quotas, la diversité musicale et la consommation de musique pour cet écosystème musical pourraient fournir de nouvelles idées aux participants et aux décideurs politiques.

Un petit nombre d'études ont examiné la consommation de musique à l'aide de données à grande échelle et récentes. [Datta et al. \(2017\)](#) fournit la première preuve empirique à grande échelle sur les effets de l'adoption de Spotify sur la consommation et la découverte de la musique. Ils trouvent que Spotify peut augmenter la consommation globale de musique. D'autres études reposent sur des données d'enquête ([Nguyen et al. \(2014\)](#), [Aguiar and Martens \(2016\)](#), [Wlömert and Papies \(2016\)](#)). Les travaux académiques utilisant des données françaises à grande échelle sont rares et se concentrent sur des pays spécifiques. (Voir par exemple [Zentner \(2009\)](#) et [Liebowitz \(2006\)](#), [Aguiar and Waldfogel \(2016\)](#))

Dans cette thèse, je m'appuie sur plusieurs sources de données à grande échelle sur la consommation de musique en France. J'utilise des données détaillées sur les listes de lecture des principales stations de radio en France de 2013 à 2016, fournies par Yacast, une société spécialisée dans la surveillance des médias. Yacast rapporte la programmation minute par minute des principales radios françaises à couverture nationale (représentant plus de 34 grandes stations de radio en France). J'utilise les données de consommation musicale des principaux services de streaming opérant en France à partir de 2016, fournies par Universal Music. Je conçois une méthodologie pour nettoyer les datasets et combiner des données radio avec des données en streaming en France. J'utilise également les méta-données fournies par Universal Music en tant que jeu de données supplémentaire. Il donne accès à une vaste base de données d'informations

sur l'enregistrement sonore, y compris le code IRSC de chaque artiste et nom de la chanson, le genre musical et le pays de production de musique, etc.

La fiabilité de ces ensembles de données est essentielle à l'analyse empirique de la consommation de musique dans cet écosystème en évolution. La mesure de l'effet de divers types de services de musique est un exercice intrinsèquement difficile, principalement pour les raisons suivantes. L'utilisation de divers services de diffusion en continu et stations de radio ne fournit pas un enregistrement complet du comportement de l'utilisateur, ce qui rend sa mesure difficile. Il n'est donc pas facile d'obtenir des données sur chaque service ni de lier des données sur tous les services. De plus, en supposant que de telles données soient disponibles, l'identification de l'effet de la consommation de musique est rendue difficile par la complexité des données. Enfin, les données sur les caractéristiques musicales provenant de différentes plates-formes musicales manquent souvent d'harmonisation, ce qui nécessite un important travail de données supplémentaires.

L'analyse de la consommation de musique entre les stations de radio et les plateformes de diffusion est importante pour comprendre l'industrie de la musique. En revanche, pour les enregistrements et les téléchargements où le nombre de lectures ne peut être déterminé, le modèle de radio et de streaming permet une mesure par le morceau. Cela nécessite une adaptation des données disponibles. Des recherches récentes menées sur cette question ont été faussées en raison de la mauvaise méthodologie et l'omission d'inclure des données importantes. Le chapitre 2 est conçu pour répondre à ces défis méthodologiques en utilisant des mesures appropriées de la consommation de musique et en corrigeant les déficiences des données. L'exactitude de l'appariement de l'artiste et du nom du titre entre les différentes plates-formes prouve la validité de la consommation de musique en France (voir le chapitre 2 pour plus de détails).

Chacun des chapitres de cette thèse traite de questions de recherche indépendantes et peut être lu séparément. Je vais brièvement présenter chaque chapitre et expliquer pourquoi j'utilise l'approche empirique spécifique dans la section suivante.

Pourquoi est-il important d'étudier la consommation de musique dans l'écosystème musical en évolution? Nelson (1970) postule que la musique est intrinsèquement une bonne expérience; sa vraie valeur est inconnue a priori et n'est révélée qu'après consommation. Étant donné que l'industrie de la musique a radicalement changé au cours des dernières décennies, il est important

de comprendre les mécanismes qui déterminent le comportement des consommateurs. Dans cette thèse, je vais essayer de répondre à trois questions principales liées au sujet de l'industrie de la musique:

- **La réglementation des quotas dans l'industrie de la radio est-elle nécessaire?**
  - Les stations de radio se conforment-elles à la réglementation des quotas?
  - Comment les stations de radio peuvent-elles se comporter stratégiquement selon ces réglementations? Les stations choisissent-elles des chansons francophones plus courtes? Les stations changent-elles stratégiquement le jeu francophone en réponse? aux quotas?
  - Quel est l'effet contrefactuel de chaque réponse stratégique faite par les stations de radio?
- **Comment combiner des données entre plusieurs plateformes musicales?**
  - Comment un nom d'artiste et de chanson est-il unifié entre différentes plateformes musicales?
  - Comment ajuster et faire correspondre les données de consommation entre la radio et les services de streaming?

Qu'est-ce qui détermine la diversité musicale parmi les différents types de stations de radio?

- **Comment la diversité musicale et le modèle de consommation musicale varient-ils entre les stations de radio et les plateformes de streaming?**
  - L'efficacité de la réglementation des quotas dans la protection de la musique francophone diminue-t-elle avec le développement des services de streaming?
  - Existe-t-il des relations symbiotiques dans la programmation entre la radio et les services de streaming?

Dans **chapter 1** de cette thèse, j'essaierai d'aborder le premier numéro. Le premier chapitre est composé de l'article suivant:

- Réponses stratégiques aux quotas culturels: témoignages de la radio française (co-écrit avec Margaret Kyle)

Le chapitre 1 ajoute à la littérature sur la régulation du contenu culturel une caractéristique inhabituelle: les quotas réglementaires pour le contenu culturel en France sont compliqués et varient selon les stations. Cette étude contribue également en mesurant les incitations des stations de radio à répondre à la réglementation des quotas, et en simulant l'importance de chacune de ces réponses stratégiques. De nombreux articles ont tendance à considérer un régime de réglementation dans son ensemble ou à se concentrer sur une réglementation particulière et ses effets. Cependant, l'effet de la régulation culturelle n'est pas explicitement expliqué. Comme il existe diverses réponses stratégiques aux quotas réglementaires, j'ai l'occasion de commenter les effets potentiels de chaque réponse individuelle.

Je me concentre sur la nécessité de réglementer le contenu culturel dans l'industrie de la radio. Le chapitre 1 est une tentative de fournir les premières preuves empiriques sur les réponses stratégiques des stations de radio contraintes par les quotas culturels. J'analyse en particulier s'ils sélectionnent des chansons francophones relativement plus courtes et comment les stations françaises ajustent le contenu en fonction de la taille de leur public. Ce sujet est important parce que les régulateurs sont confrontés à un défi lorsqu'ils imposent des quotas culturels qui ne sont pas conformes aux goûts du public. Les réponses stratégiques compensent partiellement les effets escomptés de ces quotas, et les stations qui respectent davantage l'esprit de la loi risquent de perdre de l'audience, ce qui réduira davantage l'exposition du contenu que le quota est censé protéger.

Dans **chapitre 2** de cette thèse, je vais essayer de répondre à la deuxième question. Ce chapitre est composé de l'article suivant:

- Consommation musicale en France: une base de données reliant les services de streaming et les stations de radio

Dans le chapitre 2, je construis un nouvel ensemble de données pour fournir des preuves descriptives sur les services de radio et de streaming. Afin de comparer la taille du nombre de spectateurs pour un titre de chanson en particulier sur les stations de radio avec le nombre de flux sur les services de streaming, je développe une méthodologie pour combiner les données

de consommation de la musique entre les stations de radio et les services de streaming en France en 2016 et de compléter l'ensemble de données avec des informations détaillées sur les caractéristiques de la musique. Cette méthodologie est importante parce que les stations de radio et les services de diffusion en continu sont des modèles économiques entièrement différents et ne sont pas comparables sans ajuster l'ensemble de données pour refléter les différences. Le streaming et la radio pourraient être comparés efficacement là où je peux suivre le comportement d'écoute des consommateurs à travers le nombre de jeux. Le chapitre 2 tente de fournir un nouvel ensemble de données pour les études statistiques du chapitre 3.

Dans **chapitre 3** de cette thèse, je vais essayer d'aborder le troisième problème. Ce chapitre est composé de l'article suivant:

- Musique en streaming: Effets sur la variété et les types de consommation de musique.

Dans le chapitre 3, je propose une analyse descriptive sur la mesure de la diversité musicale entre services de streaming et radio en France et analyse comment les deux principales plateformes diffusent du contenu musical en début de transition de la musique numérique en 2016. Le chapitre 3 fournit également des preuves empiriques les externalités des deux marchés. Je trouve que, contrairement à l'argument des stations selon lequel le quota francophone entraîne une baisse du nombre d'auditoires, les services de diffusion jouent plus de musique francophone que les stations de radio. Ces modèles nécessitent d'explorer comment les quotas réglementaires peuvent augmenter la diversité musicale, car c'est le but ultime des régulateurs. Ce sujet est intéressant parce que la compréhension de la diversité musicale et du modèle de consommation de musique entre le streaming et les ventes sera cruciale pour les participants de l'industrie de la musique, ainsi que pour les décideurs politiques.

## Introduction

The term ecosystem is primarily used in biology to designate a community of living organisms (plants, animals and microbes) and their interaction with the non-living components of their environment (things like air, water, and mineral soil). Willis (1997) defines ecosystems as the network of interactions among organisms, and among organisms and their environment. By analogy, a business ecosystem applies to a community of economic agents interacting for the balance of all, in a framework favorable to externalities (Teece (2007)).

Digital technologies are bringing new media to all ecosystems. In effect, a media ecosystem reflects the state of the technology (Bomsel (2016)). Under the phonographic period, music was taped on records and mediated through record sleeves, radio stations, concerts, magazines, video clips, and record shops. The radio stations had to recognize and announce the release of the records in order to start creating a buzz. New technologies have disrupted the phonographic ecosystem from both the media and the distribution side. On the media side, streaming platforms can create and amplify a buzz that was formerly produced by radio. On the distribution side, music downloads and, increasingly, streaming services substitute CD sales.

The novelty of the digital ecosystems is that mediation gets blurred with distribution. The music consumption in a digital ecosystem (see Sonnac (2013)), adds new elements, and therefore calls for new digital methods. Digitization makes music contents distribution a particular case of mediation. Mediatization, according to Bomsel and Nègre (2012), is “to make the artist and his work known by the public.” The mediatization also includes advertising.<sup>3</sup> Musical content can be advertised by giving free versions, and an ecosystem can consist of a media providing a free version or a teaser, while other media sell paid versions. With digitalization, the paid media continues to benefit externalities from the free media. An audio platform teases for free until the viewer decides to pay for a service. The multiplicity of media channels and the differences in their pricing schemes underline the importance of external effects.

This practice already existed when, for instance, radio stations had to pay license fees to mediatize music. But with digital ecosystems, such practice is widespread and continuously

---

<sup>3</sup>See details from Bomsel and Nègre (2012), page 115. La médiatisation, c’est faire connaître l’artiste et sa production. Les faire connaître, c’est lancer le buzz de l’artiste sur Internet, lui créer une communauté, faire que, peu à peu, les gens soient incités à découvrir son clip sur YouTube ou Dailymotion, obtenir une programmation à la radio, des passages à la télévision, susciter des articles de presse. C’est aussi la publicité.

expanding. For instance, streaming platforms like Spotify or YouTube allow consumers to create their own playlist for free or to pay a small subscription fee. With the continuous surge and rollout of new media, the music ecosystem gets increasingly dense, making the internalization strategies more open and flexible than in the past.

Consumption of cultural content has network externalities ([Rauch and Trindade \(2009\)](#)). Cultural works that are protected copyright generate specific types of externality, both positive and negative [Bomsel \(2013\)](#). Consumption of music content not only affects future cultural distributions, but also fosters innovation and creativity that enhances future economic performance ([Bernier \(2003\)](#)). However, the existence of externality is elusive, hard to verify and hard to measure ([Bomsel \(2016\)](#)). Difficulties lie in identifying and implementing effective cultural protection regulation ([Lee and Bae \(2004\)](#)). In the media industry, protections are often criticized for leading to production with no external value ([Gasher \(2000\)](#)).

Protection of cultural content can come in several forms: tariffs, subsidies or quota regulation. Regulatory quotas have been used mostly in international trade ([Ray \(1981\)](#), [Aw and Roberts \(1986\)](#), and [Anderson and Neary \(1992\)](#)). In the media sector, quota regulation requires a certain percentage of content to be of domestic origin ([Helpman and Krugman \(1985\)](#)), a minimum number of days or proportion of time devoted to domestic programs, or a maximum proportion of time devoted to imported programs ([Bernier \(2004\)](#)). France has imposed quotas for Francophone music since 1996.<sup>4</sup>

Despite their widespread use, the literature on cultural quotas is relatively sparse and focuses mainly on the diversity of content and consumer welfare ([Epstein \(1998\)](#), [Sweeting \(2007\)](#) and [Ryan \(2012\)](#)). [Ren \(2011\)](#) presents evidence that both quota and investment restrictions increase the diversity of local content, and concludes that quotas are an effective way to counter the domination of foreign cultural content. However, [Spence \(1976\)](#) thinks cultural regulations are framed as protection of consumers with niche tastes. If firms are not perfect price discriminators, the market can fail to provide products for small groups with intense preferences. ([Richardson \(2006\)](#)) argues that quotas leave consumers with products of less variety or higher costs. Some literature argues that quotas often lead to production of low-quality with low cultural and external values ([Hoskins and McFadyen \(1991\)](#), [Marvasti \(1994\)](#)). [Ulf-Møller \(2001\)](#) studies the

---

<sup>4</sup>See la loi du 1 février 1994, which replaced an earlier statute on quotas, for details.

French screen quotas and finds that quotas do not increase domestic content.

It is still an open question as to which mechanisms a regulator should use to implement quota regulation in order to foster music diversity and exposure of French songs when only radio stations are regulated. Increasing technological integration makes quota regulation increasingly impractical ([Hoskins et al. \(1989\)](#), [Hoskins et al. \(2004\)](#)). For instance, [Raboy et al. \(1994\)](#) think economic globalization has called into question the traditional basis for intervention in the cultural sphere. Quota regulation may not work when consumers can access media using multiple channels and technologies ([Middleton \(2002\)](#), [Bruner \(2007\)](#)). With musical content increasingly available through streaming services, the difficulties of monitoring transactions rise.

This thesis contributes to the empirical literature on the digital markets and tries to investigate some aspects of the regulation for digital markets that have been overlooked. It highlights the different strategic responses between radio stations and provides original evidence on their scope and dynamics. Because an understanding of the changing music ecosystem is critical, I also explore the differences in music consumption and variety between radio and streaming services. The findings of this thesis regarding quota regulation, music diversity and music consumption for this music ecosystem could provide novel insights for the participants as well as policy makers.

A small number of studies have examined music consumption using large scale and recent data. [Datta et al. \(2017\)](#) provides the first large scale empirical evidence on the effects of Spotify adoption on individual music consumption and discovery. They find that Spotify can increase overall music consumption. Other studies rely on survey data ([Nguyen et al. \(2014\)](#), [Aguiar and Martens \(2016\)](#), [Wlömert and Papies \(2016\)](#)). Academic works using large scale French data are rare, and focus on specific countries. (See for instance [Zentner \(2009\)](#) and [Liebowitz \(2006\)](#), [Aguiar and Waldfogel \(2016\)](#))

In this thesis, I rely on multiple large-scale sources of data on music consumption in France. I use detailed data on playlists of major radio stations in France from 2013-2016, as provided by Yacast, a company specializing in monitoring the media. Yacast reports the minute-by-minute programming of major French radio stations that have national coverage (representing over 34 major radio stations in France). I use music consumption data for major streaming services operating in France from 2016, provided by Universal Music. I design a methodology to clean

the datasets and to combine radio data with streaming data in France. I also exploit the meta data provided by Universal Music as a supplementary dataset. It provides access to an extensive database of sound recording information, including the IRSC code of each artist and song name, music genre, and music production country, etc.

The reliability of these datasets is critical to the empirical analysis of the music consumption in this changing ecosystem. Measuring the effect of various types of music services is an inherently difficult exercise, mainly for the following reasons. The use of various streaming services and radio stations do not provide a complete record of user behavior, which renders its measurement difficult. It is therefore not easy to obtain data on each service nor to link data on all the services. In addition, assuming that such data is available, identifying the effect of music consumption is made difficult by the complexity of the data. Finally, data on music characteristics from different music platforms often lack harmonization, thus requiring substantial additional data work.

Analyzing music consumption between radio stations and streaming platforms is important to understanding the music industry. In contrast, for records and downloads where the number of plays cannot be determined, the model of radio and streaming allows a measurement by the song. This requires an adaptation of the available data. Recent research conducted on this issue has been flawed because of poor methodology and failure to include important data. Chapter 2 is designed to address these methodological challenges by using appropriate measures of music consumption and correcting data deficiencies. The accuracy of matching artist and title name between different platforms, provides evidence of the validity of music consumption in France (See chapter 2 for more details).

Each of the chapters in this thesis deals with independent research questions and can be read separately. I will briefly introduce each chapter and explain why I use the specific empirical approach in the following section.

Why is it important to study music consumption in the changing music ecosystem? [Nelson \(1970\)](#) posits that music is inherently an experience good; its true value is unknown a priori and is only revealed after consumption. Since the music industry has changed dramatically in the past decades, it is important to understand the mechanisms that drive consumer behavior. In this thesis, I will try to answer to three main issues related to the topic of the music industry:

- **Is quota regulation in the radio industry necessary?**
  - Do radio stations comply with quota regulations?
  - How can radio stations behave strategically to those regulations? Do stations select shorter Francophone songs? Do stations strategically shift Francophone play in response to quotas?
  - What is the counterfactual effect of each strategic response made by radio stations?
- **How to combine data between multiple music platforms?**
  - How does one unify artist and song name between different music platforms?
  - How does one adjust and match consumption data between radio and streaming services?
- **How do music diversity and music consumption pattern vary between radio stations and streaming platforms?**
  - Does the effectiveness of quota regulations in protecting Francophone music decrease with the development of streaming services?
  - Are there any symbiotic relationships in programming between radio and the streaming services?

In **chapter 1** of this thesis I will try to address the first issue. The first chapter is composed by the following article:

- Strategic responses to cultural quotas: evidence from French radio (co-authored with Margaret Kyle)

Chapter 1 adds to the literature on the regulation on cultural content with an unusual feature: regulatory quotas for cultural content in France are complicated and vary for different stations. This study also contributes by measuring the radio stations' incentives to respond to the quota regulations, and by simulating the importance of each of these strategic responses. Many papers tend to look at a regulatory regime as a whole or focus on a particular regulation and its effects. However, the effect of cultural regulation is not explicitly explained. Since there

are various strategic responses to regulatory quotas, I have an opportunity to comment on the potential effects of each individual response.

I focus on whether regulating cultural content in the radio industry is necessary. Chapter 1 is an attempt to provide the first empirical evidence on the strategic responses of radio stations constrained by cultural quotas. In particular, I analyze whether they select relatively shorter Francophone songs and how French stations adjust content in response to the size of their audience. This topic is important because regulators face a challenge when imposing cultural quotas that do not conform to audience tastes. Strategic responses partly offset the intended effects of these quotas, and stations showing greater compliance with the spirit of the law may lose audience, further reducing the exposure of content the quota is meant to protect.

In **chapter 2** of this thesis, I will try to address to the second issue. This chapter is composed by the following article:

- Music consumption in France: A database linking streaming services and radio stations

In chapter 2, I build a novel dataset to provide some descriptive evidence on radio and streaming services. In order to compare the size of the audience number for a particular song title on radio stations with the number of streams on streaming services, I develop a methodology to combine music consumption data between radio stations and streaming services in France in 2016 and complement the dataset with detailed information on music characteristics. This methodology is important because radio stations and streaming services are entirely different economic models and are not comparable without adjusting the dataset to reflect the differences. Streaming and radio could be effectively compared where I can track the consumers' listening behavior through number of plays. Chapter 2 is an attempt to provide a novel dataset for the statistical studies in Chapter 3.

In **chapter 3** of this thesis, I will try to address the third issue. This chapter is composed of the following article:

- Music Streaming: Effects on Variety and Types of Music Consumption.

In chapter 3, I provide a descriptive analysis on measuring the music diversity between streaming services and radio in France and analyze how the main two platforms play music content in the early transition of digital music during 2016. Chapter 3 also provides empirical

evidence on the consumption externalities of both markets. I find that contrary to the stations' argument that the Francophone quota leads to a low audience numbers, streaming services play more Francophone music than radio stations. These patterns necessitate the exploration of how regulatory quotas can increase music diversity as this is the ultimate goal for regulators. This subject is of interest because understanding the music diversity and music consumption pattern between streaming and sales will be crucial to participants of the music industry, as well as to the policy makers.



---

## Strategic responses to cultural quotas: evidence from French radio

---

### Résumé

La réglementation des médias dans de nombreux pays inclut des quotas culturels. Bien que destinés à protéger les artistes locaux, ils sont également critiqués comme une forme de protectionnisme. Cet article examine empiriquement les réponses stratégiques des stations de radio françaises aux quotas pour la musique francophone. En utilisant des données détaillées sur les playlists des principales stations de radio en France entre 2013 et 2016, nous montrons que les stations ont une certaine latitude pour ajuster leurs playlists soumises à des contraintes de quotas. Plus précisément, ils peuvent choisir le moment et la durée des chansons pertinentes pour le quota. Pour de nombreuses stations, le public réalisé pour la musique francophone est inférieur à ce qu'il serait en l'absence de ces ajustements. Nous estimons ensuite un modèle de régression pour montrer comment les stations françaises ajustent le contenu en fonction de la taille de leur public, en utilisant des variables instrumentales pour répondre à l'endogénéité de la demande. Les résultats montrent que les quotas augmentent la diffusion de la musique francophone, les stations réduisent le jeu francophone durant les périodes de pointe, ce qui a un effet compensateur sur l'exposition de la musique française. Nous montrons en outre que ces réponses stratégiques sont plus prononcées pour les stations qui ont gagné de l'audience au

cours de notre période d'échantillonnage que pour celles qui ont perdu de l'audience. Nos résultats suggèrent que les réponses stratégiques aux quotas culturels ont un effet statistiquement et économiquement significatif sur l'exposition de la musique francophone.

## **Abstract**

Media regulation in many countries includes “cultural quotas.” While intended to protect local artists, they are also criticized as a form of protectionism. This paper empirically examines the strategic responses of French radio stations to quotas for Francophone music. Using detailed data on playlists of major radio stations in France from 2013-2016, we show that stations have some scope for adjusting their playlists subject to quota constraints. Specifically, they can choose the timing and the duration of quota-relevant songs. For many stations, the realized audience for Francophone music is lower than would be the case in the absence of these adjustments. We then estimate a regression model to show how French stations adjust content in response to the size of their audience, using instrumental variables to address the endogeneity of demand. The results show that although quotas increase the diffusion of Francophone music, stations reduce Francophone play during times of peak demand, which has a countervailing effect on the exposure of French music. We further show that these strategic responses are more pronounced for stations that gained audience during our sample period than for stations that lost audience. Our results suggest that strategic responses to cultural quotas have a statistically and economically significant effect on the exposure of Francophone music.



## 1.1 Introduction

Many countries regulate the media, particularly television and radio. For example, the United States restricts foreign ownership of broadcast media,<sup>1</sup> and in China, most media outlets are state-run. A specific form of media regulation observed in some countries concerns cultural quotas. That is, broadcast media may be required to include a minimum of nationally-produced content (e.g., Australia) or a minimum of content in the local language (e.g., Quebec). Governments justify this intervention in markets as necessary to support local culture or protect it from an international cultural hegemon. As media markets have evolved, however, the effect of these regulations may also be changing. International trading partners sometimes push for the removal of quotas, arguing that they constitute non-tariff barriers to trade.<sup>2</sup> Traditional media now face greater competition from online content providers that are not always subject to the same regulations. The strategic responses of regulated media to this increased competition may result in market outcomes unanticipated by lawmakers.

This paper focuses on the impact of cultural quotas in the French radio industry. Regulations require that French radio stations devote a minimum percentage of airplay to Francophone artists, as well as to new talent and new productions.<sup>3</sup> If binding, these quotas change the composition of radio programming and the diversity of music to which French consumers are exposed. Since radio play is historically a driver of music sales, these quotas are meant to support Francophone and new talent. However, by restricting how radio stations can respond to consumer demand, quotas may also affect the ability of radio stations to adapt to competition from streaming services or other means of accessing content. If quotas lower demand for radio and therefore their advertising revenues, they may threaten the sustainability of the radio industry. In addition, there are implications for the owners of intellectual property rights tied to music. A shift of the audience from radio to other media, with different terms for compensating artists, may affect other parts of the music ecosystem.

---

<sup>1</sup>Section 310(b)(4) of the Communications Act of 1934.

<sup>2</sup>For example, in 2006 South Korea halved the number of days per year that cinemas were required to show locally-produced films under pressure from the United States, with which it was negotiating a free trade agreement.

<sup>3</sup>The law defines Francophone as a work that is recited mostly in French or in a regional French language; new talent as an artist with fewer than two gold albums<sup>4</sup>; and new production as a title released during the previous one year. See <http://www.csa.fr/Radio/Le-suivi-des-programmes/La-diffusion-de-chansons-d-expression-francaise/Les-criteres-pris-en-compte-pour-mesurer-les-quotas> for details.

Using a novel dataset of radio programming from 34 radio stations in France from January 2013-April 2016, we show that radio stations respond strategically to cultural quotas in three ways. First, we show that stations vary in their compliance with the law, which we describe in more detail in the following section. Second, since quotas specify the fraction of songs played rather than the minutes played, stations choose short Francophone songs relative to Anglophone content, which reduces the time devoted to Francophone airplay. Third, using instrumental variables to address the endogeneity of demand, we show that radio stations shift *when* they play Francophone music from hours of peak demand to those with smaller audience. In contrast, the quota for new music does not appear to induce strategic responses. The audience lost due to noncompliance of the regulatory quota is the most significant factor, followed by strategic shifting. These strategic choices made by the radio stations highlight the difficulties in using regulations to protect cultural content.

This study contributes to the growing debate on regulatory quotas. The results have relevance outside France. As the European Commission develops a plan for the “digital single market,” one contentious issue is the requirement that streaming services such as Netflix and iTunes offer at least 30% European-produced content, while France (along with Germany, Spain, and Italy) continue to argue for the right to establish national content quotas. Disagreement between Europe and the US on this issue led to the exclusion of audiovisual content from negotiations over the Transatlantic Trade and Investment Partnership (TTIP) trade agreement.

The paper is structured as follows. After a review of the literature in section 1.2, we describe the institutional environment of quota regulations in section 1.3. In section 1.4, we describe our data sources and the construction of our dataset. We explain our identification strategy and provide empirical results in section 1.5. Section 1.6 presents our simulation results. Finally, we conclude in section 1.7.

## 1.2 Literature review

While much literature exists on strategic responses to regulation, here we specifically focus our attention on cultural quotas. This type of regulation has received a lot of attention in trade models that provide a rationale for the protection of cultural goods based on the existence of

consumption externalities. [Bala and Van Long \(2005\)](#) provide a dynamic analysis of trade on culture diversity and show that a large country's preferences can dominate those of its smaller trading partner. Nonetheless, [Francois and Van Ypersele \(2002\)](#) demonstrate that trade restrictions of cultural goods (through tariffs or quotas) can improve welfare. [Rauch and Trindade \(2009\)](#) argue that cultural policy with the purpose of protecting cultural goods production can generate welfare gains in the short run, but reduce quality and welfare in the long run.

Theoretical models that examine the behavior of content providers and broadcasters highlight several subtle effects of quotas. [Richardson and Wilkie \(2015\)](#) suggests a mild quota will increase the diversity of local content by inducing domestic record companies to sign up more new bands and will improve the welfare of consumers who value diversity. However, quotas can also have adverse effects on diversity. When a quota requires that a certain percentage of new content be aired, the introduction of local content may be altered. A greater share of local content will be produced by bands in genres where international music is most prevalent. [Perona \(2015\)](#) suggests that broadcasters facing a quota will compensate for the reduction of foreign programming by increasing the number of diffusions of substitutable domestic programs. Because total broadcasting time is limited, the broadcaster will be forced to abandon less popular types of programming, thus reducing overall program diversity. In [Richardson \(2006\)](#), quotas can increase *diffusion* of local content, but the number of *audience* overall increase by less. [Crampes and Hollander \(2008\)](#) also looks at the impact of quotas in the bundle composition of television broadcasting, and finds that a quota may increase the number of channels but reduce the audience of these programs.

Most empirical work on cultural trade focuses on motion pictures. [Lee and Bae \(2004\)](#) find that quotas do not limit the number of foreign film screenings in domestic theaters, while in a study of the cinema sector in Brazil, [Masood \(2015\)](#) concludes that quotas reduce the diversity of foreign imports. [Disdier et al. \(2010\)](#) find that quotas have a positive effect on the trade of domestic products by promoting cultural links to other countries. [Ren \(2011\)](#) presents evidence that both quotas and investment restrictions increase the diversity of local content, and concludes that quotas are an effective way to counter the domination of foreign cultural content. [Ferreira et al. \(2012\)](#) studies the counterfactual impact on consumers and producers of the elimination of subsidies in Europe, concluding that the benefits accrue mainly to producers.

In a study covering an extensive panel of 22 countries, [Ferreira and Waldfogel \(2013\)](#) find that broadcasters provide predominantly local content rather than imported music. [Messerlin and Parc \(2014\)](#) find cultural regulation has not improved interest in of French movies in France. [Parc \(2017\)](#) suggests quota regulations have not been effective for increasing the number of domestic Korean movies and does not ensure that the domestic audience will watch these movies.

As far as we can tell, no existing empirical study has investigated cultural regulation with regards to radio stations' strategic reactions to quotas. Other studies have examined the strategic behavior of radio stations, although not with respect to cultural quotas. In his study of the US market, [Sweeting \(2009\)](#) estimates stations' strategic incentives to coordinate the timing of commercial breaks. Our focus here is on the interaction of quotas with playlist choices, which is new to the empirical literature.

### 1.3 Institutional environment of cultural quotas in France

Regulators around the world, particularly in Europe, pay close attention to trade in cultural products. Governments can protect local content through subsidies for the production of content, or impose import quotas or cultural quotas. The latter emerged during the 20th century with the expansion of broadcasting. In addition, in some countries, quota regulations were introduced in response to the increased reach of “Anglo-saxon” content. Their use is widespread: fewer than 30 countries impose no content quotas. The United States and New Zealand are two exceptions that have opted for a *laissez-faire* approach to content ([Puppis, 2008](#)).

#### 1.3.1 Quota regulation in France

For decades, France has imposed quotas for Francophone music, as well as new “production” and new “talent.”<sup>5</sup> A similar regulation exists in Canada, where the Francophone minority is always keen to preserve its cultural identity [Machill \(1996\)](#). Since 1996, radio stations have been required to have a minimum percentage of total song plays be French-language songs, and have a separate minimum for new talent or new productions; a summary of the current

---

<sup>5</sup>France also regulates the quantity of advertising for both public stations and those that are privately owned. For public stations, advertising is limited to an average of 30 minutes per day over the year. From 7:00 to 9:00 in the morning, a maximum of 3 minutes of advertising is permitted. For private stations, advertising can be no more than 12 to 14 minutes per hour. The total ad time is about 25% programming per day.

quotas is provided in Table 1.1.<sup>6</sup> Songs mostly in French are considered Francophone, while songs performed by a French artist in another language are not. “New” music is that which has premiered within the previous year. “Recurrent” music is defined as having premiered 1-2 years ago, and “gold” is older than 3 years. The stated goal of this regulation is to protect French culture and increase the diversity of music offered. Quotas vary by station format: stations with younger audiences generally have lower Francophone quotas than “heritage” stations, and public stations face different quotas than privately-held stations. Public stations and national stations have higher quotas in general (as well as higher audiences). The public stations need to play 50% or more French music. In response to complaints from some private radio stations about the difficulty in meeting the 40% quota (as well as concerns that to do so, they played a small number of French songs many times), the quota for some stations was lowered to 35% in March 2016.<sup>7</sup>

Quotas apply from 6:30-22:30 on weekdays and 8:00-22:30 on weekends (i.e., hours when audience numbers are likely to be high). Advertising revenues are the main financial income for French radio stations, and they pay licensing fees as a share of their advertising revenues (between 3% and 4%) regardless of the titles they broadcast. The producers and SACEM (the Society of Authors, Composers and Publishers of Music) then distribute these fees to the artists in proportion to the rotations of each song. The Conseil supérieur de l’audiovisuel (CSA)<sup>8</sup> monitors compliance with these quotas on a monthly basis.<sup>9</sup> We describe enforcement of these regulations in more detail below.

### 1.3.2 Quotas and competition between broadcasters

Traditional radio stations compete in a two-sided market using an advertising-based business model. Listeners do not pay directly for content, but they must tolerate advertising. Standard models of competition, in which price is the tactical variable and product characteristics are often considered as exogenous, do not apply in this context. Rather, radio stations compete for audience by choosing differentiated playlists.

---

<sup>6</sup>See la loi du 1 février 1994, which replaced an earlier statute on quotas, for details.

<sup>7</sup>See Les quotas francophones à la radio ont été assouplis...mais la bataille continue.

<sup>8</sup>The CSA was created on 17 January 1989 to monitor broadcasting in France.

<sup>9</sup>The data is provided to the CSA by Yacast, a company specializing in monitoring media.

Listeners choose radio stations based on their expectation that the content will match their tastes for variety and musical genre. Likewise, each radio station’s choice of playlist characteristics is based on its expectations of audience preferences and the playlists of its competitors, subject to regulatory quotas and the attractiveness of the outside option. Regulatory quotas constrain playlist choice, which affects competition, the size of the audience attracted, and advertising revenues.

The effect of cultural quotas depends on the preferences of listeners for local<sup>10</sup> content. If demand for local content is high, quotas are unlikely to be binding. Alternately, if listeners have a strong taste for non-local content, quotas affect the revenue of both radio stations and local artists or producers. In the absence of quotas, local content receives less exposure, which has two effects on the revenues of local artists and producers. First, it reduces their share of royalties paid by stations from advertising revenues. Second, because they benefit less from the publicity provided by radio play, their sales of physical or digital content are likely to be lower.

From the perspective of radio stations, quotas restrict their ability to meet the demands of listeners. If this reduces demand for radio, advertising revenues fall; this could be particularly salient in the presence of competition from streaming platforms or other options for listeners. Stations may therefore have incentive to strategically shift quota-required content, for which there is low demand, to times when their audience is low. Put another way, the opportunity cost of playing an additional minute of local content is higher when the audience is large, because the foregone advertising revenue is higher at these times. In addition, listeners may switch stations if their taste for local content is low.

## 1.4 Data and summary statistics

We use data on the minute-by-minute programming of major French radio stations that have national coverage from Yacast. This dataset, used by the CSA to monitor quotas, covers January 2013 to April 2016. In total, this yields 11,534,843 songs played by 34 major French radio stations<sup>11</sup>, which have more than 90% of the total market. Thus, we have fairly complete

---

<sup>10</sup>We refer to Francophone music as “local,” although regulations do not require that it be locally produced.

<sup>11</sup>About 1200 private operators are authorized in France. For reasons both technical and economic, it is impossible to observe all of them.

information on the supply side of the French radio market. We exclude talk stations from our analysis, as music quotas are less relevant for them. The Yacast dataset includes details of the broadcast content, such as the language, genre, and release date of each song. Table 2.1 shows an extract from the play log of Skyrock, a station dedicated to rap and R&B.

On the demand side, we have data on the average audience during 15-minute intervals for weekdays and weekends for each week and each station, based on measurements made by Médiamétrie, a private company measuring the audience of radio and television. Its shareholders are both major television channels (France Télévision, TF1) as well as radio stations (Radio France, Europe 1) and advertisers. The database compiles data on programming and corresponding audiences on major radio stations in France. This aggregate measure is based on a representative panel of listeners from the French population aged 13 and over who listen to radio at least once per day.

We convert play logs into observations of 15-minute intervals (for a total of 96 observations per day) for each station and calculate the total number of minutes of music played. We then break down the total minutes into minutes by language and status as “new.” Table 2.4 presents the descriptive statistics. About one-third of each 15-minute interval is devoted to non-music minutes, i.e. advertising or talk (we cannot distinguish between the two). An average quarter hour has about a mean of 3.1 minutes of French music, and more than double that of Anglophone music. “New” music accounts for an average of 5.31 minutes, while “gold” (music more than 3 years old) has 3.53. Note that new music here refers to new music production.

#### 1.4.1 Compliance with quotas

Figures 1.1 to 1.4 show the average compliance of radio stations during our sample period. We calculate the fraction of Francophone plays to total music played during the hours for which the quota applies and compare this to the minimum percentage specified by the regulations. Note that we exclude Francophone plays which are longer than 1 hour and shorter than 2 minutes. We also exclude instrumental songs. It is clear that most stations fall short of perfect compliance with their Francophone quotas. In contrast, the quota for new music does not appear to be followed (see Figures 1.5-1.6).

These patterns beg the question of how strictly quotas are enforced. In the appendix,

we include a table of all CSA actions from 1991-2016. From table 1.15 and table 1.16, we compile a list of all CSA actions in the appendix and show which stations (and at what level of noncompliance) are affected. Over time, either the CSA increased its enforcement or stations were more flagrant in their violations, as we see an increase in the number of warnings, demands, and penalties. Stations which do not fully comply with the quotas face the risk of fines or sanctions. During the years for which we can directly observe compliance, the stations that were well below their quotas (meeting less than 50% or less of the required Francophone play, such as Radio Nova and OUI) were more likely to be cited. Stations that are below the quota, but not “too” far are betting that the regulator won’t enforce too rigorously.

In response to complaints from broadcasters, the CSA has adopted some modifications to the quotas. Recall that the baseline regulations stipulate that Francophone songs should comprise at least 40% of total plays, and that at least half of the Francophone play should be new talent or production.<sup>12</sup> However, the CSA now allows stations to choose between three implementations of quotas. Option A is the default, i.e. 40% French songs, half of which (20% of all music programming) comes from new talent or new production. Option B specifies 50% French-language songs and 15% new talent or new production, while Option C decreases the Francophone quota to 30% but increases that for new talent or production to 25%.

Despite imperfect compliance, stations do not ignore Francophone quotas completely. For example, in Figure 1.32 from appendix A, we show the average percentage of Francophone plays by hour of day for Fun Radio. During non-quota hours, the percentage of Francophone play is very small. In other words, when stations are constrained by the Francophone quota, we see a persistently higher percentage of French music play. Figure 1.33 from appendix A shows a similar breakdown for new music, where quota-relevant hours appear very similar to those that are unconstrained. The Francophone quota is associated with more strategic shifting than the new music quota.

---

<sup>12</sup>The only change during our dataset period is Cherie FM; its Francophone quota changed from 50% to 40% in June 2014. See this <http://www.csa.fr/Espace-juridique/Decisions-du-CSA/Cherie-FM-nouveaux-quotas-de-chansons-d-expression-francaise> for more details.

## 1.5 Estimation and results

One of the primary objectives of the Francophone quota is to defend French language and culture by ensuring significant exposure of French-language song on radio stations. French regulations specify Francophone (or new) play as a percentage of songs played, although the actual audience reached is arguably more relevant for goals of the regulations. In practice, 40% of songs played does not necessarily imply exposure to 40% of the total audience. [Richardson \(2006\)](#)'s theoretical model predicts that stringent quotas can increase diffusion (in time played) of local content, but the audience reached will be less of an increase.

To explore this, we calculate a “counterfactual” weekly audience exposed to Francophone music that assumes the Francophone quota is strictly applied in each 15-minute interval, or equivalently, that stations are not strategic in their Francophone play. That is, in each quarter hour, we assume that the fraction of Francophone minutes should be equal to the quota level. We compare this to the actual weekly audience reached. In both cases, we focus only on the hours to which the quota applies, and compare weekends to weekdays. We do similar calculations for new music.

We explore differences between the commercial (profit-maximizing) stations and the public stations. As [Figure 1.7](#) shows, the weekly reach of Francophone music is well below the counterfactual for privately owned stations. The opposite is true for public stations ([Figure 1.8](#)). In contrast, [figures 1.9 and 1.10](#) show that new music has a greater reach than that suggested by the counterfactual for both public and private stations.

The realized audience may be less than the counterfactual for three reasons. First, consumers can switch to a different station to avoid listening to Francophone music. Our data do not allow us to test this directly, because we only have average audience for a 15-minute block across all weekdays or the weekend. Second, stations can shift Francophone play to periods when the audience is lower. And third, stations could select relatively short Francophone songs, so that the total time devoted to Francophone music (and the realized audience) is smaller. The patterns described above are consistent with profit-oriented stations (i.e., private stations that are more dependent on advertising revenues than public ones) engaging in either of the second two responses, which we explore in greater detail next.

### 1.5.1 Do stations select shorter Francophone songs?

The quotas specify the fraction of Francophone songs that stations are required to play. In theory, stations might comply with the quota by playing the regulated number of songs but choosing shorter Francophone songs. We begin by examining whether stations reduce the minutes of Francophone play, conditional on the number of diffusions, by selecting shorter songs.

Figure 1.11 shows the different song length between Anglophone and Francophone songs by year of release using one observation per song. We find that the song length changes over time. The Francophone song is shorter than the Anglophone since 2000.

Figure 1.12 and figure 1.13 show the distribution of song length for Francophone and Anglophone songs. Figure 1.12 includes one observation per song, based on all songs played during our sample period. Figure 1.13 includes one observation per diffusion, so that songs that receive more frequent play have greater weight. In both cases, it appears that Francophone songs that receive airtime are shorter than Anglophone songs.

We further explore the strategic selection of songs using the following regression model:

$$\begin{aligned} Diffusion_{ijw} = & \beta_0 + \beta_1 song\_length_{ijw} + \beta_2 language_j + \beta_3 song\_length_{ijw} * language_j \\ & + \beta_4 music\_genre_j + \beta_5 music\_age_j + \gamma_i + \epsilon_{ijw} \end{aligned}$$

Here  $i$  indexes stations,  $w$  corresponds to calendar week, and  $j$  corresponds to the category of music content. The dependant variable  $Diffusion_{ijw}$  is the number of diffusions of music content  $j$  of station  $i$  per week. We restrict the dataset to Francophone and Anglophone songs (the remainder is very small). We are interested in whether Francophone songs that are shorter receive more plays, relative to Anglophone songs that are shorter. We also control for the music genre, taking into account that certain music genres like rap might have shorter song lengths than pop, on average. The “other” music genre is relatively small, for example, instrumental music without any lyrics, such as jazz or classical music. We keep the 3 music genres dance, groove, pop/rock in our regression. Station fixed effects are included as the  $\gamma_i$ . We exclude public and talk radio from our analysis.

The dependent variable  $Diffusion_{ijw}$  is highly over dispersed. The variance(55.86) of the number of diffusion per week exceeds the mean(3.99) by a great deal. Therefore, a negative

binomial model is more appropriate than a Poisson model.

Results for the first definition are presented in Table 1.5. Table 1.6 adds the results for quota levels of 35%, 40% and 50% plus separately. This allowed us to test whether stations from different quota levels are more likely to choose shorter Francophone songs, and the omitted category is Anglophone songs, the omitted music genre is pop international. The omitted music age is gold music. We find that those stations affected by the 35% quota level play more Francophone music, but that radio stations from this level choose to play shorter Francophone songs when compared to stations that adhere to other quota levels.

$$Diffusion_{ijw} = \beta_0 + \beta_1 song\_length_{ijw} + \beta_2 music\_genre_j + \beta_3 music\_age_j + \gamma_i + \epsilon_{ijw}$$

Moreover, we want to see whether this differs for Francophone and Anglophone. Table 1.7 provides regressions from the same exercise, but we do separate regressions for Francophone and for Anglophone. There is no much difference in how often stations play shorter Francophone and Anglophone songs.

Finally, we consider whether this differs for stations that target at different audience groups. Are the strategic selection of songs related to audience demographics? We divide stations into two categories based on their audience demographics from the Yacast Report. Audience “young” denotes stations with a majority of their audience from the 13-19, 20-24, and 25-34 year old age brackets. while Audience “old” denotes stations with a majority of their audience from the 35-49 and 50-59 year old age brackets. We estimate the model separately for those with young audience and those with old audience. The omitted categories are Anglophone, Pop/Rock, and Gold. These results are presented in Table 1.8. Relatively young stations play more Francophone during quota-relevant hours, but they choose to play shorter Francophone songs when compared to stations target at old audience. This may suggest that selection of songs are associated with younger audience (assuming that young audiences are more active and may generate increases in advertising revenues).

### 1.5.2 Do stations shift Francophone play?

Here, we test whether the patterns of strategic shifting described in the previous section hold in a regression model. Specifically, we examine how stations choose Francophone play as a function of the audience using the following regression model:

$$Minutes_{ijt} = \beta_0 + \beta_1 \ln(audience_{it}) + \beta_2 quota\_applies_{ijt} + \gamma_i + \epsilon_{it}$$

where  $i$  indexes stations,  $t$  corresponds to a 15-minute interval, and the dependent variable  $j$  is the number of minutes devoted to Francophone, Anglophone, or non-music content during that interval. Station fixed effects are included as the  $\gamma$ s. Here, audience is the aggregated measure based on a representative panel of listeners over our sample period, as described previously. The variable *quota\_applies* is a dummy variable corresponding to periods covered by the quota, 6:30-22:30 on weekdays and 8:00-22:30 on weekends.  $\beta_1$  captures the marginal impact of a change in audience on the minutes of the various types of content.  $\beta_2$  controls for whether the interval falls within the hours to which the quota applies.

A key challenge for identification is the endogeneity of the audience, which is a response to a DJ's music selection. If we observe lower audiences when Francophone music is played, we don't know whether this reflects audience shifting to other stations (because listeners don't like Francophone music) or the strategic choice to play Francophone music when the station expects few listeners. Note that our audience measure is an average across weekdays and weekends within a week for a given 15-minute interval, so does not pick up real-time changes in audience behavior; this presents a problem of measurement error. We address the endogeneity problem by using instrumental variables.

We argue that the audience for radio varies over the course of a day for reasons unrelated to content. Figure 1.14 shows the average total audience in each 15-minute interval during our sample period. There are obvious peaks during commuting hours (07:00-09:00 and 17:00-19:00). Assuming that listeners do not change their commuting habits in response to expectations about radio content, the day of week and time of day are exogenous shifters of radio audience that should not affect content except through the change in audience. Similarly, demand for radio varies over the year for exogenous reasons, such as school holidays. We therefore instrument for

audience using month of the year, hour of the day, weekday, and weekend dummies.

We begin by estimating the regression using the minutes of Francophone music as the dependent variable. In Table 1.9, we compare the results using OLS with those obtained from instrumental variables, using the instruments just described. The Wu-Hausman F-stat is 27083.5 ( $p = 0.0000$ ), so we reject the null hypothesis that audience is exogenous. The F-stat for the excluded instruments is 3747.52, suggesting that our instruments are reasonably strong. In both OLS and IV estimations, the dummy variable for when the quota applies has a positive and significant impact on the minutes of Francophone music played. In addition, Francophone music is negatively associated with increases in audience. However, our IV estimates are larger in magnitude than OLS, which suggests that accounting for endogeneity is important. When quotas apply, stations play 1.5 minutes more of Francophone music (almost 50% more than the mean of 3.10 minutes of Francophone music per quarter hour) compared to non-quota hours. Within quota hours, strategic shifting implies about 10% less Francophone play during peak times.

Of course, it is possible that stations reduce minutes of music play in general when audience numbers are high, because advertising is most valuable during these periods. To test whether the shift we observe is more pronounced for Francophone music, we compare the Francophone results to those obtained for Anglophone music and non-music minutes in Table 1.10. Not surprisingly, Francophone quotas crowd out Anglophone play: the coefficient on  $quota_{hour}$  is negative and significant for the Anglophone specification, and roughly the opposite of that for Francophone play. While stations devote more time to non-music minutes when audience is high (the coefficient on  $ln_{audience}$  is 0.617 for non-music), they reduce Francophone play more than Anglophone play. Given a mean of 3.1 minutes of Francophone music and 6.8 minutes of English music, the coefficients imply that stations decrease Francophone play by 10%, but only 3% for Anglophone, when audiences double.

We next focus exclusively on the behavior of stations only during the hours when quotas apply. To do so, we estimate the following pooled model:

$$Minutes_{ijt} = \beta_0 + \beta_1 music\_genre_j + \beta_2 ln(audience_{it}) + \beta_3 ln(audience_{it}) * Category_j + \gamma_i + \epsilon_{ijt}$$

As before,  $i$  indexes station,  $t$  indexes 15-minute intervals.  $j$  corresponds to the category of content, which we define first as Anglophone, Francophone, other language, and non-music. In a subsequent specification, we will break this down further into New Anglophone, New Francophone, New other language, Non-new Anglophone, Non-new Francophone, Non-new other language, and non-music.

Results for the first definition are presented in Table 1.11. Table 1.12 includes interactions with whether the music is new, allowing us to test whether new Francophone music is differentially affected. As before, we instrument for audience using month of the year, hour of the day, weekday, and weekend dummies. The omitted category is non-music minutes.

Results from both models show that Francophone play is more responsive to changes in audience than Anglophone play. The main effects of new Anglophone as well as new Francophone show that older music of both languages receives slightly more play, although this difference is larger for Francophone music. The interaction with audience, however, suggests that stations are more likely to reduce play of older music when audiences increase. Again, Francophone music sees larger reductions than Anglophone, both for new music as well as for older content.

Finally, we consider whether strategic responses differ for stations that gained audience during our sample period versus those that are struggling. In other words, are strategic responses related to market success? To examine this, we divide stations into net gainers and net losers. Figure 1.16 shows the percent change in audience for each station in our sample by comparing the first quarter of 2013 and the first quarter of 2016. We then estimate the model separately for those that increased their audience and those that lost. These results are presented in Table 1.13. Relatively successful stations show a bigger difference in Francophone play during quota-relevant hours, and a bigger reduction in Francophone play in response to increases in audience. Although not necessarily a causal relationship, this suggests that strategic responses are associated with greater profits (assuming that gains in audience generate increases in advertising revenues), but a smaller audience reached by Francophone play.

## 1.6 The importance of each strategic response

In this session, we quantify the importance of each of these strategic responses. We simulate counterfactual audiences as the following four categories.

A. Each hour, a station randomly selects songs with 40% share of Francophone songs; draws a random song from the total distribution of Francophone songs and the total distribution of Anglophone songs (distribution song). That is, the station complies perfectly with the 40% diffusion rule, and does not deliberately select shorter songs, and does not shift to periods with a smaller audience.

B. Each hour, a station randomly selects songs with their actual share of Francophone songs (based on the number of diffusions over the entire sample period). This is the same as (A), except with the observed compliance.

C. Each hour, a station selects songs with their actual share of Francophone songs from their actual distribution of Francophone songs played (distribution play). This is the same as (B), except that now we are allowing for stations that choose shorter Francophone songs.

D. The actual play per hour.

We calculate the empirical distribution of the length of Francophone songs for each station. Here, we take the station Virgin Radio as an example. From table 1.1 in the above section, Virgin Radio had an actual francophone play rate of 33.15% against the regulatory quota of 40%. For each category, we do approximately 50,000 simulations in order to generate a corresponding playlist from Jan 2013 to April 2016. For category A, we first draw from a binomial distribution where  $p=0.4$  (the quota). If the draw is a Francophone song, then we draw from a normal distribution song where the mean is the empirical mean and the empirical variance. That's the length of the random song. If the initial binomial draw is an Anglophone song, then we use the empirical mean and variance for Anglophone songs. For category B, we run a similar process except the binomial distribution is the actual Francophone play rate where  $P=0.3315$ . For category C, we draw from an actual Francophone play rate where  $P=0.3315$ , expect with the actual distribution play. Category D is the actual playlist per hour. We exclude songs longer than 1 hour and shorter than 2 minutes. We then separate the playlist by 15 minutes intervals in order to measure the audience number in that 15 minutes intervals.

We generate the simulated playlist based on the actual ratio of Anglophone and Francophone

music played as the following  $\frac{anglo\_actuel+franco\_actuel}{15mintues} \cdot anglo\_simulation + franco\_simulation$  for each 15-minute interval. One shortcoming from our simulation at this stage is that we do not consider the effect of gap time. For example, the playlist we simulate is a playlist with Anglophone and Francophone songs only. In real broadcasting, radio stations may add gap time in the 15 minutes interval, such as advertising and other music categories.

Table 1.14 presents the descriptive statistics of the simulation for all stations. The ratio between the non-strategic play and the perfect compliance denotes the comparison between categories A and B categories of simulation which shows the audience lost to non-compliance with quotas. The ratio between the selection of shorter song and the perfect compliance denotes the comparison between B and C categories of simulation which shows the audience lost due to selection of shorter songs. We can find there difference if stations choose to select shorter songs is smaller. The ratio between the actual play and the perfect compliance denotes the comparison between C and D categories of simulation which shows the audience lost due to shifting of play. On average, the difference if stations choose to select shorter songs (mean ratio = 0.8410) is smaller compared to stations that choose to not comply with the quotas (mean ratio = 0.8431) and to a station's actual play (mean ratio = 0.8544). We find that the audience lost due to the selection of shorter songs is the most important factor, followed by the effect of noncompliance.

Figures 17 to 29 present some additional comparison of the simulation categories. Stations with the least stringent quotas (35%) show the largest difference of audience lost between the perfect compliance and non-strategic play. For those facing a 40% quota, imperfect non-strategic play leads to a larger drop in audience than the perfect compliance, although the difference is smaller. For the other quota categories, the rate of perfect compliance is larger than the non-strategic shifting, as public stations may play more Francophone music than is required by the quota and may have more audiences accordingly.

## 1.7 Conclusion and future extensions

This paper explores the strategic responses of radio stations constrained by cultural quotas. Our findings suggest, unsurprisingly, that stations play more quota-required music when the quota applies. This is consistent with the goals of media regulators in France. Francophone

quotas increase the quantity of Francophone music aired, even if compliance with the quotas is imperfect.

More interestingly, we also find that strategic responses by radio stations are present and take several forms. First, stations select relatively shorter Francophone songs. While a difference of 10-20 seconds per song may seem insignificant, this corresponds in a meaningful way to the number of minutes of play over the course of a month and a corresponding reduction in the audience exposed to Francophone music. Second, radio stations shift their play of Francophone music to hours when they expect demand to be low, so that Francophone music gets less airtime when the audience is large. As a result, the audience reached by Francophone music increases by less than the change in minutes of Francophone music played. Stations with stronger strategic responses are also those that gained audience during our sample period. Only the language quota appears to be binding; regulatory intervention may not be necessary to ensure play of new talent.

Thus, regulators face a challenge when imposing cultural quotas that do not conform to audience tastes. Strategic responses partly offset the intended effects of these quotas, and stations showing greater compliance with the spirit of the law may lose audience, further reducing the exposure to content the quota is meant to protect. The resistance of radio stations in France to these quotas suggest that they have significant consequences for their profitability, particularly now that they face additional competition from streaming services that, thus far, are not subject to the same quotas.

Many important questions remain. For example, how has the advent of streaming affected the exposure of quota-protected talent? Does this differ for new artists? What are the consequences of these changes for the compensation of rights-holders? Have technological and market changes rendered obsolete the traditional forms of cultural quotas? We leave these topics to future research.

## 1.8 Main part of paper

Table 1.1: Quota category from 2014 to 2016

Francophone	New	Number of stations	Stations
60%	7.5%	1	Nostalgie
50%	20%	2	Cherie FM, MFM Radio
40%	20%	14	Europe 1, Hit West Kiss FM, OUI FM, RFM, RTL, RTL2, Radio 6, Rire & Chansons, Skyrock, Sud Radio, Top Music, Virgin Radio, Wit FM
35%	25%	13	Ado, Alouette, Champagne FM, Contact, Fun Radio, NRJ, Radio Espace, Radio FG, Radio Scoop, Vibration, Radio Star Mediterranee, Radio Nova, Voltage FM

Note: Cherie FM changed its Francophone quota from 50% to 40% from June 2014.

Table 1.2: Skyrock on March 30, 2015 from 10-11 AM (source: Yacast)

<b>Time</b>	<b>Artist</b>	<b>Song</b>	<b>Language</b>	<b>Premiere</b>	<b>Audience</b>
10:01:28	Major Lazer - DJ Snake - MO	Lean on	English	27/02/15	315000
10:04:13	JUL	La fusée	French	08/12/14	315000
10:08:25	Jay Sean - Lil Wayne	Down	English	02/06/09	315000
10:11:52	Kaaris	Le bruit de mon âme	French	26/01/15	315000
10:19:31	Ariana Grande	One last time	English	27/08/14	292000
10:22:40	Soprano feat. Uncle Phil	Fresh Prince	French	15/09/14	292000
10:25:52	Selah Sue	Alone	English	27/10/14	292000
10:29:31	Black M.	On s'fait du mal	French	10/11/14	292000
10:32:39	Destiny's Child	Say my name	English	15/01/99	302000
10:36:37	Natalie La Rose - Jeremih	Somebody	English	03/12/14	302000
10:39:43	Usher - Juicy J	I don't mind	English	27/06/14	302000
10:52:11	Chris Brown - Tyga	Ayo	English	18/12/14	294000
10:55:53	Soprano	Clown	French	07/10/14	294000

Table 1.3: Summary statistics

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>	<b>N</b>
Francophone minutes	2.86	3.13	0	15	3,916,800
Anglophone minutes	6.26	4.18	0	15	3,916,800
New minutes	4.89	3.85	0	15	3,916,800
Gold minutes	3.53	3.66	0	15	3,916,800
Recurrent minutes	1.39	2.10	0	15	3,916,800
New Francophone minutes	1.54	2.06	0	15	3,916,800
New Anglophone minutes	2.96	3.11	0	15	3,916,800
Non music minutes	5.19	4.55	0	15	3,916,800
ln(audience)	8.48	3.84	0	14.50	3,916,800

Data source: Yacast data from January 2013 to April 2016.

Note: the unit of observation is song-station by 15 minutes interval.

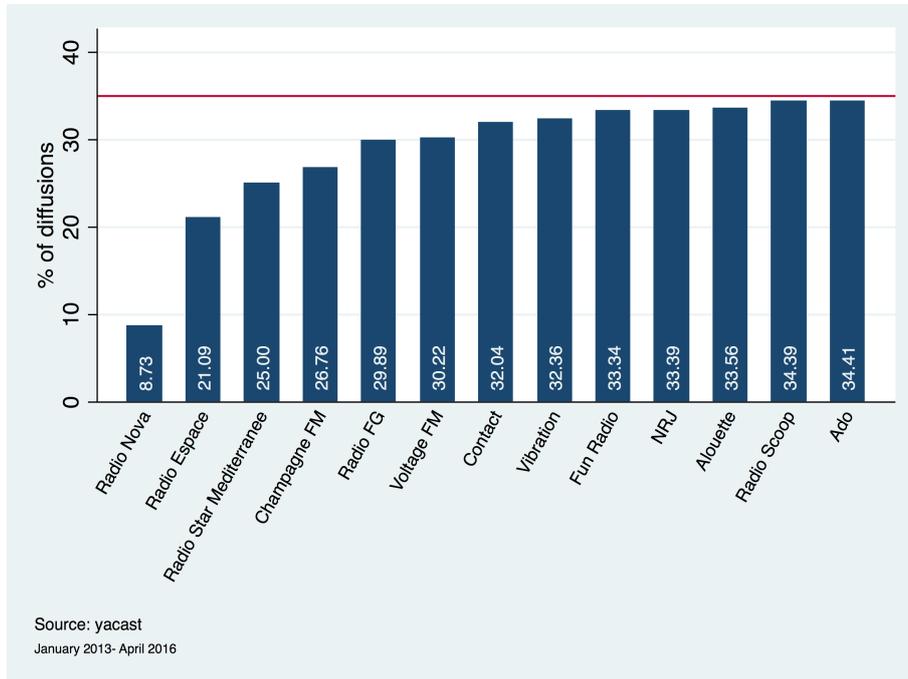


Figure 1.1: Compliance with 35% quota for Francophone music

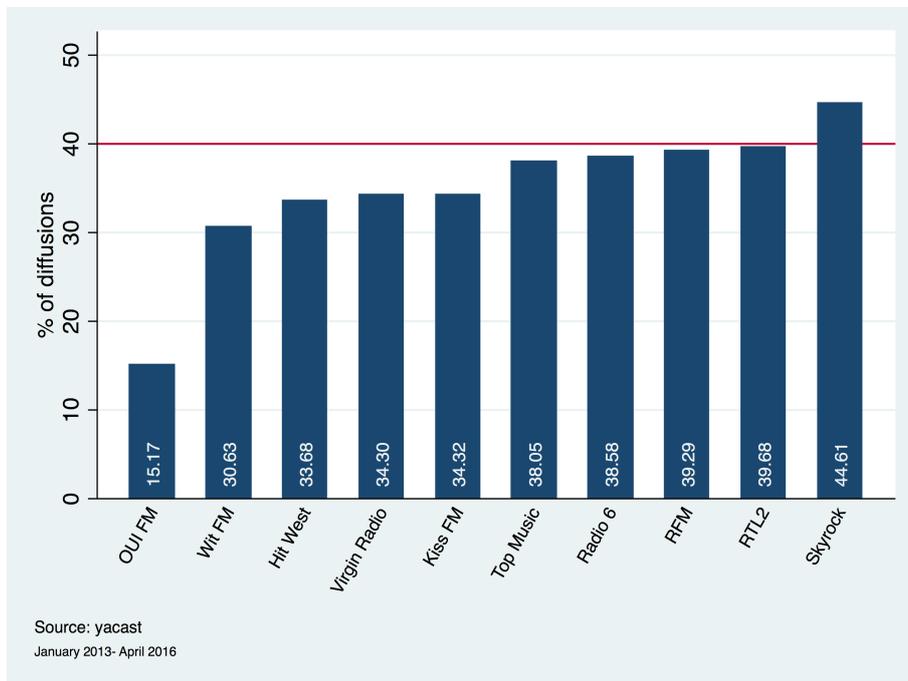


Figure 1.2: Compliance with 40% quota for Francophone music

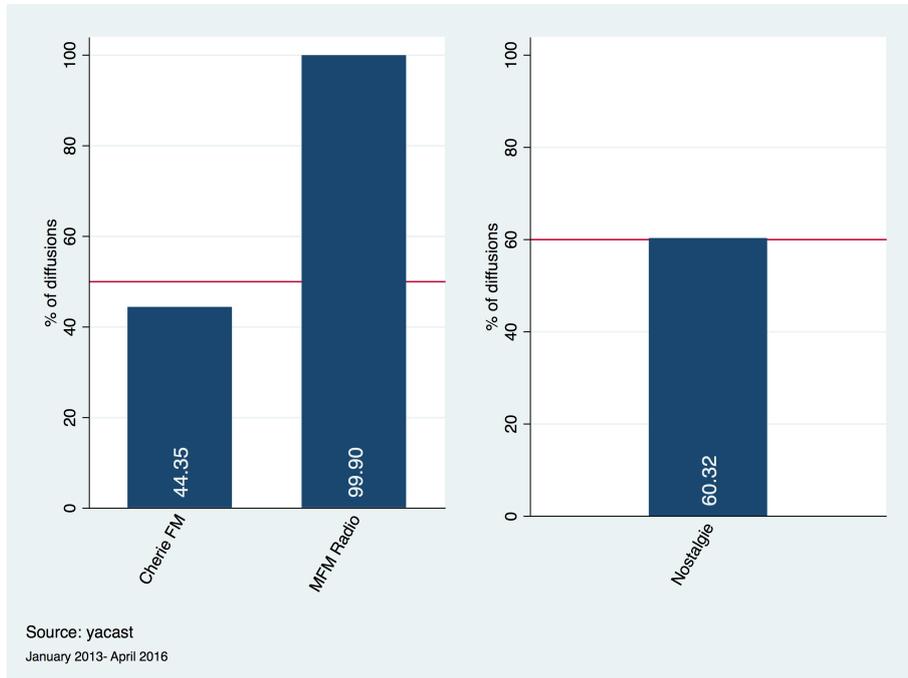


Figure 1.3: Compliance with 50-60% quota for Francophone music

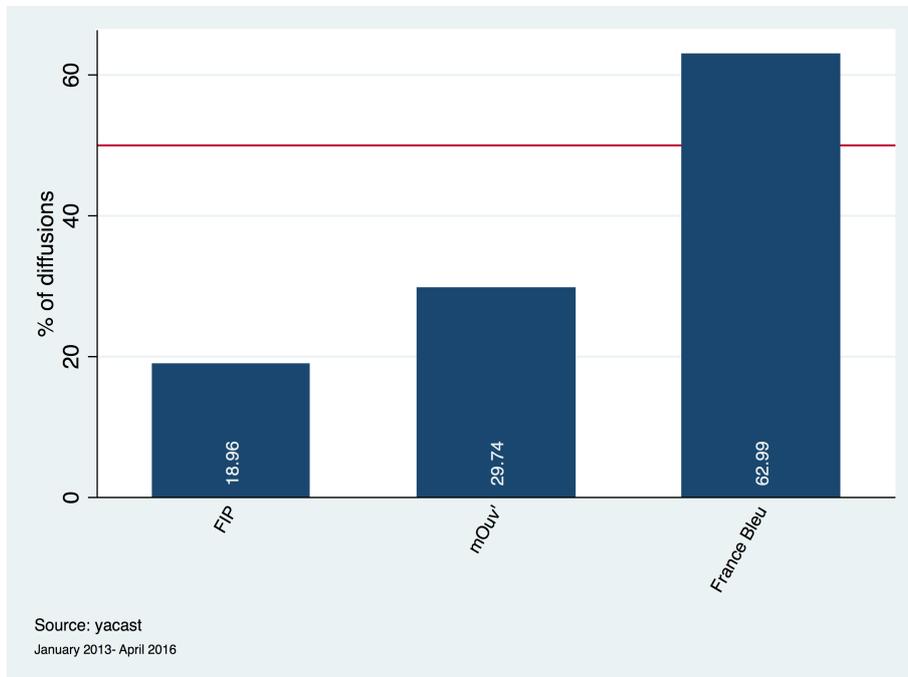


Figure 1.4: Compliance of public stations with 50% quota for Francophone music

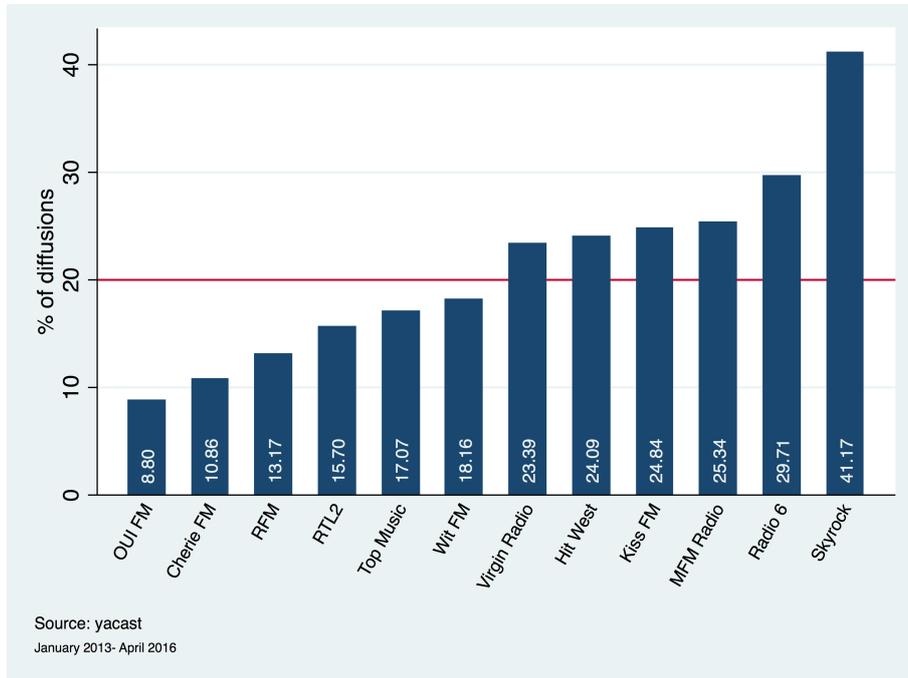


Figure 1.5: Compliance with 20% quota level for new music

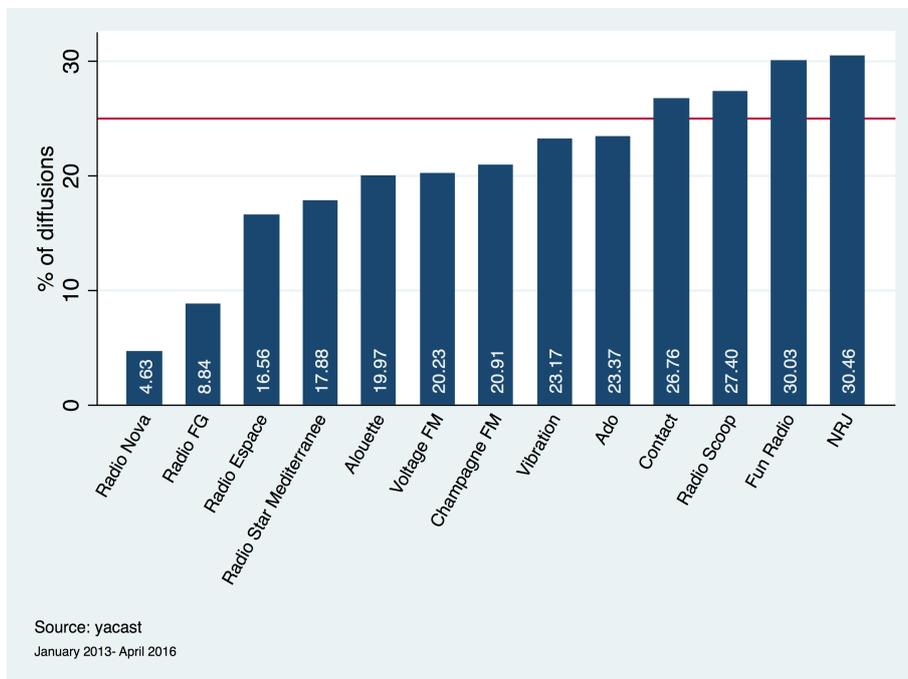


Figure 1.6: Compliance with 25% quota for new music

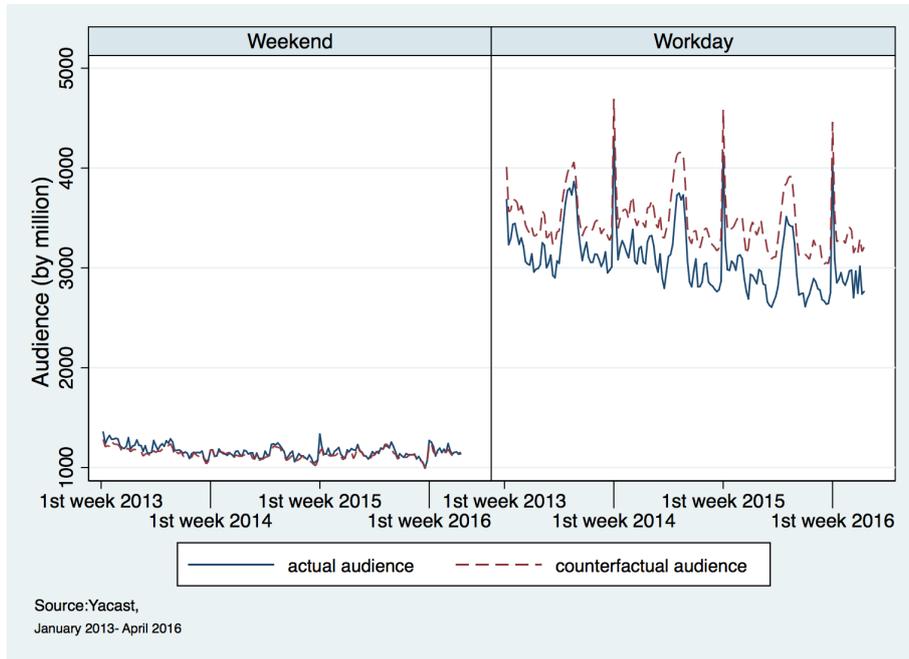


Figure 1.7: Private stations: Exposure of Francophone music

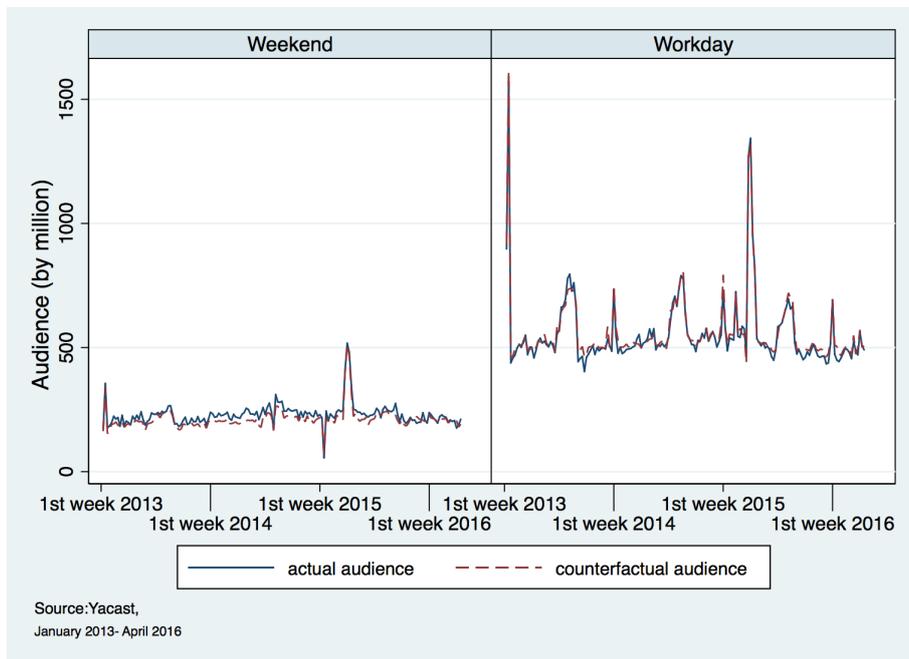


Figure 1.8: Public stations: Exposure of Francophone music

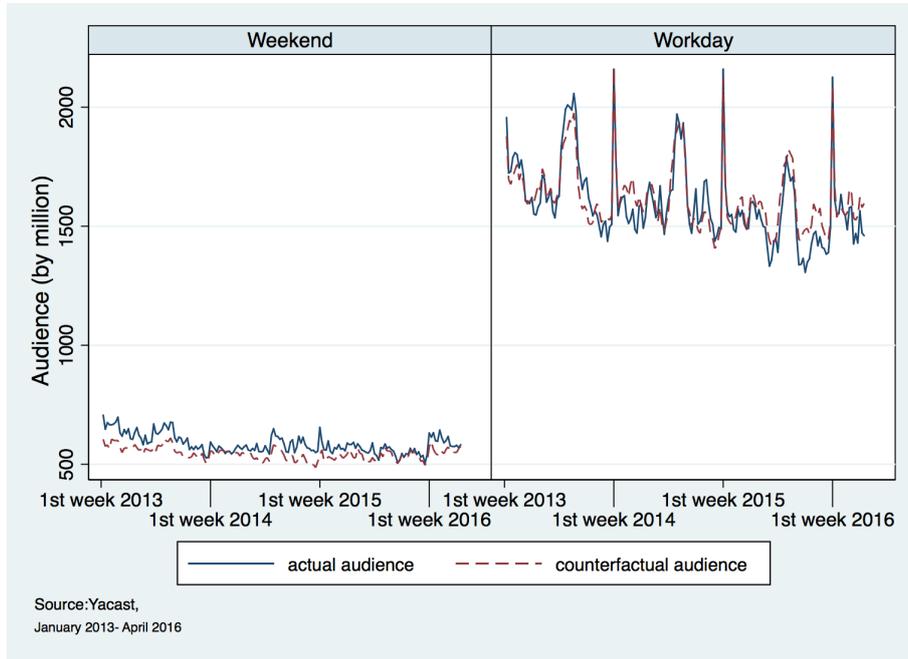


Figure 1.9: Private stations: Exposure of New Francophone music

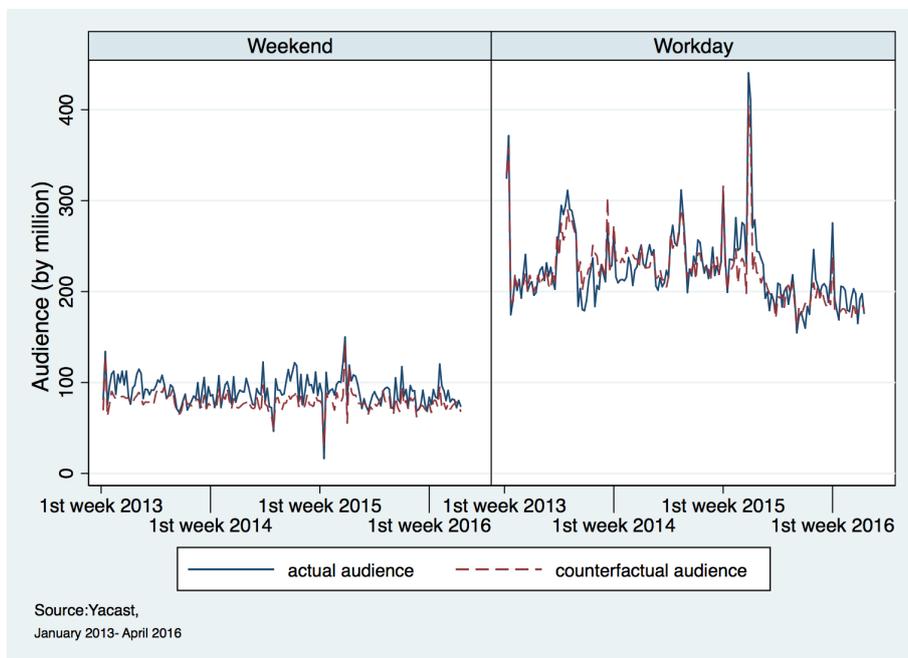


Figure 1.10: Public stations: Exposure of New Francophone music

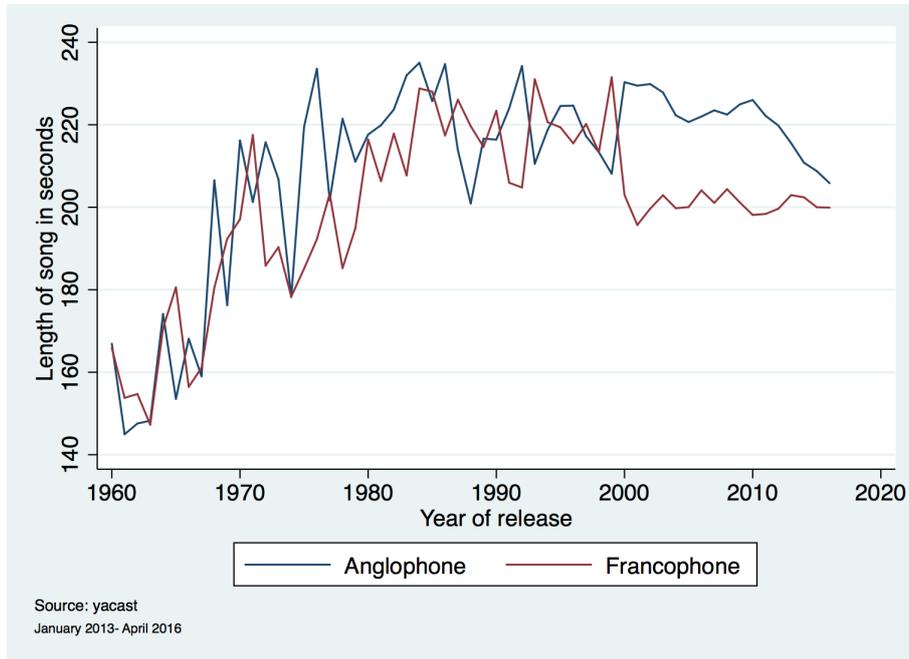


Figure 1.11: Length of song in seconds, by year of release between Anglophone and Francophone songs

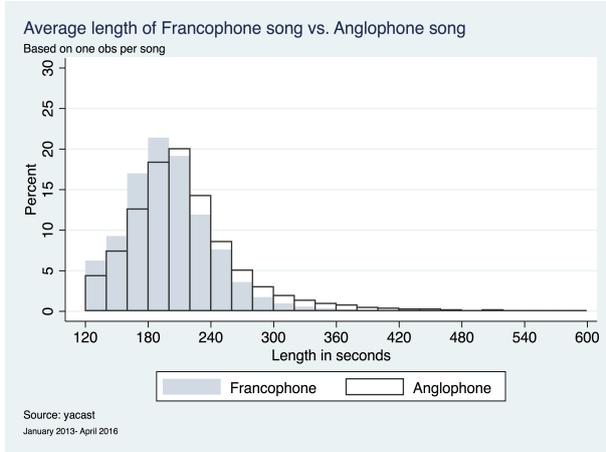


Figure 1.12: Average length of Francophone song and Anglophone song: one observation per song

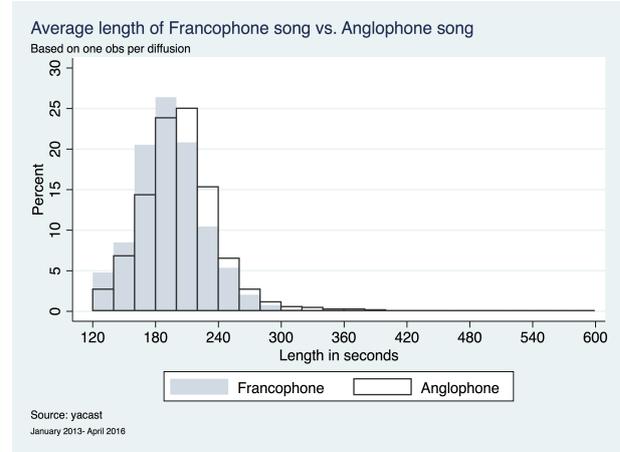


Figure 1.13: Average length of Francophone song and Anglophone song: one observation per diffusion

Table 1.4: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Song length	207.86	47.54	120	1577	2255466
Number of diffusions by week	2.55	3.26	1	78	2255466
Francophone	0.27	0.45	0	1	2255466
Anglophone	0.73	0.45	0	1	2255466
Dance	0.16	0.37	0	1	2255466
Groove	0.14	0.34	0	1	2255466
Pop	0.70	0.46	0	1	2255466
New	0.23	0.42	0	1	2255466
Recurrent	0.14	0.34	0	1	2255466
Gold	0.63	0.48	0	1	2255466

Data source: Yacast data from January 2013 to April 2016.

Note: the unit of observation is the number of diffusions by station by week.

Table 1.5: Negative binomial estimates, full sample

	Number of diffusions b/se
Francophone	-0.107373*** (0.014076)
Song length	0.000448*** (0.000027)
Francophone#Song length	-0.000777*** (0.000064)
Dance	-0.574754*** (0.005721)
Groove	-0.173013*** (0.006546)
New	0.281990*** (0.003396)
Recurrent	-0.393336*** (0.003006)
Constant	2.203185*** (0.007212)
N	2198170

\* p<0.10, \*\* p<0.05, \*\*\* p< .01.

Note: the omitted categories are Anglophone, Pop/Rock, and Gold.

Table 1.6: Negative binomial estimates by quota level

	35%	40%	50+%
	b/se	b/se	b/se
Francophone	-0.227964*** (0.033932)	-0.470972*** (0.032256)	-0.699252*** (0.039700)
Song length	0.000534*** (0.000073)	-0.000280*** (0.000070)	-0.000373*** (0.000068)
Francophone#Song length	-0.001110*** (0.000173)	-0.000372*** (0.000133)	-0.000669*** (0.000119)
Dance	-0.380707*** (0.011104)	-0.283677*** (0.020751)	0.021876 (0.032753)
Groove	-0.024040* (0.013455)	-0.078548*** (0.019566)	0.042244** (0.019947)
New	0.273566*** (0.007488)	0.234629*** (0.009578)	0.428752*** (0.009158)
Recurrent	-0.302036*** (0.005973)	-0.328037*** (0.007720)	-0.019133** (0.008613)
Constant	1.852935*** (0.017542)	2.671077*** (0.019847)	4.078701*** (0.034157)
N	361145	443430	396940

\* p<0.10, \*\* p<0.05, \*\*\* p< .01.

Note: the omitted categories are Anglophone, Pop/Rock, and Gold.

Table 1.7: Negative binomial estimates, by Anglophone and Francophone

	Anglophone b/se	Francophone b/se
Song length	0.000110*** (0.000042)	-0.000147** (0.000072)
Dance	-0.589116*** (0.011371)	-0.803048*** (0.015938)
Groove	-0.099112*** (0.011247)	-0.544053*** (0.022802)
New	0.330955*** (0.006761)	0.089153*** (0.008361)
Recurrent	-0.257996*** (0.005242)	-0.414369*** (0.007335)
Constant	2.469940*** (0.011977)	2.154961*** (0.016272)
N	712928	382035

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < .01$ .

Note: the omitted categories are Pop/Rock, and Gold.

Table 1.8: Negative binomial estimates, by station demographics

	Audience young b/se	Audience old b/se
Francophone	-0.438980*** (0.041702)	-0.738052*** (0.035063)
Song length	0.000626*** (0.000063)	-0.000382*** (0.000061)
Francophone#Song length	-0.002184*** (0.000205)	-0.000592*** (0.000100)
Dance	-0.634830*** (0.012573)	0.140757*** (0.030833)
Groove	-0.096207*** (0.014391)	0.075143*** (0.020304)
New	0.065441*** (0.009008)	0.635551*** (0.008289)
Recurrent	-0.564381*** (0.007871)	0.008215 (0.008050)
Constant	1.959485*** (0.016821)	4.247676*** (0.031761)
N	293516	565500

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < .01$ .

Note: the omitted categories are Anglophone, Pop/Rock, and Gold. We created two categories based on audience demographics from the Yacast Report. Audience “young” denotes stations with a majority of their audience from the 13-19, 20-24, and 25-34 year old age brackets. while Audience “old” denotes stations with a majority of their audience from the 35-49 and 50-59 year old age brackets.

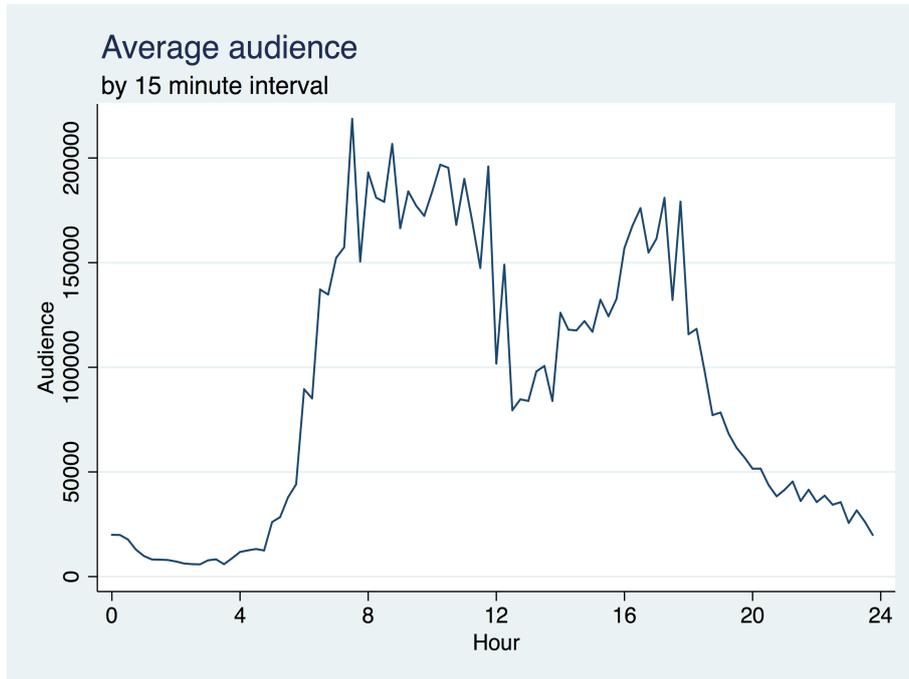


Figure 1.14: Average audience by hour of the day

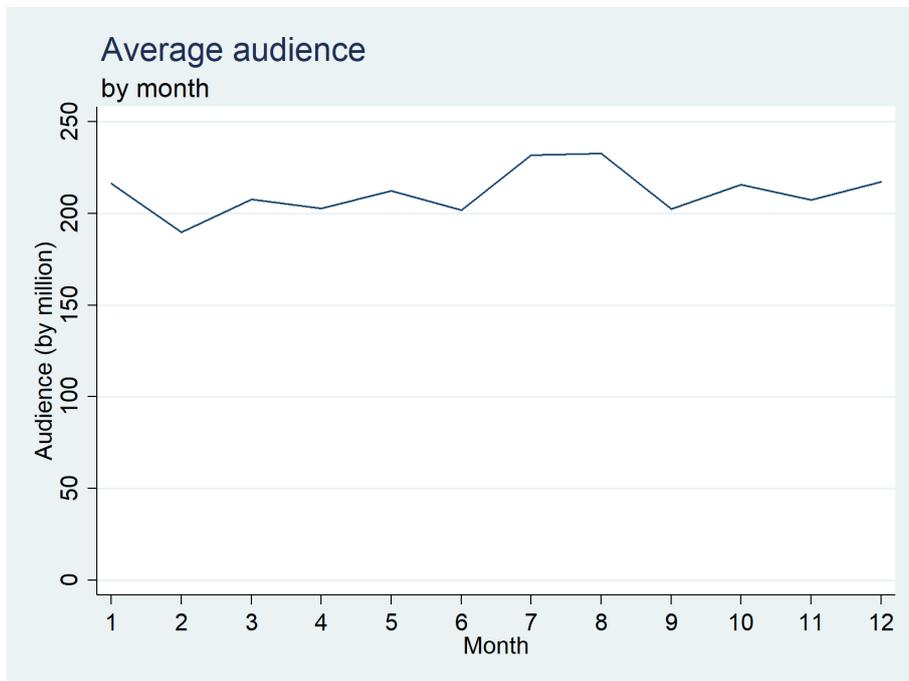


Figure 1.15: Average audience by month of the year

Table 1.9: OLS and IV estimates for Francophone

	OLS b/se	IV b/se
Ln(audience)	-0.0970 * ** (0.000786)	-0.281 * ** (0.00154)
Quota applies	1.042 * ** (0.00386)	1.605 * ** (0.00560)
Constant	3.493 * ** (0.398)	4.855 * ** (0.015)
N	2,939,118	2,939,118

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt; .01.

Table 1.10: IV estimates for Francophone, Anglophone and Non-music minutes

	Anglophone b/se	Francophone b/se	Non_Music b/se
Ln(audience)	-0.203 * ** (0.00192)	-0.281 * ** (0.00154)	0.618 * ** (0.00183)
Quota applies	-1.685 * ** (0.00700)	1.605 * ** (0.00560)	0.147 * ** (0.00668)
N	2,939,118	2,939,118	2,939,118

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt; .01.

Table 1.11: IV estimates with language interactions

	minutes b/se
ln(audience)	0.353 * ** (0.00658)
Anglophone#ln(audience)	-0.335 * ** (0.0114)
Francophone#ln(audience)	-0.601 * ** (0.0101)
Other#ln(audience)	-0.478 * ** (0.00743)
Anglophone	5.513 * ** (0.114)
Francophone	5.255 * ** (0.100)
Other	0.938 * ** (0.0744)
Constant	0.823 * ** (0.0652)
N	7,808,128

\* p<0.10, \*\* p<0.05, \*\*\* p< .01.

Table 1.12: IV estimates with language and age interactions

	minutes b/se
ln(audience)	0.353 * ** (0.00658)
Anglo New#ln(audience)	-0.306 * ** (0.00918)
Anglo Non-new#ln(audience)	-0.382 * ** (0.00918)
French New#ln(audience)	-0.386 * ** (0.00824)
French Non-new#ln(audience)	-0.569 * ** (0.00823)
Other New#ln(audience)	-0.452 * ** (0.00717)
Other Non-new#ln(audience)	-0.380 * ** (0.00683)
Anglo New	2.050 * ** (0.0918)
Anglo Non-new	2.639 * ** (0.0917)
French New	1.460 * ** (0.0816)
French Non-new	2.972 * ** (0.0820)
Other New	0.494 * ** (0.0717)
Other Non-new	-0.379 * ** (0.0679)
Constant	0.823 * ** (0.0652)
N	13,664,224

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt; .01.

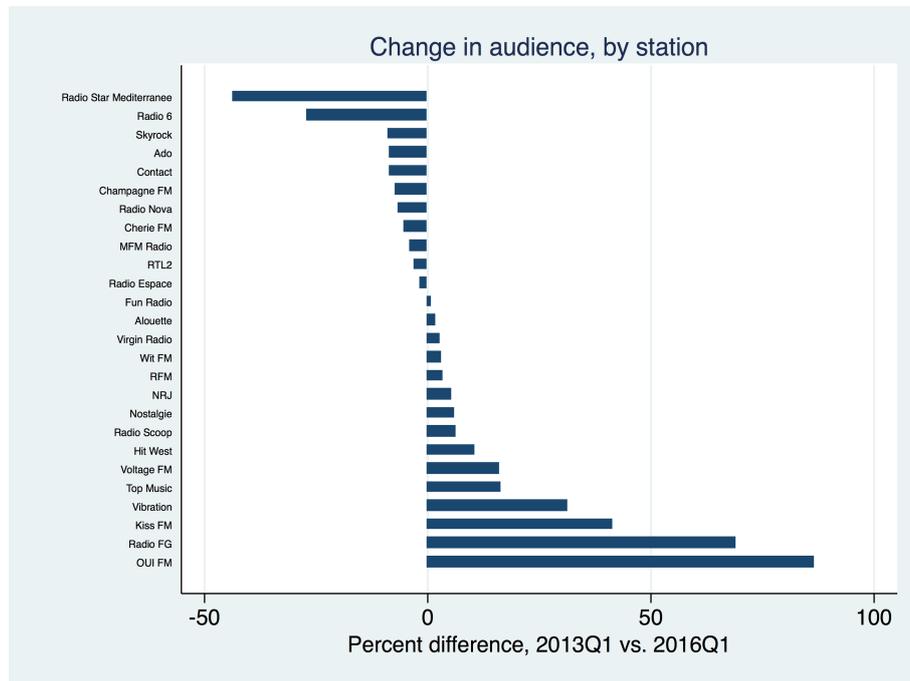


Figure 1.16: Percent difference in audience for each station between 2013 Q1 and 2016 Q1

Table 1.13: IV estimates by Gain/Loss group

	Net Gain b/se	Net Loss b/se
Log(audience)	-0.234 *** (0.00203)	-0.194 *** (0.00239)
Quota applies	1.945 *** (0.00716)	0.678 *** (0.00898)
N	1,474,839	1,360,628

\*\*\* p < .01.

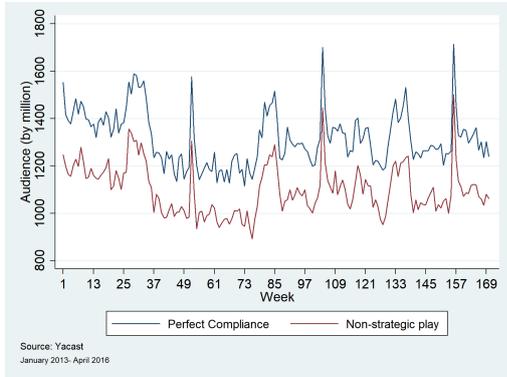


Figure 1.17: Simulation comparison between AB, stations with 35% quota

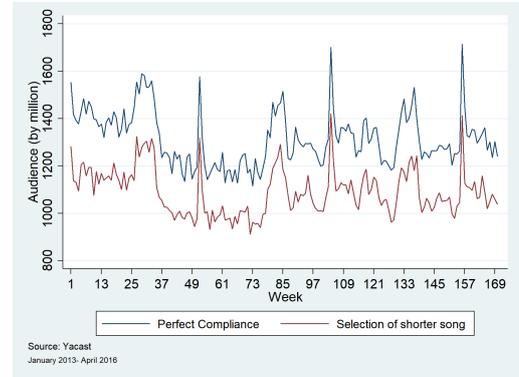


Figure 1.18: Simulation comparison between AC, stations with 35% quota

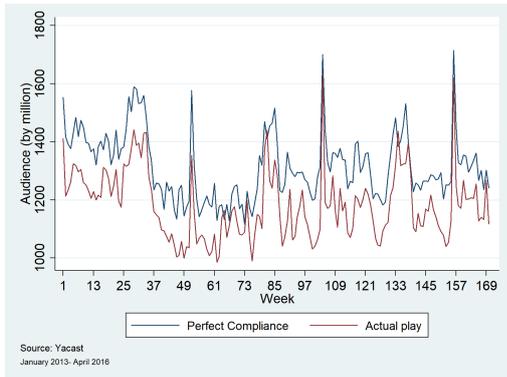


Figure 1.19: Simulation comparison between AD, stations with 35% quota

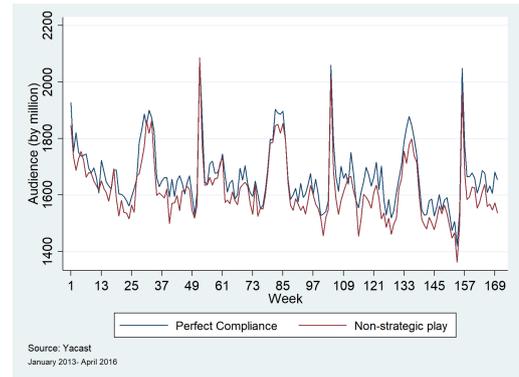


Figure 1.20: Simulation comparison between AB, stations with 40% quota

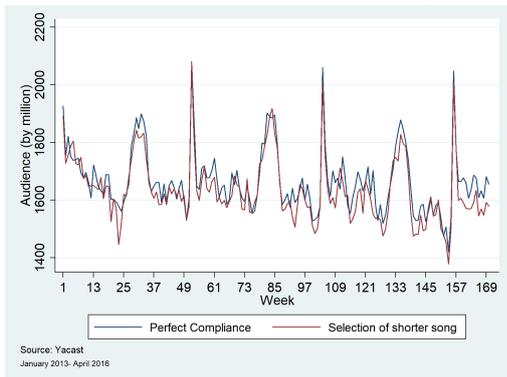


Figure 1.21: Simulation comparison between AC, stations with 40% quota

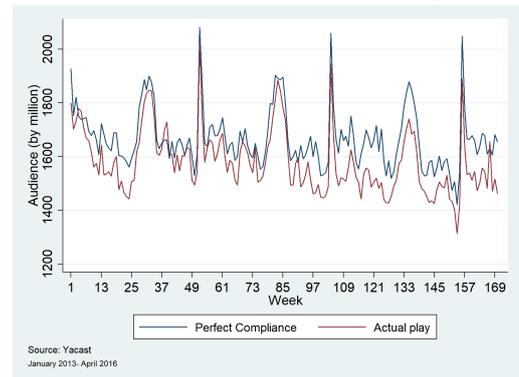


Figure 1.22: Simulation comparison between AD, stations with 40% quota

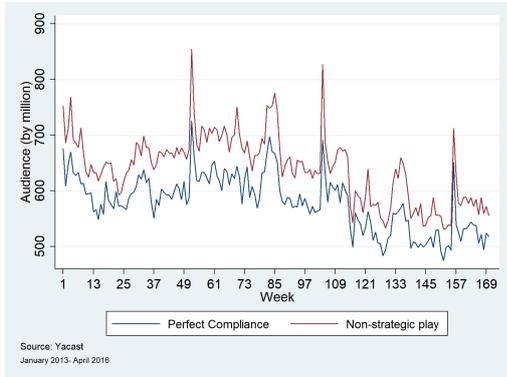


Figure 1.23: Simulation comparison between AB, stations with 50% quota

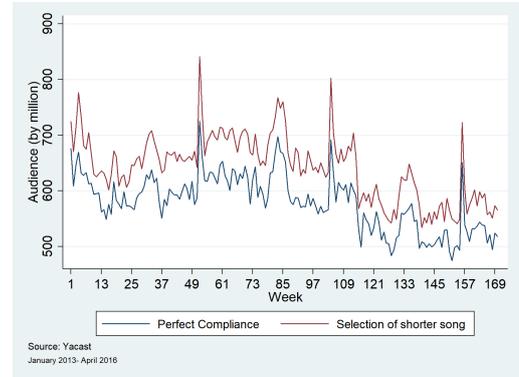


Figure 1.24: Simulation comparison between AC, stations with 50% quota

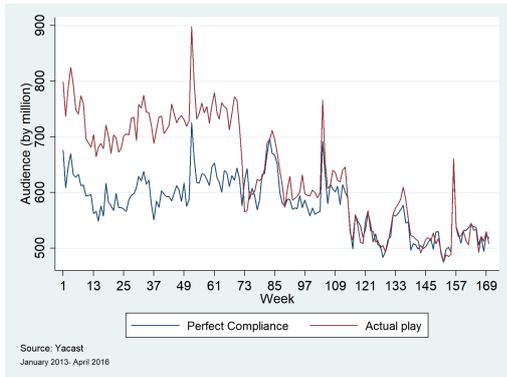


Figure 1.25: Simulation comparison between AD, stations with 50% quota

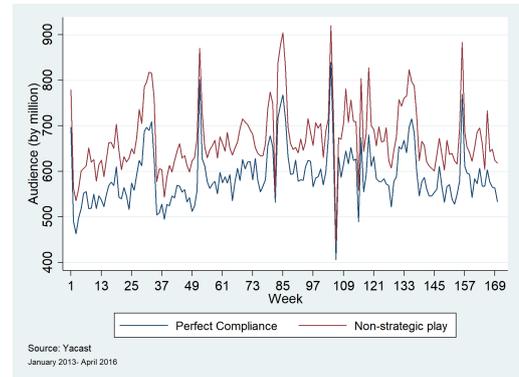


Figure 1.26: Simulation comparison between AB, public stations with 50% quota

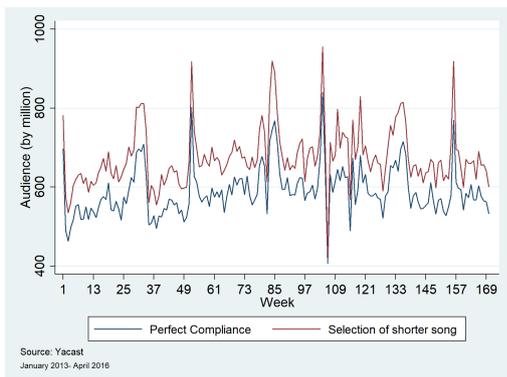


Figure 1.27: Simulation comparison between AC, public stations with 50% quota

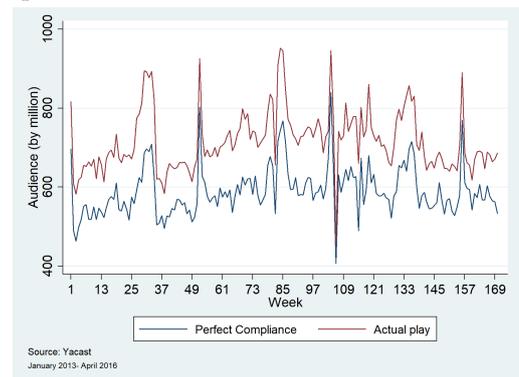


Figure 1.28: Simulation comparison between AD, public stations with 50% quota

Table 1.14: Summary statistics of simulation for all stations

Variable	Mean	Std. Dev.	Min.	Max.	N
Ratio: Non-strategic play vs Perfect compliance	0.8431	0.3084	0.1673	2.0927	4959
Ratio: Selection of shorter song vs Perfect compliance	0.8410	0.3115	0.1608	2.0939	4959
Ratio: Actual play vs Perfect compliance	0.8544	0.3101	0.1184	2.0962	4959

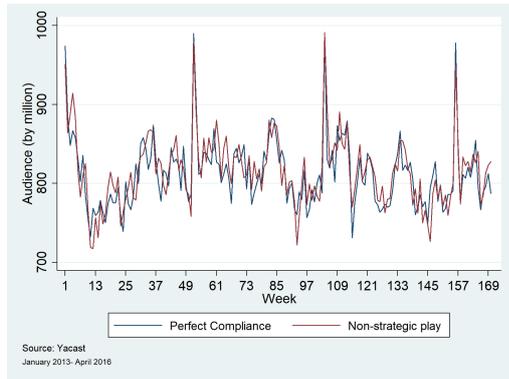


Figure 1.29: Simulation comparison between AB, stations with 60% quota

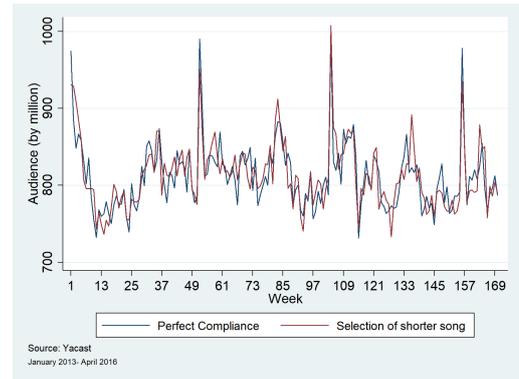


Figure 1.30: Simulation comparison between AC, stations with 60% quota

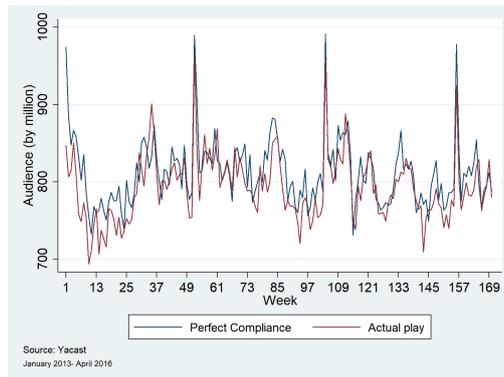


Figure 1.31: Simulation comparison between AD, stations with 60% quota



## Appendix A

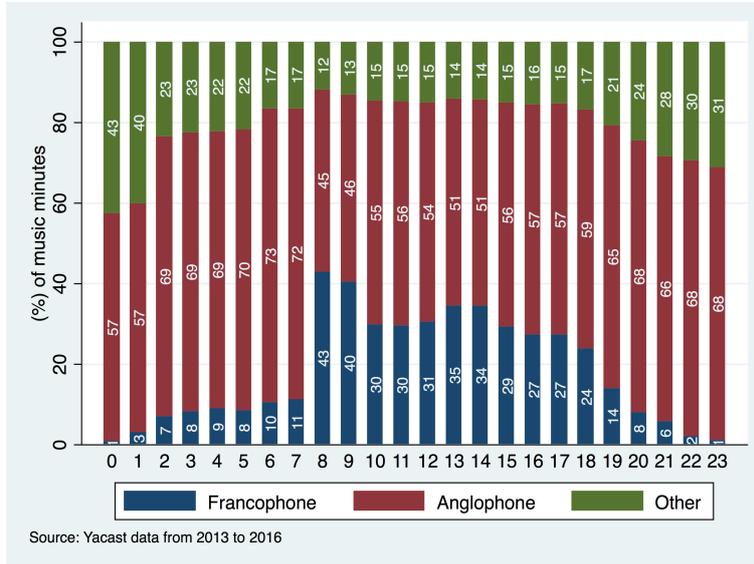


Figure 1.32: Francophone play by hour, Fun Radio

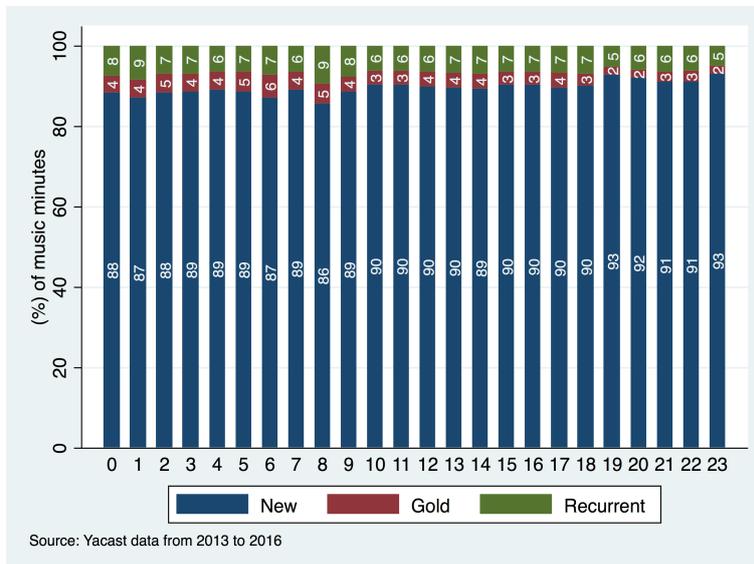


Figure 1.33: New music play by hour, Fun Radio

Table 1.15: Sanctions

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year	Month	Warning	Stations	Notice	Station	Letter	Station	Sanctions	Station
1991	Jul			5	Fun, NRJ, Europe 2				
1997	Mar			1					
1997	Jul					1	Contact FM		
1997	Aug			1	Vibration				
1998	Jul-Aug	2	Voltage, Contact FM	3	Vibration, Radio Scoop, Top Music			suspendre	Vibration
1999	Jul			5	RTL 2, Cherie FM Nostalgie, RFM, MFM				
2000									
2001	Mar			1	RFM	1	Oui FM		
2001	May			2	Europe 2, RFM	5	Voltage, Contact FM Ado FM, Vibration		
2001	Jul			4	Voltage, Contact FM, Vibration, Europe 2	3	Top Music, Hit West, Ado FM		
2001	Jul-Sep			3	NRJ, Radio Scoop, Oui FM, Kiss FM			Sanction	RFM
2001	Oct					1	Hit West		
2001	Dec					1	Top music		
2002	Jan			1	Top music				
2002	Jun							Sanction	RFM
2002	Jul					1	Contact FM		
2002	Sep	1	Hit West						
2003	May					2	Oui FM, Radio Scoop		
2003	Jun-Jul					2			
2003	Jun-Sep			1	Hit West				
2003	Dec					1	Oui FM		
2004	Feb-Mar	1	Europe 2						
2004	May					1	Voltage		
2004	Aug					1	Vitamine		
2004	Sep					1	Europe 2		
2004	Oct					1	Oui FM		
2004	Dec			1	Oui FM				
2005	Apr					3	RFM, Vitamine, Radio Scoop		
2005	July			1	Vitamine				
2005	Aug	1	Wit FM						
2005	Oct	1	Oui FM						
2005	Nov								
2006	Jan	2	Rire et Chansons			2	Radio Star Mediterra- nee		
2006	Feb	1	Hit West			2	Radio Star Mediterra- nee		
2006	Apr	2	Radio Nova, Ra- dio Espace			1	Rire et Chansons		
2006	May			1	Hit West				
2006	July			2	Radio Star Mediterranee	2	Oui FM		
2006	Sep	1	RTL 2			2	Ado FM, Vitamine		
2006	Otc	2	Radio Espace	1	Radio Nova				
2006	Dec	1	Cherie FM						

Table 1.16: Sanctions (continue)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year	Month	Warning	Stations	Notice	Station	Letter	Station	Sanctions	Station
2007	Jan	2	MFM	1	Radio Espace				
2007	Mar	2	Radio Scoop, Vitamine						
2007	Aug	2	NRJ, Champagne FM						
2007	Sep	1	Radio Espace						
2007	Oct	2	Hit West, Oui FM						
2007	Dec	1	Alouette						
2008	Feb	1	Alouette						
2008	Feb-Apr	1	Vitamine			1	Rire et Chansons		
2008	Sep			1	Vitamine				
2008	Oct	1	Radio Star Mediterranee						
2008	Nov	2	Oui FM, NRJ						
2009	Jan	2	Oui FM, NRJ						
2009	May	1	Contact FM						
2009	June	1	Vitamine						
2009	Oct	1	Oui FM						
2009	Nov	2	NRJ, Radio Espace						
2009	Nov	1	Radio Scoop	1	Vitamine				
2010	Jan	1	Contact	1					
2010	Mar	2	RFM, Radio Scoop						
2010	Sep	1	Nostalgie						
2011	Mar	3	Contact, Fun Radio, Virgin						
2011	Apr	2	Oui FM, Top Music						
2011	Aug	1	MFM						
2011	Dec	2	Hit West, NRJ						
2011	Mar	1	Radio Nova						
2011	Otc	2	Oui FM Star Mediterranee						
2011	Dec	2	Hit West et Virgin Radio						
2013	Feb	2	Oui FM, Contact						
2013	Mar	1	Contact						
2013	Apr	1	Hit West						
2013	May	2	Fun Radio, Top Music			4	Oui FM, Hit West Alouette, Contact		
2013	Oct	3	Radio Star, Star Mediterranee						
2014	Sep	1	NRJ						
2014	Apr	1	Scoop						
2015	Oct	2				Contact			
2015	June	2	Ado, Hit West						
2015	May	1	Contact						
			Ado, Alouette, Cerise FM. Chérie FM, Contact, Direct FM ECN, Flor FM, FG, Fun Radio, Galaxie, Hit West, Kiss FM, Magnum La Radio, Maritima, NRJ, Oui FM, Radio Nova, Scoop, Radio Star, Raje Nîmes, Sea FM, Top Music, Skyrock, Virgin Radio et Wit FM						
2016	Aug, Sep, Oct	26							

Definition of warning, notice, etc. See for details.

Table 1.17: Changes in quotas from 2001 to 2014

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Year	Month	Stations	Francophone quota	Changes	New quota	Changes
2014	June	Cherie FM	50%	40%		
2012	June	Hit west		35%		25%
2010	Mars	Oui FM		40%		20%
2007	Jul	Radio Espace	40%	35%	20%	35%
2008	Nov	NRJ		35%		25%
2008	Feb	Alouette	40%	35%	25%	20%
2008	July	Alouette	35%	40%	25%	20%
2008	Sep	Alouette		35%		25%
2005	Dec	Europe 2	40%	35%	20%	25%
2006	May	NRJ		40%		20%
2006	May	Nostalgie		60%		10%
2005	Mar	Voltage FM	35%	40%	25%	20%
2005	Jun	Voltage FM	40%	35%	25%	20%
2003	May	Europe 2	40%	35%	25%	20%
2002	Apr	Kiss FM	35%	40%	25%	20%
2002	Jun	RFM	60%	50%	10%	20%
2002	Jan	NRJ		40%	25%	20%
2001	Feb	Radio Scoop	35%	40%	25%	20%
2002	Jan	RFM	60%	50%	10%	20%
2002	Jan	NRJ	35%	40%	25%	20%
2001	Jun	RFM		60%		10%
2001	Mar	Voltage, Ado FM, Oui FM		35%		25%
2001	Feb	Radio Scoop, Vitamine, Kiss FM		35%		25%
2001	Jan	Radio Espace	40%	35%	20%	25%
		Contact FM	40%	35%	20%	25%

See [www.csa.fr/Espace-juridique/Decisions-du-CSA](http://www.csa.fr/Espace-juridique/Decisions-du-CSA) for details.

## Appendix B

In this appendix, we include additional robustness checks. First, we estimate separate regressions of Francophone play for weekdays and weekends in Tables 1.18 and 1.19. Strategic shifting of Francophone play appears more pronounced on weekdays, when audiences are generally larger.

Table 1.18: IV estimates of music genre by Weekday

	Anglophone b/se	Francophone b/se	Non music b/se
ln(audience)	-0.183 * ** (0.00240)	-0.262 * ** (0.00192)	0.544 * ** (0.00230)
quota_hour	-1.784 * ** (0.00863)	1.488 * ** (0.00690)	0.442 * ** (0.00828)
N	2,102,578	2,102,578	2,102,578

\* p<0.10, \*\* p<0.05, \*\*\* p< .01.

Table 1.19: IV estimates of music genre by Weekend

	Anglophone b/se	Francophone b/se	Non music b/se
ln(audience)	-0.251 * ** (0.00343)	-0.152 * ** (0.00271)	0.572 * ** (0.00314)
quota_hour	-1.454 * ** (0.0126)	1.363 * ** (0.00999)	0.115 * ** (0.0115)
N	837,262	837,262	837,262

\* p<0.10, \*\* p<0.05, \*\*\* p< .01.

In Table 1.20, we estimate a pooled model with categories based on the age of the content played. New music receives more play overall, and substitution to non-music as audience increases is more pronounced for gold music than for the new or recurrent categories.

Finally, we present some additional figures comparing the counterfactual audience and realized audience for different quota categories. Stations with the least stringent quota (35%) show the largest difference between the counterfactual and observed audience for Francophone music. For those facing a 40% quota, the observed audience is also lower than the counterfactual, but the difference is smaller. For the other quota categories, the actual audience is larger than the counterfactual, as several of these stations play more Francophone music than is required by the

Table 1.20: IV estimates with age interactions

	minutes b/se
ln(audience)	0.353 * ** (0.00658)
Gold#ln(audience)	-0.593 * ** (0.00915)
New#ln(audience)	-0.437 * ** (0.0105)
Recurrent#ln(audience)	-0.384 * ** (0.00782)
Gold	5.008 * ** (0.105)
New	5.651 * ** (0.105)
Recurrent	1.048 * ** (0.0778)
Constant	0.823 * ** (0.0652)
N	7,808,128

\* p<0.10, \*\* p<0.05, \*\*\* p< .01.

quota.

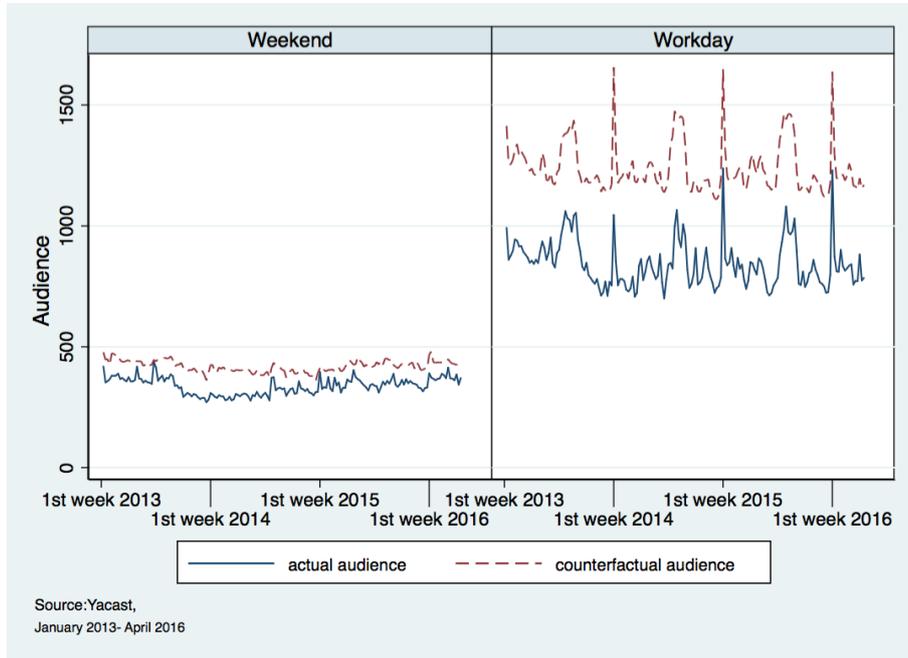


Figure 1.34: Exposure of Francophone, stations with 35% quota

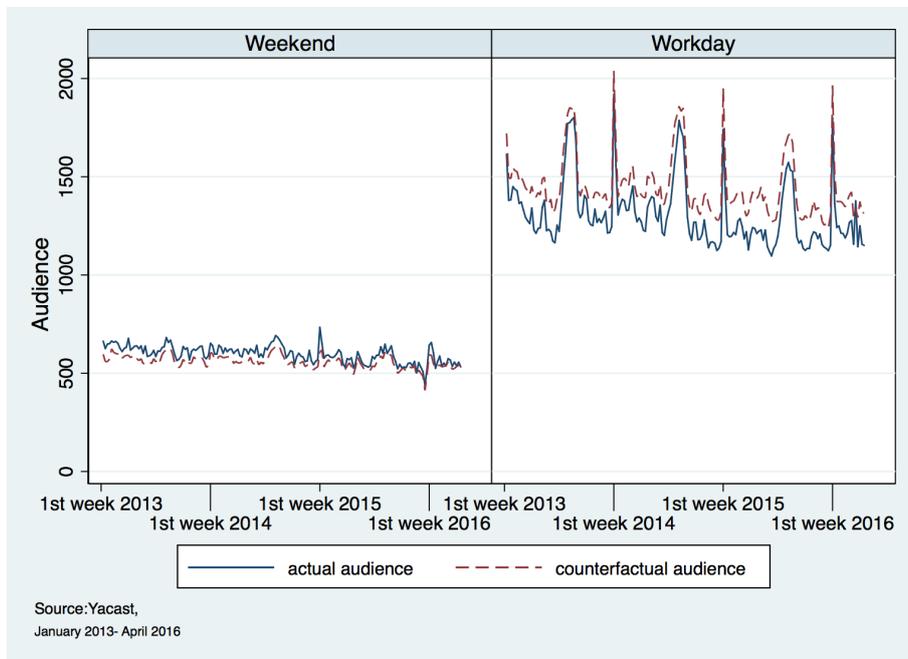


Figure 1.35: Exposure of Francophone, stations with 40% quota

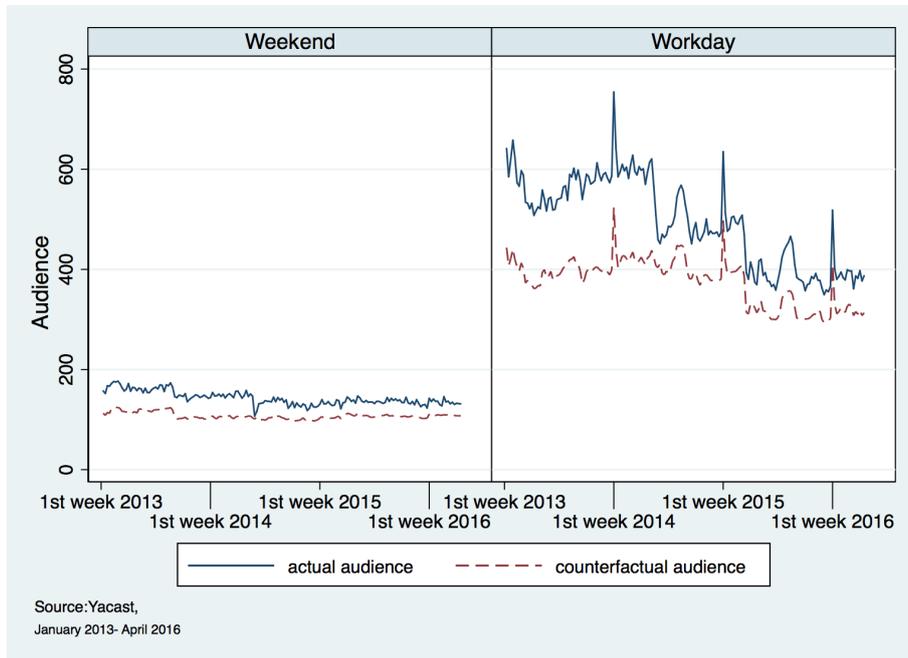


Figure 1.36: Exposure of Francophone, stations with 50% quota

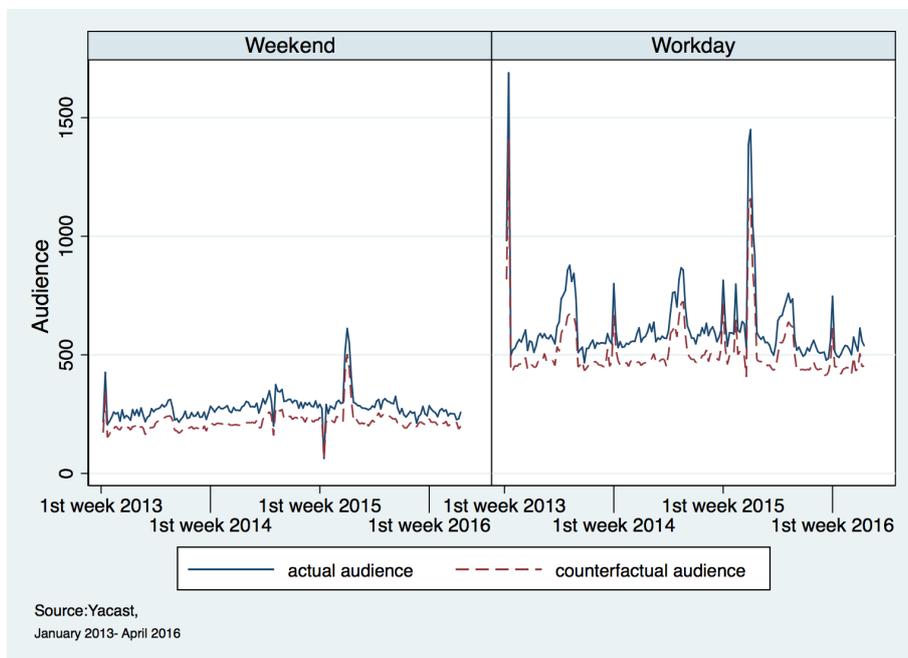


Figure 1.37: Exposure of Francophone, public stations with 50% quota

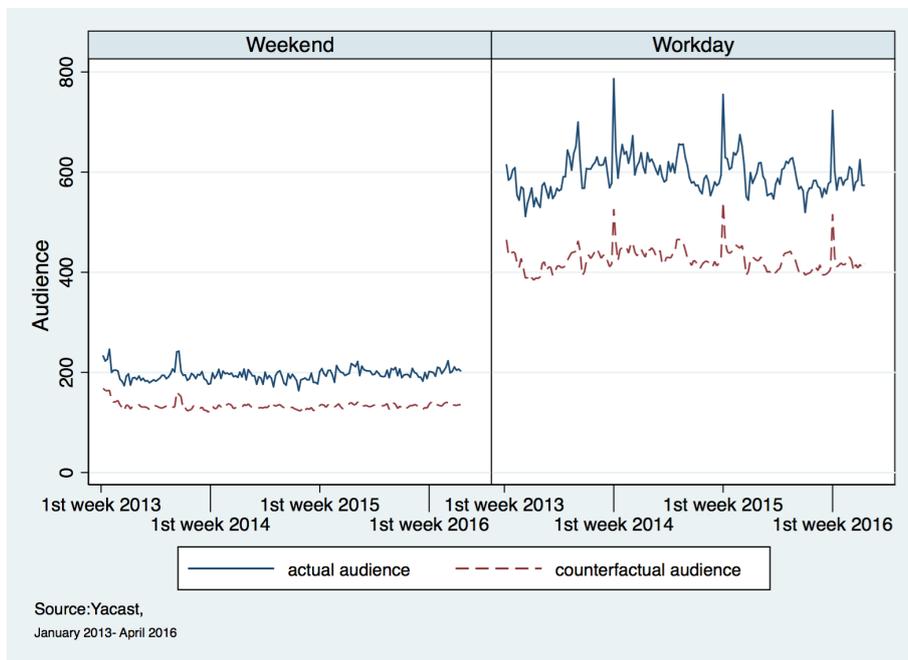


Figure 1.38: Exposure of Francophone, stations with 60% quota

Table 1.21: Summary statistics of simulation for each station

Media	Variable	Mean	Std. Dev.	Min.	Max.	N
Ado	Perfect Compliance	21357293.19	7838224.29	3625721.75	33071158	171
Ado	Non-strategic play	21008056.19	7778193.43	3517102.5	34315032	171
Ado	Selection of shorter song	20777195.06	7715602.88	3486671	32889206	171
Ado	Actual play	18219522.05	7040014.51	3253453.25	33741552	171
Alouette	Perfect Compliance	76132607.04	6776479.78	17352888	97890040	171
Alouette	Non-strategic play	70263150.44	6347913.68	16812438	91869376	171
Alouette	Selection of shorter song	72857987.16	6633539.76	16693672	94313128	171
Alouette	Actual play	75062037.7	7056095.27	20077082	94674440	171
Champagne FM	Perfect Compliance	17279159.59	2300400.18	4714905.5	24824222	171
Champagne FM	Non-strategic play	12893296.92	1723408.53	3297514	18355616	171
Champagne FM	Selection of shorter song	12681196.32	1720001.4	3898414.25	17458560	171
Champagne FM	Actual play	13028785.54	3706170.8	2565358.25	22592542	171
Cherie FM	Perfect Compliance	454009405.38	37108242.01	375471104	554676928	171
Cherie FM	Non-strategic play	401718803.46	35434890.08	330795584	518857152	171
Cherie FM	Selection of shorter song	402048095.81	34302766.22	325165632	505347872	171
Cherie FM	Actual play	397501563.13	78868498.08	283339456	561940928	171
Contact	Perfect Compliance	35209407.11	5720694.85	21388996	56210412	171
Contact	Non-strategic play	28499245.65	4714815.86	18146570	47145780	171
Contact	Selection of shorter song	28240772.92	4720210.31	17921236	45411892	171
Contact	Actual play	30624164.18	6448789.8	14227808	49619564	171
FIP	Perfect Compliance	52571491.3	8565851.33	12908595	77469960	171
FIP	Non-strategic play	13739932.74	2541118.29	3336795.25	22058080	171
FIP	Selection of shorter song	13665980.2	2446692.37	2270515.5	20913348	171
FIP	Actual play	25557904.16	4721676.01	6706563.5	40674988	171
France Bleu	Perfect Compliance	505487991.02	58070547.31	311332864	736087424	171
France Bleu	Non-strategic play	640876615.86	71522918.2	403561472	875945344	171
France Bleu	Selection of shorter song	643161484.35	72901995.77	381965568	913485568	171
France Bleu	Actual play	672165458.71	76542509.58	402176576	891129472	171
Fun Radio	Perfect Compliance	324418910.5	40412164.3	247702032	438942048	171
Fun Radio	Non-strategic play	256970808.61	32744042.77	188483632	350867232	171
Fun Radio	Selection of shorter song	256423164.26	32448267.01	197514432	350750784	171
Fun Radio	Actual play	294741526.83	40418837.33	208071600	427363520	171
Hit West	Perfect Compliance	51837764.02	5378413.24	41946316	72540680	171
Hit West	Non-strategic play	41772397.11	4449085.08	33440562	57846096	171
Hit West	Selection of shorter song	41737213.75	4551042.63	33819304	60899740	171
Hit West	Actual play	44271454.6	4466007.66	35983320	62134160	171
Kiss FM	Perfect Compliance	11608530.15	2113602.91	8887391	17979732	171
Kiss FM	Non-strategic play	9691957	1665262.07	7356207	15172862	171
Kiss FM	Selection of shorter song	9637981.76	1743245.34	7219599.5	15567163	171
Kiss FM	Actual play	9634290.79	1815806.69	7408470	14533992	171
MFM Radio	Perfect Compliance	125054270.27	15621477.81	99102984	174438800	171
MFM Radio	Non-strategic play	239697489.03	29357343.69	191461632	335909728	171
MFM Radio	Selection of shorter song	239700760.89	29353897.31	191296080	336083872	171
MFM Radio	Actual play	239926095.91	29373021.93	191676832	336322912	171
NRJ	Perfect Compliance	691544585.73	66858981.25	580820864	904450880	171
NRJ	Non-strategic play	606511144.42	64720797.7	479781312	836283584	171
NRJ	Selection of shorter song	597277945.64	59580866.92	491755584	804705920	171
NRJ	Actual play	647696320	73830387.13	510843488	964074560	171
Nostalgie	Perfect Compliance	811798050.81	43153085.71	731249792	991395584	171
Nostalgie	Non-strategic play	815920049.03	43988350.31	717696256	990968832	171
Nostalgie	Selection of shorter song	813271264.56	43279663.56	733262528	1007465728	171
Nostalgie	Actual play	792675557.05	42824144.67	693725824	964168640	171
OUI FM	Perfect Compliance	38292864.2	14395371.23	22884496	78119104	171
OUI FM	Non-strategic play	14259514.45	5335556.61	7747897.5	28185052	171
OUI FM	Selection of shorter song	13981535.59	5221291.55	8181147.5	27886234	171
OUI FM	Actual play	12684595.69	5933402.28	2910583.25	25403892	171
RFM	Perfect Compliance	418078864	35050181.34	259924144	536975936	171
RFM	Non-strategic play	409006845.85	33212197.14	253105040	506230016	171
RFM	Selection of shorter song	415290140.82	34468633.11	253370208	527969376	171
RFM	Actual play	408741722.85	36246040.5	243385936	510854688	171
RTL2	Perfect Compliance	391867341.29	29431438.39	324571936	510319552	171
RTL2	Non-strategic play	388837704.14	30832683.59	335585952	536621568	171
RTL2	Selection of shorter song	393486984.42	30308987.69	330971904	509522304	171
RTL2	Actual play	363108931.56	27814343.84	299841248	454723296	171
Radio 6	Perfect Compliance	14849816.49	2291210.03	8829477	22017706	171
Radio 6	Non-strategic play	14146967.11	2063253.13	9496237	20434224	171
Radio 6	Selection of shorter song	14049826.19	2141995.22	8925246	20113218	171
Radio 6	Actual play	14921513.55	3615744.24	9722177	23913336	171

Table 1.22: Summary statistics of simulation for each station

Media	Variable	Mean	Std. Dev.	Min.	Max.	N
Radio Espace	Perfect Compliance	7944870.59	726600.46	6736203.5	10978858	171
Radio Espace	Non-strategic play	4491321.92	459551.49	3642506.75	6205423	171
Radio Espace	Selection of shorter song	4383851.21	432645.07	3501348.5	6029372.5	171
Radio Espace	Actual play	5198296.06	1690039.31	2846436.75	10860630	171
Radio FG	Perfect Compliance	15124088.69	5521667.94	8657961	30000354	171
Radio FG	Non-strategic play	9782852.13	3521990.28	5451713	18236666	171
Radio FG	Selection of shorter song	9268196.07	3369566.46	5184818	18989644	171
Radio FG	Actual play	12787605.48	4309608.24	7611166.5	26380962	171
Radio Nova	Perfect Compliance	35642974.28	4542316.31	27072498	52429664	171
Radio Nova	Non-strategic play	8016207.42	1192129.63	5357018.5	12639939	171
Radio Nova	Selection of shorter song	7849261.29	1204575.63	5416414	11342233	171
Radio Nova	Actual play	9081894.58	2019702.36	4811133.5	14825858	171
Radio Scoop	Perfect Compliance	31953219.02	4315982.87	17455424	45218976	171
Radio Scoop	Non-strategic play	29886775.09	4030790.75	14647772	42735332	171
Radio Scoop	Selection of shorter song	29703124.16	4050066.26	15835694	43864688	171
Radio Scoop	Actual play	31916811.89	4914861.01	17080936	48533576	171
Radio Star Mediterranee	Perfect Compliance	10526381.73	2322239.65	5199571.5	16328603	171
Radio Star Mediterranee	Non-strategic play	7377268.74	1754248.12	3322710.5	11863717	171
Radio Star Mediterranee	Selection of shorter song	7396872.69	1743750.56	3134181.25	11878304	171
Radio Star Mediterranee	Actual play	8064099.79	2312836.65	2951075	14262965	171
Skyrock	Perfect Compliance	446774878.13	37872058.08	375127040	563683008	171
Skyrock	Non-strategic play	496115705.26	42191883.21	423049888	624957696	171
Skyrock	Selection of shorter song	502018216.23	42709221.73	421206976	619925056	171
Skyrock	Actual play	493809274.57	48177108.38	404900288	639985984	171
Top Music	Perfect Compliance	25811311.95	1672524.52	22025334	34572820	171
Top Music	Non-strategic play	24481509.94	1636747.83	21451762	32392662	171
Top Music	Selection of shorter song	24625723.02	1594189.2	21394106	32574194	171
Top Music	Actual play	22525548.58	1484313.1	19409466	30618190	171
Vibration	Perfect Compliance	31596556.37	3832537.82	24557828	45959816	171
Vibration	Non-strategic play	28526645.87	3609327.26	21981782	40325616	171
Vibration	Selection of shorter song	28271326.75	3461142.51	21516056	42012672	171
Vibration	Actual play	23403421.37	2882566.2	17067908	30287974	171
Virgin Radio	Perfect Compliance	242203957.52	21148653.74	208978416	315467424	171
Virgin Radio	Non-strategic play	199923057.12	18152302.79	164868752	279430848	171
Virgin Radio	Selection of shorter song	201104579.56	17655927.38	172183168	281448928	171
Virgin Radio	Actual play	192515361.78	20700923.45	160130816	280252544	171
Voltage FM	Perfect Compliance	18167190.05	2265001.17	13005960	26049434	171
Voltage FM	Non-strategic play	15259261.8	1850639.39	11101285	21304552	171
Voltage FM	Selection of shorter song	15067964.67	1861189.24	10576035	21396844	171
Voltage FM	Actual play	12071033.74	2214436.64	7264540	18786100	171
Wit FM	Perfect Compliance	26312055.1	4835540.97	19545214	40814536	171
Wit FM	Non-strategic play	19624419.47	3612615.38	14331526	30341740	171
Wit FM	Selection of shorter song	19440757.42	3654224.65	13973811	29833314	171
Wit FM	Actual play	17014592.56	5034323.44	8401518	34520152	171
mOuv'	Perfect Compliance	31661415.92	6439189.7	20259354	47417308	171
mOuv'	Non-strategic play	18247609.46	3721389.71	11005048	28100024	171
mOuv'	Selection of shorter song	18389559.69	3769685.33	11654862	28630806	171
mOuv'	Actual play	18850874.35	5367579.06	10017750	29511034	171



---

### Music consumption in France: A database linking streaming services and radio stations

---

#### Résumé

Cet article donne un aperçu d'une nouvelle base de données pour les principaux services de streaming et les stations de radio en France. Le document discute les principaux défis impliqués dans la construction de cette base de données intégrée et fournit une explication de l'approche adoptée pour résoudre ces problèmes. Je conçois une méthode pour clarifier les noms d'artistes et de chansons et créer un algorithme de correspondance entre plusieurs canaux musicaux. J'utilise l'ensemble de données intégré pour fournir la preuve descriptive sur la diversité musicale et les modes de consommation de musique entre les services de streaming et la radio en France en 2016.

## **Abstract**

This paper provides an overview of a new database for the major streaming services and radio stations in France. The paper discusses the principal challenges involved in the construction of this integrated database and provides an explanation for the approach taken to address these issues. I design a method to clarify artist and song names, and create a matching algorithm between multiple music channels. I employ the integrated dataset to provide the descriptive evidence on the music diversity and music consumption patterns between streaming services and radio in France in 2016.

## 2.1 Introduction

In the digital market, music contents are available on a large number of different platforms in various models. First, the traditional sales model under which the consumer purchases a license to their copy of a song, which they can then permanently download to a device, such as physical CD sales. Second, the interactive model under which a consumer chooses what music to listen to and creates a copy on his device that exists as long as he is a paying subscriber, such as the premium service provided by Deezer and Spotify. Third, the ad-funded model in which a consumer chooses what to listen to in exchange for listening to commercials, such as the freemium service from Spotify. Lastly, we have the non-interactive model in which radio stations provide musical content to consumers based on certain genres or recommendations. Consumers in this case have no control over which music content is played. These are entirely different economic models and are not comparable without adjusting the dataset to reflect crucial differences. For example, the number of plays for a downloaded song title cannot be counted, but radio and streaming models allow for this measurement. This requires an adaptation of the available data which is the topic of this chapter.

Here, I build a novel dataset to compare music consumption between streaming services and radio. Physical sales should be thought of as an advance payment on a future of unlimited plays. Under that sales model, the same amount of revenue is generated whether a user listens to the song once or 1,000 times. Conversely, streaming is based on a pay-as-you-listen model, in which payments to rights holders directly correspond to the number of times the song is listened to over time. Streaming and radio can be effectively compared when I can track the consumers' listening behavior through number of plays.

The goal of this chapter is to present our datasets and detailed data construction for the support of descriptive evidence presented in Chapter 3. I first provide an overview of 5 datasets that contain music consumption data, for the major streaming services and radio stations in France. Then I discuss the principal challenges involved in the construction of this integrated database and provide an explanation for the approach taken to address these issues.

Ideally, to measure the music consumption between streaming and radio, I would have volumes of data on all the major steaming services. I would like to have data for a period covering substantial growth in all the streaming services that I might view as exogenous to song demand.

I could then measure the change of music consumption after the popularity of streaming services for a long term. I would need data before and after 2007, when the streaming service Deezer introduced in France. After the entry of streaming services in the music market in France, it has surely transformed the market for music listening.

In reality, I have weekly song-level streaming measures for 2016 in France. Our data cover a period in streaming with some variation in the growth patterns across platforms. While our streaming data includes the most widely used streaming services in France, they do not cover all streaming services. For example, one of the major competitors, Apple Music, is not included in our dataset.

Studies relying on data from both streaming services and radio are quite rare. I have several challenges. In fact, information on historical records of music consumption by individual is often opaque and difficult to collect. The music industry has yet to require music services to provide complete, readable, and up-to-date data about their music consumption in a uniformed format. In addition, the data is either too scattered or complicated to be useful or lacks relevant details. Data on music characteristics often lacks harmonization, thus requiring substantial additional data work.

Spotify, another streaming service, has grown very quickly since 2011 but at different rates in different countries. Deezer, founded in France, has grown rapidly since 2008. Napster and Google have also grown, but more slowly, since 2013. For each music diffusion record, our data provides us with the full access to over 5.5 billion observations of music consumption, and therefore allows us to identify the specific pattern, both from radio and streaming services.

This paper is the first to merge several very large datasets, from streaming services to radio stations, covering the French market. Using this original dataset, I provide the first descriptive evidence of music variety and types of music consumption in France in Chapter 3.

The rest of the paper is organized as follows: Section 2.2 provides a review of the literature that is related to the study. Section 2.3 turns to the dataset used for this study. Section 2.4 and section 2.5 provide the method to match the dataset. Section 2.6 concludes.

## 2.2 Literature

This paper adds to the scarce empirical literature on the methodology of matching datasets between multiple music platforms. To my knowledge, this paper is the first to offer a general and empirical perspective on the issue of matching data between streaming services and radio.

Studies relying on a comprehensive dataset from multiple music platforms are quite rare. Before the popularity of streaming services, studies examined the impact of radio on physical music sales. [Liebowitz \(2004\)](#) studies the period surrounding the diffusion of radio broadcasting and its effect on the already-established recorded music industry in the US during the 1920s. He documents that the diffusion of radio was accompanied by a collapse of the recorded music industry, which he interprets as displacement of recorded music sales by radio. [Waldfogel \(2012\)](#) relies on a dataset from album sales released between 1980 and 2010 along with their Billboard chart rankings and airplay on both terrestrial radio (since 1990) and Internet radio (2006-2011). He finds that Internet radio play affects the number and kinds of products consumers have information on and an increasing number of albums find commercial success without substantial traditional airplay.

Some recent research examines the impact of streaming on music consumption. [Kretschmer and Peukert \(2015\)](#) study the impact of videos excluded from YouTube in Germany in 2009, and re-introduction of videos with an agreement with the platform VEVO in 2013. They find that online music videos trigger album sales but have no effect on the sales performance of individual songs. [Hiller and Walter \(2016\)](#) find that streaming and album sales have similar trend in playing the top music, but the relationship is declining. [Aguiar and Waldfogel \(2017\)](#), however, show a significant displacement effect of streaming services on digital music sales. [Yu et al. \(2017\)](#) study the effect of video streaming on the sales of physical media using a natural experiment when content owner Epix switched its streaming partner from Netflix to Hulu on October 1, 2015. They found that streaming displaces the music consumption of the physical DVD sales. [Hiller \(2016\)](#) uses the removal of Warner music from YouTube in November 2015 and its restoration later in October 2016 as a natural experiment to study music consumption at album-level and find that YouTube is negatively correlated to Warner albums sales. [Aguiar \(2017\)](#) exploit the introduction of a listening cap by Deezer to identify the effect of freemium service on the music purchase and piracy. Freemium service positively affects music sales.

Some studies use individual-level survey data as a source of information on the streaming industry. [Nguyen et al. \(2014\)](#) executed large-scale surveys of streaming music use to assess consumer willingness to pay for services and streaming's effect on music purchases and illegal downloads. But they find that music consumption through streaming services has no impact on physical sales. [Aguiar and Martens \(2016\)](#) use clicks-stream data on a survey data of 5000 individuals to analyze the effect of online streaming service on the digital music purchasing behavior and find that streaming works as a complement service to digital music sales. [Hong \(2013\)](#) find a comparable result. However, [Waldfogel \(2010\)](#) uses an online survey of 5000 students and finds free songs from streaming service reduces paid digital music consumption. [Wlömert and Papies \(2016\)](#) use an individual-level survey dataset to analyze the adoption of on-demand streaming services. Their results show that individuals who adopt such services purchase significantly less recorded music. While they find a larger displacement effect for paid compared to free streaming, their results also show a positive net effect of paid streaming services on revenue. They conclude that the overall effect of streaming on the music industry revenue is positive.

Other studies using country-level panel data, such as [Zentner \(2009\)](#) and [Liebowitz \(2006\)](#). [Aguiar and Waldfogel \(2016\)](#) uses digital sales data over 15 European countries and find that music products with low ex ante appeal account for an increasing share of music sales. But the music sales become more concentrated during their sample period. Although the literature has direct measures of music consumption using difference data sources, it's still a challenge to collect a comprehensive data source that contains data from major music providers, and it has never been done for the French Market.

## 2.3 Data

I have drawn data for this study from 5 datasets. I describe these datasets separately and then turn to the dataset I construct by combining them.

### 2.3.1 Data sources

I build a database covering all major French digital platforms and linking music consumption data for the year 2016. The database draws from two sources: (i) Yacast, a company specializing in monitoring media. It reports the minute-by-minute programming of major French radio stations that have national coverage (representing over 34 major radio stations in France). The Yacast dataset is used by the French government to monitor music broadcasting. It also includes details of the broadcast content, such as the language, genre, duration of the play, and release date of each song. It also covers seasonally adjusted audience numbers at an aggregated individual level. Thus, I have fairly complete information on both the supply and demand side of the French radio market in 2016. (ii) Universal Music, which provides extensive music consumption information for all major streaming services operating in France. It also provides off-line physical album sales at the week-level and contains detailed information on all album sales and rankings. In my analysis I will focus on all streaming services and on aggregated radio stations.

### 2.3.2 Novelty of the data

The data collected by most music consumption providers (e.g., Spotify, YouTube) is inadequate because those platforms only observe consumers after they arrive at their website and are only exposed to their own platform. This may be the reason, I speculate, that others have not been able to study the question.

Several features of the sample dataset allow me to contribute to the existing literature. First, this new dataset covers a comprehensive consumption history of all the major music services in France in 2016. It provides an ideal set-up for the purpose of analyzing music variety and music consumption. When a user registers for streaming services under the catalog of Universal Music, a history file is extracted from the user's consumption history. Second, the combination of radio and streaming services via various platforms thus gives us a comprehensive view of the user's behavior for a full year. More detail is given in the following section.

### 2.3.3 Radio

My first database is the radio dataset from Yacast in 2016 which contains detailed information about music consumption.

To be precise, I use data provided by Yacast on the minute-by-minute broadcasts of major French radio stations that have national coverage. The radio dataset yields a total of 3,534,472 songs played by 34 major French radio stations in 2016.<sup>1</sup> There are 40,093 distinct artists, and 69,153 distinct songs during our sample period.

On the demand side, I have data on the average audience during 15-minute intervals for weekdays and weekends for each week and each station based on a survey by Mediamétrie.<sup>2</sup> The survey attempts to maintain geographic and socio-demographic representativeness. Interviews are conducted every three months for the population aged 13 and above. For instance, during a survey from December 2015 to January 2016, 22,865 interviews from the Monday-Friday period and 11,084 interviews from the Saturday-Sunday period were conducted by Mediamétrie.<sup>3</sup> A limitation of the survey data available for this project is that it does not permit one to observe individuals switching from station to station or capture the degree of their engagement.

The Yacast dataset includes details of the broadcast content, such as the language, genre and release date of each song. Table 2.1 shows an extract from the play log of Fun Radio, a station dedicated to music playing.

## 2.3.4 Streaming

### 2.3.4.1 Spotify, Deezer, Napster, Google

The second data source provides me with data for streaming services in France. The corresponding data on streaming platforms was compiled using data extracted from the Universal Music database. This dataset provides information on the date of music consumption, the aggregated number of users, the aggregated number of clicks, artist name, song name etc.

I have access to data for the major streaming platforms such as Deezer, Spotify, Napster and Google in France for year 2016. Music consumption widely differs between the four streaming platforms. This corresponds to around 5 billion observations and the number of observations increases every month over 2016.

The Deezer, Napster and Google datasets have observations at the song-week level for 2016.

---

<sup>1</sup>We have access to radio data from 2013 to 2016, however, in order to link the radio data to the other 4 streaming service data, we focus on the radio data from 2016.

<sup>2</sup>Médiamétrie is a private company in France measuring the audience of radio and television.

<sup>3</sup>Interviews were conducted between 5.30 pm and 9.30 pm on fixed telephones (including telephone numbers starting with 09) and on mobile phones in order to optimize the reachability of the population by telephone.

The Spotify dataset has observations at the song-day level, with a total of 540,725,559 observations for 44,579 distinct artists and 448,611 distinct songs. Table 2.2 shows an extract from the play log of Spotify on March 31, 2016.

Spotify also makes disclosures of listener time in seconds by song level. Table 2.3 shows the definition of the consumer groups in the Spotify dataset. Table 2.4 presents the descriptive statistics for Spotify in January 2016. The unit of observation for Spotify is a song-day, where any song played at least once during the month is included. If no user listened to a song on a particular day, the number of users is 0 for that day. I have 12 consumer categories which can be divided into 4 groups: (1) Total user group; (2) Premium and ad-funded user group; (3) Lean back, and lean forward user group; (4) Album, artist, collection, search, playlist, undeveloped, and other user group. I can observe how music consumption arrives at a song by comparing within the groups.

The Spotify data includes information on whether a user is active or passive, and how a user “arrived” at a song. For example, a user may search for a specific song. Alternatively, the user might begin at the artist or album page and arrive at a song directly from one of those pages. Some users arrive through listening to a collection or playlist. On average, each song is listened to by 2.97 active (or “lean-forward”) users and 1.56 passive (or “lean-back”) users. Premium users account for an average of 2.51, while the average for ad-funded users is 2. The playlist user here exceeds all the other user counts, which means that most consumers rely on playlists to suggest content. The variation between these groups motivates me to compare the impact of music recommendation across different types of consumers.

#### **2.3.4.2 Meta data**

I have meta data provided by Universal Music as a supplementary dataset which includes the ISRC ID<sup>4</sup>, artist name, song name, artists’ country of origin (for instance, Germany, France, United States, United Kingdom), and music genre. The meta data include all the ISRC ID from 4 streaming services, Spotify, Deezer, Napster and Google, with a total of 886,345 observations. I combine the meta data and four streaming services based on the unique ISRC ID to obtain

---

<sup>4</sup>See [Http://www.usisrc.org](http://www.usisrc.org) The International Standard Recording Code (ISRC) system is the international system for the identification of recorded music and music videos. Each ISRC is a unique identifier that can be permanently encoded into a recording or music video.

the related information on music characteristics.

### **2.3.5 Other data: physical album sales**

I have data provided by Universal Music on the physical album sales at album-week level for 2016. The physical album sales have a total of 512,484 observations for 6442 distinct artists and 24,343 distinct albums. I have information on the format of the album which can be divided into 3 formats: short album, or EP, with a lower number of songs released; long album, or LP, with a full set of songs released; and single song, with only one song released. The unit of album sales is one copy of the music content sold to the market. Noted that one album can have several versions for the same master project. For example, an album released by artist “Beyoncé”, can have different versions, e.g. remastered and deluxe albums. I aggregate the album sales from all the revision together. The minimum number of album sales can be below 0, which denotes the albums sent back by a consumer or defective products.

As mentioned before, the amount of listening time is not clear given the durable nature of album sales. Therefore, I cannot compare music consumption using album sales to streaming services or to radio.

### **2.3.6 Challenges**

In the wake of digitization, analyzing the effect of music consumption on alternative streaming platforms is important to understanding the music industry. Measuring the effect of various types of music services is an inherently difficult exercise, mainly for two reasons. First, the use of various streaming services and radio stations do not provide a complete record of the user’s behavior, which renders its measurement difficult. It is therefore not easy to obtain data on each service nor to link data on all the services. Second, assuming that such data is available, identifying the effect of music consumption is made difficult by the complexity of the data. The main challenge is to overcome is the existence of unobserved heterogeneity that renders the variable measuring radio broadcasting or streaming services potentially endogenous.

In addition, there may be concerns that the choice to focus on only a short period of the music consumption might induce a selection bias. I have artist-week level data on the major radio and streaming services in France for a full year, I might face the possibility of getting misleading

results in general. However, the sample dataset covers a context of rapid and continuous growth in streaming with some variations in the growth pattern across platforms. Our analysis is not confined to music consumption coming from a particular segment of the sales distribution, and the sample data allows us to measure the music consumption of any kind of music platform.

### **2.3.6.1 Geographic representativeness of consumers**

Another concern could arise from the geographic representativeness of consumers collected from our database. First, the consumer from Yacast is generated from a survey made by Mediamétrie. They provide daily monitoring of the socio-demographic representativeness and the geographical stratification of the sample audience with equal distribution of interviews between survey days. Second, it is difficult to track the number of consumers in the radio industry, surveys are the most frequent method used to deduce consumer geography. Interviews are conducted every three months on the population aged 13 and above. For instance, during a survey from December 2015 to January 2016, 22,865 interviews from the Monday-Friday period and 11,084 interviews from the Saturday-Sunday period were conducted by Mediamétrie.

As for streaming services, it's important to note that I am only able to observe the number of music listening counts aggregated across all consumers. That is, I do not have individual-level data. The consumer from the four streaming platforms is calculated based on a cumulative click count per music listening longer than 20 seconds. If there is no play by any user, the observation is included as a zero. The "user-count" for streaming services is calculated as the number of consumers who listened to at least one song on the platform per day. I also have a "stream-count", which is the number of clicks the song was played across all users on the platform during per day.

For simplicity, I assume in this paper that consumers do not switch between radio and streaming services. Consumers from radio stations cannot change the playlist while listening to the radio stations. Also, consumers from streaming services should stick to the playlist. The user count is comparable to the audience data from radio, while the stream count gives a sense of user-driven preferences. Although it's difficult to gather the consumption data on each individual, I still believe that the consumption data I have is a good proxy to the listening audience.

## 2.4 Matching

The purpose of this procedure is to match song and artist name from the four streaming databases to the radio database. Before establishing the empirical relationship of interest, several technical obstacles must be overcome. First, I need to match messy data within the streaming datasets. Second, I need to identify each unique artist and title in streaming services and radio stations to construct our variety measures. For instance, artists such as “The Beatles” and “beatles” are counted as one artist, and not two. Additionally, song titles often have different versions. (e.g. remix in year “Ed Sheeran - Shape Of You (BKAYE Remix)” and Ed Sheeran - Shape Of You are counted as different titles)

### 2.4.1 Match messy data within streaming dataset

Due to problems with the encoding of accented characters in some of the datasets, the raw data contains messy characteristics for artist and title name. This happens often in the cases where songs are played in languages with special accents such as French and German. For instance, instead of “Champs-Élysées”, this famous French song might be displayed as “Champs-?lys?es” due to encoding problems. About 25% of my available streaming datasets contains messy artist and song names. Before I match the streaming dataset with the radio dataset, I need to clean the streaming dataset where artist and title names are displayed with the wrong characteristics.

In order to match the five datasets, ideally, it would be easy and fast to match artist and song based on ISRC codes. The meta data provides identical ISRC codes and permits a straight forward match between Spotify and other streaming services. It provides access to an extensive database of sound recording information, including the IRSC code of each artist and song name, music genre, and music production country, etc. The meta-data from radio, however, does not provide the ISRC code. To be precise, the radio dataset contains artist and song title but no ISRC code. I need to first match streaming data based on ISRC code using the meta data provided by Universal Music, then match it with radio data based on artist and song names. Thus, if I have many incorrect artist and song names, which don’t match radio names, I could be introducing bias into the dataset.

Before matching the streaming datasets with radio data, I create a new dataset of distinct

music products by merging the four streaming platforms together based on their ISRC ID. Once completed, I am able to extract 886,035 distinct music products, where 159,386 of them have wrongly-encoded artist and song titles. I am able to fix the incorrect information so that only 2% artist names and 1% song names remains un-identifiable. This match yields correctly-encoded artist names and song titles that can then be linked to the radio data.

- For all artists and titles, obtain the corresponding ISRC ID and aggregate all IDs together from the four streaming services. Drop those artist and song names with encoding problems.
- I match the right artist name and song name based on ISRC ID with the meta data.

#### 2.4.2 Unify song and artist name between streaming services and radio

Although each streaming service has a unique identifying number (ISRC) across all databases, radio does not identify artists and titles by ISRC ID but instead uses the name. Indeed, radio stations only report the name of song and artist. Not only can this information be slightly different from the name reported in the other two databases, it may also change over time because of encoding mistakes (for instance, a song name or artist name with a French accent may be wrongly displayed). I thus developed a matching algorithm to map artist and title between the corresponding datasets. The advanced methodology, described below, is a novel compared with other methods proposed by the other studies. Various algorithms have been developed to harmonize artists' names (see, for example, [Datta et al. \(2017\)](#)'s database for Spotify consumption from 2013 to 2014) but none of those have been applied to the French digital market.

In particular, I use a rigorous matching algorithm to link each artist and title with the ISRC ID from streaming services to the corresponding artist and title from radio. This new method, based on supervised learning, provides significant performance improvements relative to previous methods used in the empirical literature.

It is important to link the distinct artist and song name from the streaming datasets to the radio dataset. The metadata contains information on each song's name, but no uniform standard that can be readily used to cross-reference the data between streaming and radio. The

standards of naming the artist and song are different from streaming and radio. For example, we have “The Coldplay” from streaming, and “Coldplay” from radio. Or a music title with a remix or feat version, “Crazy by love” and “Crazy by love (remix)”, would be identified as different songs. In addition, it’s hard for the computer to identify between “Ed Sheeran” and “ed sheeran.” I need to be able to identify the unique artists and songs.

Table 2.5 presents an example of the matching procedure. I match the artist and song name in the following steps, whereby each subsequent step is performed on the unmatched cases resulting from the previous step:

- I use a combination of clear-text names to establish the linkage between streaming and radio datasets. For each identified and matched artist and title from streaming services, I link them to the radio data based on variants of their clear-text names in the following order:
  - Replace “&” with “and” in song names. For instance, “Reason Unknown (Body & Soul Remix)” to “Reason Unknown (Body and Soul Remix)”.
  - Remove articles such as “the” and “a” in the beginning of the song name. For instance, from “The Beginning” to “Beginning”.
  - Remove non-alphanumeric characters. For instance, from “Con Quién Estás?” to “Con Quién Estás”.
  - Replace numbers by letters in the beginning of the song/artist name (e.g., to match “10 Veranos Después” to “Ten Veranos Después”).
    - \* Note that I did not replace numbers by letters for the classical music, where it’s often the case where it contains numbers in the middle of a song. For instance, “Symphony No. 6 In F - Andante”
  - Account for collaborations (For instance, “Never Be Your Woman (Jaymo & Andy George’s Moda Mix) [feat. Emeli Sandé]”) by retaining only the foremost artist (“Jaymo”).
    - \* I implement this by removing text after the collaboration qualifier (feat, featuring, vs, versus, with, dash (-), slash (/), semicolon (;), plus (+), and (&, and), comma (,)).

- Changing artist and song names from all data sets to upper case and removing leading and trailing spaces. For instance, from “La Melodía de Dios” to “LA MELODIA DE DIOS”.
- Note that when I match titles, there are always different versions of the titles. I match titles based on artist, title, album together to make sure I match the right version of titles.

## 2.5 Aggregate data

This paper is the first to merge those five very large, datasets covering French digital music market. Merging week-level data from one streaming service to another streaming service is fairly straightforward as artist and title can be identified by its ISRC ID in both datasets. Thus, the main challenge is to match these datasets with radio stations.

### 2.5.1 Aggregate data to weekly level

I aggregate the radio and Spotify data to week-level in order to maintain consistency with Deezer, Napster, and Google, and also to lessen the computational burden. First, I allocate reported listening time in seconds evenly to the hours and days of the sample period. Then I aggregate to weeks. Note that I aggregate the audience number for the 34 radio stations by week as well, in order to match with the data of streaming services at the week-level. The unit of observation for all platforms is at the week level.

### 2.5.2 Aggregate data between streaming and radio

Now I have a total of 57,689,482 observations by platform-week-song level across all 5 channels. When I next match the radio and Spotify dataset based on song, artist and week, I am able to match 32,340 observations by platform-week-artist-song level. I am be able to match 11,419 mutually played songs between radio and Spotify, which is about 13.2% of the total number of songs (86,704) played on radio and is about 1.8% of the total number of songs (683,557) played on streaming. Now I have a total of 116,494 observations by platform-week-song level across radio and Spotify.

Note that the data provided by Universal Music only contains music from the Universal catalog, thus not the full catalog of music consumption. When I compare the number of artists and songs between radio and streaming, I do not restrict radio to the Universal catalog. The Universal's share of radio play for artist and title is 16.7% and 13.1% respectively, which I compute from Universal artists<sup>5</sup> or titles<sup>6</sup> played on radio to the total number of artists or titles played on radio. I keep artists and titles that are within the Universal catalog otherwise I have two different populations, artist and title within Universal catalog, and artist and title outside of the Universal catalog. Radio data includes songs that are both outside the Universal catalogue and streaming platforms. The concern arises when I compare the number of artists played on radio to the number of artists on streaming, I observe different populations of artists. I assume that Universal has the same share on streaming as on radio. Then I compare the number of artists on radio to the number on streaming within the Universal catalog.

### 2.5.3 Sample restrictions

Although our main music consumption data source is comprehensive, with more than 5.5 billion observations spanning over 5 different music services in 2016, I restrict our data sample for several reasons. The first is due to the process of matching radio with the streaming data mentioned above, which is most complete for music services on the week-level. I therefore impose this size restriction, which drops a large number of daily information but a relatively small share of aggregate music consumption. Second, I restrict our attention to the Universal Music catalog, dropping non-Universal music from the dataset. This further reduces our sample from 5.5 billion to 1.1 million observations. These remaining artist and titles are matched between Spotify and radio in the Universal Music catalog.

The dataset does not allow us to properly take into account the case of album sales, an issue which often arises when dealing with the measurement of music consumption. It's challenging to track the listening time once consumers buy a CD, for consumers may listen to the CD once or 1000 times for the same price. In this case, I cannot record the appropriate link between the

---

<sup>5</sup>I am able to match 6707 mutually played artists between radio and Universal Music catalog, which are about 16.7% of the total number of artists (40,093) played on radio

<sup>6</sup>I am able to match 11,348 mutually played songs between radio and Universal Music catalog, which are about 13.1% of the total number of songs (86,704) played on radio

music listening and consumption pattern for this consumer.

The datasets have three main shortcomings. First, this paper is missing the data from 2013 to 2015, a period of substantial growth in streaming platforms. I am not able to collect data until the end of the music ecosystem. Second, I observe song-week level or artist-week level data for only major platforms in France. Other online video music platforms such as YouTube are not studied nor is data from other countries. Third, the datasets used in this paper do not take into account concert tickets, merchandise sales, or royalty payments. Thus, I conjecture that the results would be strengthened if I had the needed information to include concert tickets and online video amongst the streaming services in the data sample.

## 2.6 Conclusion

This study provides a first step toward measuring the music variety between streaming services and radio in France. I design a data matching algorithm to clean artist and title names. The novel dataset generates 1,113,588 matches between Spotify and radio in the Universal Music catalog, among which 6707 artists and 11,348 titles are matched. By linking the streaming and radio dataset, I hope to reduce duplicative effort and provide support for the descriptive analysis in Chapter 3.

## Appendix

Table 2.1: Fun Radio on March 31, 2016 from 12-13 AM (source: Yacast)

Media	Time	Artist	Song	Language	Genre	Audience	Premiere	Duration	Age
Fun Radio	12:00:24	Sia	Cheap thrills	Anglo-saxon	Pop/Rock	314000	18/12/15	213	New
Fun Radio	12:04:05	Geronimo	Possédés	Francophone	Dance	314000	21/07/15	164	New
Fun Radio	12:07:07	J-Balvin	Ginza	Espagnol	Reggae	314000	24/07/15	159	New
Fun Radio	12:09:58	Global Deejays	Kids	Instrumental	Dance	314000	16/08/13	186	Recurrent
Fun Radio	12:13:11	Fifth Harmony - Ty Dolla \$ign	Work from home	Anglo-saxon	Groove	314000	26/02/16	203	New
Fun Radio	12:21:15	Jonas Blue - Dakota (Dance)	Fast car	Anglo-saxon	Dance	282000	29/12/15	202	New
Fun Radio	12:24:40	H-Magnum feat. Maître Gims	Pourquoi tu m'en veux?	Francophone	Rap	282000	15/01/16	197	New
Fun Radio	12:28:03	Sam Feldt - Kimberly Anne	Show me love	Anglo-saxon	Dance	282000	24/05/15	171	New
Fun Radio	12:36:12	Flo-Rida	My house	Anglo-saxon	Rap	257000	14/04/15	142	New
Fun Radio	12:38:48	R3hab - Headhunterz	Won't stop rocking	Instrumental	Dance	257000	20/09/15	174	New
Fun Radio	12:41:45	Makassy	Danse danse danse	Francophone	Groove	257000	01/09/15	175	New
Fun Radio	12:45:18	Dzeko & Torres - Delaney Jane	L'amour toujours	Instrumental	Dance	229000	16/08/15	134	New
Fun Radio	12:47:35	Chainsmokers - Rozes	Roses	Anglo-saxon	Dance	229000	17/07/15	208	New
Fun Radio	12:51:21	Pagadixx - Malee	Victory	Instrumental	Dance	229000	03/09/15	156	New
Fun Radio	12:54:01	Boostee	Feel alone	Francophone	Groove	229000	16/12/15	165	New
Fun Radio	12:57:10	Italobrothers	Welcome to the dancefloor	Anglo-saxon	Dance	229000	12/06/15	163	New

Table 2.2: Spotify on March 31, 2016 (source: Universal Music)

ISRC	Time	Total	Premium	Adfunded	Lean forward	Lean back	Album	Artist	Collection	Search	Playlist	Undeveloped	Other
DEF059130826	2016-03-31	1	0	1	0	1	1	0	0	0	0	0	0
DEN960300061	2016-03-31	1	1	0	0	1	0	0	1	0	0	0	0
GBF077130131	2016-03-31	1	1	0	0	1	0	1	0	0	0	0	0
DEF059331503	2016-03-31	1	1	0	0	1	0	0	0	1	0	0	0
GBF071540425	2016-03-31	1	1	0	0	1	1	0	0	0	0	0	0
GBAAA1340018	2016-03-31	10	4	6	2	8	0	0	7	0	0	1	2
GBAAA1200018	2016-03-31	15	8	7	3	12	1	1	9	0	1	1	2
GBAAA1203418	2016-03-31	6	4	2	1	5	0	1	3	1	1	0	0
DEFAA1206781	2016-03-31	44	27	17	10	34	1	3	28	1	9	2	1
DEFAA2252418	2016-03-31	24	21	3	6	18	1	2	14	0	6	1	0
DEFAA9789789	2016-03-31	17	0	17	1	16	0	0	13	2	1	1	0
GBAAA1397430	2016-03-31	1	0	1	0	1	0	0	1	0	0	0	0
GBFAA2737983	2016-03-31	1	1	0	1	0	0	0	0	0	1	0	0
GBF077740910	2016-03-31	1	1	0	0	1	0	0	1	0	0	0	0
GBBBA1043610	2016-03-31	1	1	0	1	0	0	0	0	0	1	0	0
GBF077740910	2016-03-31	1	1	0	0	1	0	0	1	0	0	0	0
NLA507623106	2016-03-31	1	0	1	0	1	0	0	1	0	0	0	0
USUM70604996	2016-03-31	1	1	0	0	1	0	0	1	0	0	0	0

Table 2.3: Variable Definition of Spotify dataset, for year 2016

Variable	Definition
total_user_count	Number of unique users who listened to the title at least 1 time
premium_user_count	Number of paid users
adfunded_user_count	Number of free users, who are exposed to advertising
lean_forward_user_count	Number of users from the active users. Consumers who stream from the collection, undeveloped playlist, search, or artist album page are active. Consumers search music which track back from their listening library.
lean_back_user_count	Number of users from the passive user. Consumers who stream from editorial playlists and other page streaming passively.
album_user_count	Number of users who listened to the song from the album page
artist_user_count	Number of users who listened to the song from the artist page
collection_user_count	Number of users who have listened the music from the collection page (either the library or its own personal playlists)
search_user_count	Number of users who listened to the song from the search page
playlist_user_count	Number of users who have listened the music from the playlist page recommended by Spotify.
undeveloped_user_count	Number of users who listened to the playlist with fewer than 100 unique users per week
other_user_count	Number of users for the rest songs total_user_count =premium_user_count+adfunded_user_count =lean_back_user_count+lean_forward_user_count =album_user_count+artist_user_count+collection_user_count +search_user_count +playlist_user_count +undeveloped_playlist_user_count+other_user_count

Table 2.4: Summary statistics of Spotify by song-day level, on January 2016

Variable	Mean	Std. Dev.	Min.	Max.	N
total_user_count	4.51	27.38	1	4732	42839960
premium_user_count	2.51	17.01	0	3588	42839960
adfunded_user_count	2	13.1	0	2551	42839960
lean_back_user_count	1.56	13.85	0	2018	42839960
lean_forward_user_count	2.97	18.13	0	3958	42839960
album_user_count	0.49	3.46	0	979	42839960
artist_user_count	0.48	2.08	0	1235	42839960
collection_user_count	1.8	14.03	0	3210	42839960
search_user_count	0.12	1.07	0	450	42839960
playlist_user_count	0.86	8.65	0	1250	42839960
undeveloped_user_count	0.12	0.70	0	237	42839960
other_user_count	0.70	7.13	0	1521	42839960

Table 2.5: Matching procedure

<b>ISRC</b> ISRC	<b>Before</b> Artist	<b>Before</b> Title	<b>After</b> Artist	<b>After</b> Title	<b>Procedure</b> Procedure
ATR700400204	3 Feet Smaller	Reason Unknown (Body & Soul Remix)		Reason Unknown (Body and Soul Remix)	Replace “&” to “and”
AEA041001197	Said Mrad	The Beginning		beginning	Remove articles in the begin- ning of the song name
ARA491500108	Sera Panico	10 Veranos Después		Ten Veranos De- spués	Replace numbers by letters
AEA040700578	Salma & Ziad Rahbani	The Same -Nafs Al Sheghlat	Salma and Ziad Rahbani	The Same Nafs Al Sheghlat	Remove non-alphanumeric characters “-” and trailing spaces
AEA040900923	Rony Barrak	Tabla “n” Funk		Tabla n Funk	Remove non-alphanumeric characters “ ”
ARF041000156	Cacho Castaña	Con Quién Estás?		Con Quién Estás	Remove non-alphanumeric characters “?”
AEA041000811	Fadi Tolbi	Tareeq Al Sa’adah		Tareeq Al Saadah	Remove non-alphanumeric characters “’”
AEA041000812	Fadi Tolbi	Tareeq Al Sa’Adah		Tareeq Al SaAdah	Remove non-alphanumeric characters “’”
AEA041000878	Salma & Ziad Rahbani	Band / Oghnyat Al Ors	Salma and Ziad Rahbani	Band Oghnyat Al Ors	Remove non-alphanumeric characters “/”
AEA041001217	Elie Attieh	Spring (Al Rabii)		Spring Al Rabii	Remove non-alphanumeric characters “( )”
ARF049900084	Kapanga	Miami//Frag. “Never Let Me Down Again”		Miami Frag Never Let Me Down Again	Remove non-alphanumeric characters “//”
NLA508321108	Carolyn Walkinson	Bless’d be the Lord “ - ” What though I trace		Bless’d be the Lord What though I trace	Remove non-alphanumeric characters
GBAAA1000019	Wiley	Never Be Your Woman (Jaymo & Andy George’s Moda Mix)		Never Be Your Woman Jaymo	Account for collaborations by retaining only the foremost artist
ARA491200102	Tan Biónica	La Melodía de Dios	TAN BION- ICA	LA MELODIA DE DOIS	Put artist and song names to higher case

Note: I do the same procedure for radio as well, then match artist and song name between streaming and radio.

---

### Music Streaming: Effects on Variety and Types of Music Consumption

---

#### Résumé

Les services de musique en continu ont gagné en popularité au cours de la dernière décennie, soulevant des questions sur leurs effets sur la diversité musicale et la consommation de musique. Les services de diffusion en continu permettent aux consommateurs d'avoir accès à un plus grand nombre de contenus musicaux. Dans cet article, je propose une analyse descriptive de l'impact de la croissance des services de streaming et de la radio sur la variété musicale et la consommation musicale et nous essayons de déterminer si ces deux plateformes se différencient les unes des autres. Pour fournir des preuves sur cette comparaison, j'utilise un ensemble de données complet sur la consommation de musique en France pour l'année 2016. Je déduis que les différentes chaînes musicales et catégories fournissent des incitations différentes sur les décisions des artistes de distribuer du contenu musical.

## **Abstract**

Streaming music services have gained in popularity in the past decade, raising questions about their effect on music variety and music consumption. Streaming services allow consumers to gain access to a larger pool of music content. In this article, I provide a descriptive analysis of the impact of the growth of streaming services and radio on music variety and music consumption and we try to find whether these two platforms differentiate from each other. To provide evidence on this comparison, I use a comprehensive dataset on music consumption in France for the year 2016. I deduce that various music channels and categories provide different incentives on artists' decisions to distribute music content.

### 3.1 Introduction

Music streaming services have developed rapidly in France in recent years. According to the French SNEP<sup>1</sup>, revenues from streaming almost tripled between 2013 and 2016. Streaming services have expanded consumer music options, 62% of consumers listened to music content recommended by streaming services in 2016<sup>2</sup>, suggesting that consumers rely on the editorial function of streaming as we know they do for radio.

Music services cater to different types of music consumption with heterogeneous consumer preferences. Radio stations offer consumers a pre-programmed set of songs. Consumers cannot actively select the songs they want to listen to or even observe the order of the tracks to be played. Radio competes for audiences through the quality of its editorial services or selection of playlists. In contrast, streaming services such as Spotify allow consumers to build their own playlists for free or to pay a small amount of subscription fee.

In addition, media regulations in France, such as cultural quotas, may also affect music consumption. Radio stations need to comply with a specific form of media regulation: they are required to broadcast a minimum of Francophone music content. Streaming services face no quotas. While quotas can naturally ensure visibility and access for less attractive traditional channels, this exposure can be weakened by the entry and the development of streaming services. Streaming services provide consumers with a more diverse set of choices. It is true that radio stations could introduce their listeners to a larger amount of French music if they played fewer foreign songs. However, cultural quotas seem to have a limited scope in the long term. The fragmented nature of the market for audiovisual content and the free entry of on-line platforms will likely prevail.

The goal of this paper is to provide a descriptive analysis on music variety and music consumption between radio and streaming services in France. This paper aims to tackle the following question: how music consumption and music variety on streaming services compares to that on radio.

As far as I can tell, no existing study has distinguished between the various types of streaming services and their corresponding functionalities to music consumption. To answer the question,

---

<sup>1</sup>French National Syndicate of Phonographic Publishing

<sup>2</sup>See Page 38 from <http://www.snepmusique.com/wp-content/uploads/2017/06/GUIDE-ECO-web.pdf>

this paper addresses the relationship between streaming services and radio stations, while controlling for a variety of factors that may affect music consumption, including music characteristics such as genre, language, age<sup>3</sup>. By doing so, our analysis relies on a dataset that enables us to follow the major terrestrial radio and streaming services in France for 2016.

Our data for that year covers a period in streaming with some variation in the growth patterns across platforms. Using this novel dataset described in chapter 2, I provide the first descriptive evidence of music variety and types of music consumption in France. In the descriptive statistics, I consider the music consumption between streaming services and terrestrial radio, and find they are highly heterogeneous, both in the volume of music content, and in the music variety provided.

The paper presents several results. Firstly, streaming services play more gold songs, while radio stations play more new songs. Secondly, song concentration is higher in radio than streaming, while artist concentration is higher in streaming than radio. Thirdly, consumers from streaming services listen to more music produced in France. Lastly, radio and streaming services share similarity in playing hit songs. Altogether, the above results give a hint on how artists could distribute their music to different music channels.

The rest of the paper is organized as follows: Section 3.2 provides a review of the literature that is related to the study. Section 3.3 introduces the background of the music market in France. Section 3.4 presents descriptive findings. Section 3.5 concludes.

## 3.2 Literature

[Nelson \(1970\)](#) posits that music is inherently an experience good; its true value is unknown a priori and is only revealed after consumption. Music variety and music consumption, a central issue at the heart of consumer welfare, is surprisingly limited in the discussion.

A key contribution of this paper is that I take into account the increased use of streaming services for music consumption and discovery, and how this may affect the music diversity that consumers demand on other music distribution channels. Usually, the measure of diversity used in the literature is the share of cultural content broadcast at the equilibrium where consumers

---

<sup>3</sup>Music age denotes whether the music content is new, gold or recurrent. I compute the music content based on the age of the content played. “New” music is that with a premiere within the previous year. “Recurrent” music is defined as having premiered 1-2 years ago, and “gold” is older than 3 years.

have heterogeneous preferences (De Bens and De Smaele (2001), Richardson (2006), Lee and Bae (2004), and Anderson and Coate (2005)). Streaming services can have important effects on music diversity, but the direction of change is not clear. Nguyen et al. (2014) survey 2000 French consumers, and find that consuming streaming music has no significant effect on physical sales.

An alternative view is that with the growth in the number of streaming services, music variety and music consumption rises. Datta et al. (2017) use a difference in difference approach to study the effects of Spotify adoption on individual music consumption and discovery. They find that users switching from owning (e.g. iTunes) to streaming (e.g. Spotify) start to listen to music from a more diverse set of artists and discover artists that are new to them. They also find that the adoption of Spotify increases overall music consumption. Zhou et al. (2016) find that streaming services like YouTube have a positive effect by helping consumers comb through the vast amount of content available on the platform.

This paper first relates to papers demonstrating that different types of artists, mainstream artists and new artists, could benefit disproportionately from different digital channels (Fleder and Hosanagar (2009), Oestreicher-Singer and Sundararajan (2012), Oestreicher-Singer and Sundararajan (2012)) On one hand, popular artists may become even more popular through intricate recommendation algorithms and global attention. On the other hand, new artists face fewer technological and commercial barriers to entry, giving them a chance to gather a following in specialized communities via digital channels.

There is a substantial policy related literature that discuss cultural quotas. For example, Acheson and Maule (1990) think that although content policy may contribute to a better mix of programming, the effect is indirect, and can be offset by new technology. Hervas-Drane and Noam (2017) find the regulatory quotas are not a desirable status quo and can be limited by technical or political changes. However, he focuses on the share of domestic music, which a quotas impact directly, rather than its diversity. Perona (2015) suggests that quotas reduce the music diversity of domestic content. All the papers cited above use a crude measure of cultural regulation and do not consider any strategic responses to the regulations by radio and streaming platforms.

This paper also contributes to the literature on music consumption. As far as I can tell, no existing empirical study has investigated music diversity and consumption between radio and

streaming services. Other studies have examined music consumption between streaming and album sales (Danaher et al. (2010), Walter and Hiller (2017), Aguiar and Waldfogel (2017)), or between radio and album sales (Liebowitz (2004)), and not with respect to cultural quotas. Hiller (2016) finds that the music consumption of physical albums increased when streaming platforms such as YouTube remove its music content from Warner Music in January 2009 and restore its service later in October 2009. Aguiar (2017) exploits the introduction of a listening cap by Deezer to identify the effect of freemium and premium service on music consumption. He finds that freemium streaming has a positive effect on alternative channels of music consumption.

### 3.3 The French music market

Streaming services are varied based on territory, variations in licensing requirements, and cultural norms. For instance, Europe remains a highly diverse region, with markets adopting streaming formats at different rates. Overall, the European streaming market grew by 4.0% in 2016, a slightly higher rate than the 3.7% growth in 2015.<sup>4</sup> France is now the 3rd largest streaming music market in Europe. In this section, I introduce the main competitors of music services in France. Growing adoption of streaming services have changed how, and at what cost, consumers access digital information.

#### 3.3.1 Major music services in France

At present, there are numerous music streaming providers offering comparable services and music content in France. Deezer is a company which, like Spotify, is a European start-up without a large corporate backing. Deezer does not have many distinctive features, but they provide a slightly larger music selection compared to the other 3 streaming services. Deezer lost subscribers during 2015, in a time in which the overall music streaming market saw a surge in the amount of subscribers. Nonetheless, Deezer has a large number of premium consumers as the result of their agreement with Orange mobile in France: over 3.3 million subscription consumers can use Deezer without paying extra fees, and these users are counted as premium consumers. Deezer therefore stands as the largest streaming platform in the French music market. The second

---

<sup>4</sup>see page 13 from IFPI report <http://www.ifpi.org/downloads/GMR2017.pdf>

largest among them, Spotify, has over 140 million active users worldwide (as of June 2017).<sup>5</sup> Prominently missing from our dataset is Apple’s streaming service, Apple Music. Although it is currently one of the major global competitors with about 30 million subscribers worldwide in September of 2017, they are struggling to achieve a higher market share in France. The music variety provided by types of streaming services and pattern of music consumption is rapidly becoming an almost entirely digital proposition.

To see how consumers decide to choose which streaming services to use, I need a quick detour into the payment format utilized by different platforms. A comparison between the different streaming platforms can be found in table 3.2 in the appendix. Streaming services, such as Spotify and Deezer, are ordered by their current user base (premium + freemium users)<sup>6</sup>. Of Spotify’s 140 million users, one quarter pay 9.99 euros per month for the streaming service. The freemium consumers pay nothing but have to tolerate advertising and have limited control of when they can listen to a particular song. In general, the price of other streaming services is lower in France.

Radio, on the other hand, offers free services to audiences.<sup>7</sup> Before the popularity of streaming services, terrestrial radio worked as the main tool for music discovery. Because streaming services tend to describe themselves as new tools for music discovery,<sup>8</sup> radio now faces increasing competition from streaming services for the attention of music listeners.

It seems that the music industry in France is experiencing through a transition period as streaming services increase rapidly. Since consumers do not choose between streaming services based on price, the music variety provided by streaming services and radio will be a major concern. This raises the interest possibility of studying music consumption between streaming and radio.

---

<sup>5</sup>See details from <https://press.spotify.com/us/about/>

<sup>6</sup>Premium users can have full control over what they want to listen to on both fixed devices and mobile devices, while freemium users also have entire control on fixed devices, but have less control on mobile devices, where they cannot “skip” the playlists more than three times in one hour.

<sup>7</sup>Berry et al. (1999) demonstrated that radio stations in each market were symmetrically differentiated.

<sup>8</sup>For example, Spotify offers services such as new music recommendation to make sure that new songs and artists get exposure.

### 3.3.2 Regulatory barriers

Media regulations in France were motivated by the declining diversity of music content. The legislation proposed that commercial and private music stations, whose primary programming is music, should play a certain percentage of music content for a set period of time during the day. Regulation can take many forms, even within the same regulatory framework for a particular industry. This, in turn, can offer insight into the effects of different types of regulations.

The stated goal of this regulation is to protect French culture and increase the diversity of music offered. Quotas vary by station format: stations with younger audiences generally have lower Francophone quotas than “heritage” stations, and public stations face different quotas than privately-held stations. Public stations and national stations have higher quotas in general (as well as higher audiences). The public stations, needing to play 50% or more French music. In response to complaints from some radio stations about the difficulty in meeting the 40% quota (as well as concerns that to do so, they played a small set of French songs many times), the quota for some stations was lowered to 35% in March 2016.<sup>9</sup>

Regulations vary across station format. The 34 radio stations in France are spread across the four quota categories with 35% and 40% categories comprising the largest sample of stations. These quotas may affect the behavior of stations because: in its absence, presumably, Francophone or new artists would have less exposure. By changing the composition of radio programming, the quotas may also affect the consumption of radio as well as the diversity of music played on French radio stations. The quotas may ultimately affect the ability of French radio stations to compete with other forms of entertainment by limiting how radio can respond to consumer demand. If quotas have the effect of lowering demand for radio, and subsequently those stations’ advertising revenues, they may threaten the sustainability of the radio industry.

## 3.4 Descriptive statistics

The music media presents a number of interrelated services that compete in multiple market settings in France. For decades, radio has provided programming to listeners free of charge, introducing its audience to new types of music entertainment and new artists. It is widely be-

---

<sup>9</sup>See <http://www.telerama.fr/radio/les-quotas-francophones-a-la-radio-ont-ete-assouplis-mais-la-bataille-continue,140122.php> Les quotas francophones à la radio ont été assouplis...mais la bataille continue.

lieved that radio stations, record labels, and artists enjoy a symbiotic relationship; the recording industry utilizes radio to promote its artists and music to hundreds of millions of listeners, while radio attracts listeners by airing music content. While this benefit is widely acknowledged, the streaming platforms' role had not been adequately quantified using rigorous econometric research methods.

Streaming services provide an alternative business model, which gives consumers greater choice. In the meantime, radio stations provide a music selection service for discovering and listening to new releases. Listeners could first hear new music on the radio, then seek out and gain access that same music on streaming services. When consumers have a greater choice from a larger music library provided by streaming services, the editorial or curating role of terrestrial radio may be smaller. Will this increase the total size of the music market? Or will it shift the share of market away from artists or publishers?

Measuring music variety is complex and difficult [Alexander \(1997\)](#). Recent research conducted on this issue has been flawed because of poor methodology, failure to include important data, and interpretation of results using an inappropriate market context. This section of descriptive analysis is designed to address these methodological challenges by using appropriate measures of music consumption, correcting data deficiencies, and utilizing an appropriate study design.

To answer these questions, this study examines the music variety and music consumption between streaming services and radio in 2016 in the French music market. Descriptive statistics were developed to address the relationship between streaming services and radio, while controlling for a variety of factors that may affect music consumption, such as music genre and music language.

The following sections provide a summary overview of the total sales of streaming services and radio for the purpose of providing context to the analysis of music consumption. The section begins with a discussion of music variety, identifies specific consumption trends, and concludes with a more detailed discussion of some of the important elements of the symbiotic relationship between streaming and radio.

### 3.4.1 Overview of streaming services and radio

As introduced in section 3.3, the last decade has been a turbulent period for the music industry. Beginning with Napster and the recent popularity of Spotify and Deezer, there has been a steady erosion of traditional music consumption channel such as radio and physical album sales. Streaming may affect consumption behavior in several potential ways. After subscribing to a streaming service, users might increase their consumption of music both in quantity and in variety; they also discover more new music, and tend to play repeatedly their favorite songs.

Industry sales trends for streaming services and radio are presented in figure 3.1. Figure 3.1 plots the total number of plays of all songs by week for the platforms alongside our radio broadcasting measure. The left y axis denotes the total number of plays for four streaming services, while the right y axis is the total audience number for radio stations. Radio audience had obvious peaks during the summer weeks (from week 28 to week 32). It is revealing that, over the same time period, some streaming services increased dramatically. The figure shows that the usage of Spotify grew steadily and had a big leap in the end of 2016, while Google and Napster remain stable. Deezer began in 2016 as the most popular streaming platform in France. Deezer's numbers were high because a subscription was included in many phone plans from Orange. If I exclude those subscriptions, the number of subscribers or users may decline.

### 3.4.2 Streaming services play more gold songs, radio stations play more new music

Audience preferences have changed over time, reflecting changing demographics as well as the impact of the technology changes described earlier. Streaming may affect consumption behavior in two potential ways. First, streaming may have an impact not only on the quantity of content that is consumed but also on its variety. Second, streaming may transform content discovery by allowing users to find a bundle of music content more efficiently. An important challenge for this research would be to build a model that can measure the audience's change in music consumption across various platforms, while shedding light on the underlying mechanisms.

I manually extract the 6th and 7th digit which denotes the year of music release from the ISRC code. I use the same definition of music age from previous research on the radio industry. I also have the release date from the radio dataset. I can identify the new songs that have been

played on those platforms. “New” music is music content released within the previous year. “Recurrent” music is defined as having premiered 1-2 years ago, and “Gold” is older than 3 years.

I find that consumers consume more gold music from streaming, while they consume more new music from radio. Figure 3.2 and Figure 3.3 represent the diffusion of music age by types of consumption. Note that Google music and Napster are all paid subscription streaming services (no freemium services) in France. In order to compare the types of consumptions across all the streaming platforms, I also include Napster and Google in the figure as well. As shown in Figure 3.2, consumers from streaming services consume more gold music, while consumers from radio stations consume more new music.

Although streaming services give their audience more access to a variety of program categories and genres than radio do, audience tend to listen to more gold music on streaming services. Radio, on the other hand, aired more new music.

### **3.4.3 Song concentration is higher in radio than streaming**

I measure the symbiotic relationship between streaming services and radio by comparing the number of music diffusions and artist and song plays across the five platforms.

Figure 3.4 shows the total number of distinct diffusions for the streaming services. The weekly diffusion numbers for Spotify and Deezer are much higher than Napster and Google. Table 3.1 shows the total number of distinct artists and distinct songs for the five datasets. Song concentration is higher in radio than streaming. Radio stations provide a variety of content formats, including different music genres. Although stations can use a blend of programming, there are benefits to providing a consistent format. Traditionally, high song concentration promotes less music diversity but higher audience exposure, which is attractive to advertisers that wish to target specific market segments.

### **3.4.4 Artist concentration is higher in streaming than radio**

I generate the top 10, top 100, top 1000, top 10000 songs played from each streaming platform individually, to measure the concentration of hit music. Similarly, I have the top 10, top 50, top 500, top 5000 artists played from each streaming platform as well.

Figure 3.5 through figure 3.8 present the distribution patterns for the top songs and top artists. The y axis denotes the cumulative share of top songs/artists, while the x axis denotes the number of songs/artists for the 4 streaming services. Those figures show the percentage of top songs and top artists played for each streaming service and radio separately. Ideally, the higher the percent of top music consumed, the lower the music diversity would be since less music will be consumed by consumers.

As Figure 3.5 shows, the consumption pattern for the top songs do not vary much across the four streaming services. But when I compare the top 100 and top 1000 songs consumed, radio is almost 13.6% and 28.7% higher than Google, and is almost 9.4% and 23.3% higher than Spotify. This means that consumers from streaming services are likely to listen to more different songs compared to radio. From Figure 3.7 and Figure 3.8, I find that the concentration of top 10 songs for streaming artists is higher than that of top 10 songs in radio, which means a higher rotation rate of artists are played.

While streaming services play more songs but fewer artists, radio is the opposite. The difference is probably caused by the album search service provide by streaming.<sup>10</sup> Hit artist concentration is higher in streaming than radio. These figures make it clear that radio is becoming less concentrated with a handful of artists. To say this another way, the increase in the number of available products seems to be manifested in the growth in the number of products achieving commercial success. This fact is interesting in itself, as it indicates a shift toward consumption of a broader array of music from radio. Radio creates opportunities for new artists and smaller independent labels to succeed in the competitive marketplace.

### 3.4.5 Consumers from streaming services listen to more music produced from France

Traditionally, regulators set cultural quotas with the goal of ensuring visibility and access for a less well-known artists. The original matrix of quotas was designed in a less competitive framework in the context of a limited number of linear chains. The arrival of new technology and other music platforms challenged the linear model and made it increasingly difficult for

---

<sup>10</sup>Note that artist concentration on physical sales is much higher than for streaming or radio. The cumulative share of top 10/ top 100 artist on physical sales is 33.8% and 73.2% separately. Streaming may promote more artists for physical sales.

the applicability of quotas in the radio broadcasting industry. Radio stations have lobbied to loosen quotas and argued that they have more competition from streaming music, which face no quotas. When consumers can find a set of substitutable goods, the quota loses its meaning in competition with outside players. Streaming services are trying to expand their portfolios and enhance their overall attractiveness to provide consumers with a more diverse set of choices. The popularity of streaming services is changing the relevance of the quotas. Services such as Spotify allow consumers to conduct their own playlist for free or to pay a small amount of subscription fee.

Figure 3.9 shows the average share of Francophone music played for each platforms during 2016. I calculate the fraction of Francophone plays to total music played for the four streaming platforms, radio stations as a whole, radio stations that need to play at least 35% Francophone music, and radio stations that need to play at least 40% Francophone music. I compare this fraction to the minimum percentage specified by the quota regulations (with a red line denoting the 40% Francophone quota).<sup>11</sup> It is clear that stations that belong to 35% and 40% quota levels fall short of perfect compliance with their Francophone quotas.

Radio stations argue that quotas can be weakened by changes and improvement in technology, such as streaming services. French regulations specify Francophone play as a function of songs played, although the actual audience reached is arguably more relevant for the regulatory aim. Contrary to the stations' argument that the Francophone quotas lead to a low audience number, Streaming services play more Francophone music than radio stations. These patterns beg the question of how regulatory quota can increase music diversity which is the ultimate goal for the regulators.

The quotas also require that stations play at least 20% new Francophone music. Figure 3.10 shows the differences of Francophone play across music age during year 2016.<sup>12</sup> As to the average share of new Francophone music of radio stations, the figure shows that stations turn out to be statistically higher than the regulated quota at 20.6%. Streaming services play more gold Francophone music, while radio stations play more new Francophone music.

---

<sup>11</sup>Radio stations have been different percentage requirements of total song plays for French-language songs. The baseline regulation stipulate that Francophone songs should comprise at least 40% of total plays. See <https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000363209> la loi du 1 février 1994

<sup>12</sup>Music age here denotes whether music is new, gold or recurrent.

### 3.4.6 Radio and streaming services share similarity in playing hit songs

The conventional wisdom is that radio promotes sales. This belief is certainly consistent with the anecdotal evidence, including the fact that record companies pay large sums to promote their releases. The exposure to radio is a primary method of learning about music. Unfortunately, there has been little methodology for studying music consumption since the advent of popular streaming services. With this change in delivery of a bundle of music content, artists may begin to change how they create and deliver music. As the popularity of streaming services increases the profitability of using a hits strategy, creating fewer singles and releasing them independently will become more common. It's therefore important for the artist to know whether a song will become a hit on radio first or on streaming first, and how this differs by music genre, or music language. The purpose of this section is to explore music consumption patterns between radio and streaming during our sample period, and how the two services may diverge.

It is challenging to measure the correlation between radio and streaming. On one hand, radio has data on the weekly average audience during 15-minute intervals for each station, allowing me to measure the audience to any particular song in a 15-minute interval. On the other hand, streaming has data on the number of music listening counts aggregated across all consumers. The sales number is collected by counting one streaming click as one song.

I match the weekly aggregated dataset for radio and Spotify<sup>13</sup> together based on artist and title by week. The match data from Spotify and radio account for a relatively higher percent of music consumption. The mutually played songs take about 40% and 35% of the total music consumption from streaming and radio respectively, which provides meaningful indications of the music consumption from both channels. Figure 3.11 plots the sales diffusion of the top 30 played songs on Spotify and the sales diffusion of those 30 songs on radio according to our matched dataset. The left y-axis is the number of total users (in tens of millions) from Spotify across weeks for 2016. The right y-axis denotes the number of total audience (in tens of millions) from radio stations. Here, I use an example of radio and Spotify, which I assume has similar crossover with other streaming services. From the figure, I can find certain patterns between

---

<sup>13</sup>I start the analysis by matching Spotify and radio because the dataset on Spotify provided detailed information on different categories. I can therefore compare the music consumption pattern between radio and various categories (for example, Spotify has lean back, lean forward, freemium and premium categories ) within Spotify. Unfortunately, other streaming services do not provide detailed information on various categories for now.

streaming and radio, where platforms have similar peaks and parallel trends after the peak. For the top 30 songs played, 7 songs are recurrent music, and the remaining 23 are new music.

It is important for the artists to know whether the timing of distribution of their songs to different platforms matters for their revenue. Figure 3.11 shows that over half of the hit songs were released on radio first, and the other half released almost the same time on both radio and streaming services. The generic endogeneity challenge here is that streaming and radio broadcasting may both be driven by the time-varying interest in a song. Audience demand from radio stations should respond to a DJ's music selection. The audience from radio stations, may be higher as well at times of high sales, for example, during certain seasonal peaks or the time period shortly after the release of new songs. Therefore, after a few weeks from the first release date, a particular artist can be of interest to consumers via both channels.

In addition, streaming services can broadly be divided into two distinct categories: interactive and non-interactive services. As mentioned in the former section, lean forward<sup>14</sup> on Spotify denotes the channels where users actively arrive through listening to a collection or playlist. Spotify may distribute songs in different ways, such as new releases made available on a playlist or the collection page streaming services during periods of high demand (e.g. around the songs release). Lean back<sup>15</sup> sums up the 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 lean forward services, which offer consumers the liberty to pick the songs they want to listen to. Understanding the potential differences across different services within streaming services is important for artists who contemplate its integration into a strategy.

Figure 3.12 plots the sales diffusion of the top 30 played songs on Spotify and the sales diffusion of those 30 songs on radio according to the final dataset. Lean forward on Spotify resembles radio in the timing of music play. Over half of the hit songs released were on radio first, which is consistent with the traditional model where radio served as a main tool for music discovery. Consumers may listen to the music from radio first and switch to streaming services after.

---

<sup>14</sup>Users from the lean forward category denote active users who stream from the collection, undeveloped playlists, search, or artist album page. Consumers search music which track back from their listening library.

<sup>15</sup>Users from the lean back category denote passive users who stream from editorial playlists and other page streaming inactively.

Note that I have no direct information on the relationship between the streaming time pattern of a particular song or artist across streaming platforms. To what extent streams on different services are correlated to music exposure, the use of streaming data individually might yield an unbiased estimate of streaming services' impact. Furthermore, if streaming services promote a particular music content, it is not clear that there is an overall effect of streaming on music exposure. If I observe lower audiences when a song is played, I don't know whether this reflects audience shifting to other platforms (because consumers don't like this kind of music) or the overall impact of that song.<sup>16</sup>

### **3.4.7 Summary: How artists distribute music content to different music channels**

Altogether, the above results indicate that music content distributed through different music channels provides different incentives on artists to deliver music contents. The marketability of an artist is only known after consumers have been exposed to the product. In reality, it's difficult to predict the success of music consumption, especially for the unknown artists, at the time when music is put on the market. Only a small minority of artists whose albums are released are profitable. Streaming services use a different reward structure and payment format: they pay the same royalties per play to artists based on the number of times a song is played. Thus, artists that are more well-known command higher revenues.

Streaming services offer a mixed bundle of songs from hit artists, while radio offers songs from new artists. The variation across streaming services and radio implies that creating a mixed playlist on streaming provides greater music exposure for hit artists, and that distributing songs on radio provides greater music exposure for new artists. Artists can take advantage of the streaming market to increase profits over what could be earned in the competitive market.

In addition, while it is still early in the shift toward streaming services and despite currently remaining similar to the radio markets, the descriptive analysis indicates that there is the potential for substantial impact on how artists could distribute their music content to different digital channels, on what sequence and on which channels.

---

<sup>16</sup>Note that our audience from radio stations measure is an average across weekdays and weekends within a week for a given 15-minute interval, so it does not pick up real-time changes in audience behavior.

### 3.5 Conclusion

Technological progress changed, and will continue to change, the variety of music content and the pattern of music consumption. Streaming services are still relatively immature, but some signs of a promotional effect of music sales can be seen from existing data.

This study provides a first step toward measuring the music variety between streaming services and radio in France and analyzing how the main two platforms distribute music content in the early transition of digital music during 2016 in France.

I find that radio has a much lower number of distinct artists and songs compared to streaming services. However, streaming services have more gold song broadcasts, while radio stations have more new songs. Song concentration is higher in radio, while artist concentration is higher in streaming. Consumers from streaming services listen to more music produced in France. I also pay particular attention to how artists may distribute music contents to different channels within Spotify and radio that vary with the heterogeneity of music consumption. Traditionally, radio worked as a main tool for music discovery. With the popularity of streaming services, consumers may listen to the music from radio first and switch to streaming services after. However, I find that radio and streaming services share similarity in playing hit songs. Spotify and radio have similar peaks and parallel trends after the peak. In addition, lean forward on Spotify resembles radio in the timing of music playing.

Altogether, the above results give an insight as to how artists could distribute music to different music channels. Streaming services have the potential to change the way in which music is made, bundled and delivered. The success of streaming has upended lots of conventional wisdom in the music industry: the need for a physical product, the dominance of superstars, and the boundaries between genres and between old and new music.

Our results have three main shortcomings. First, this paper is missing the data prior to a period of substantial growth in streaming, from 2013 to 2015. I am also unable to collect data for current broadcasts. Second, I observe song-week level or artist-week level data at only major platforms in France, not in the other online video music platforms, such as YouTube, and not in other countries. Third, the datasets used in this paper do not take into account concert tickets, merchandise sales or royalty payments.

Nonetheless, the preliminary results presented in this paper are what I can do at this stage.

As this transition continues, understanding the relationship between streaming and radio stations will be crucial to both our understanding, as well as the operation, of the recorded music industry. Additional work would be helpful to provide more confidence in the findings. It would be desirable to conduct studies at the song-week level for streaming services to see whether they stimulate or depress physical album sales, and to study the impact of the sales of individual album to bundled sales of streams<sup>17</sup>. Future studies might attempt to include these additional factors.

---

<sup>17</sup>Streaming services may be better viewed as a form of promotional channel in a bundled sales of music content. Bundled sales of zero marginal cost products hold the promise of raising revenue, consumer surplus, or possibly both.

## **3.6 Main part of paper**

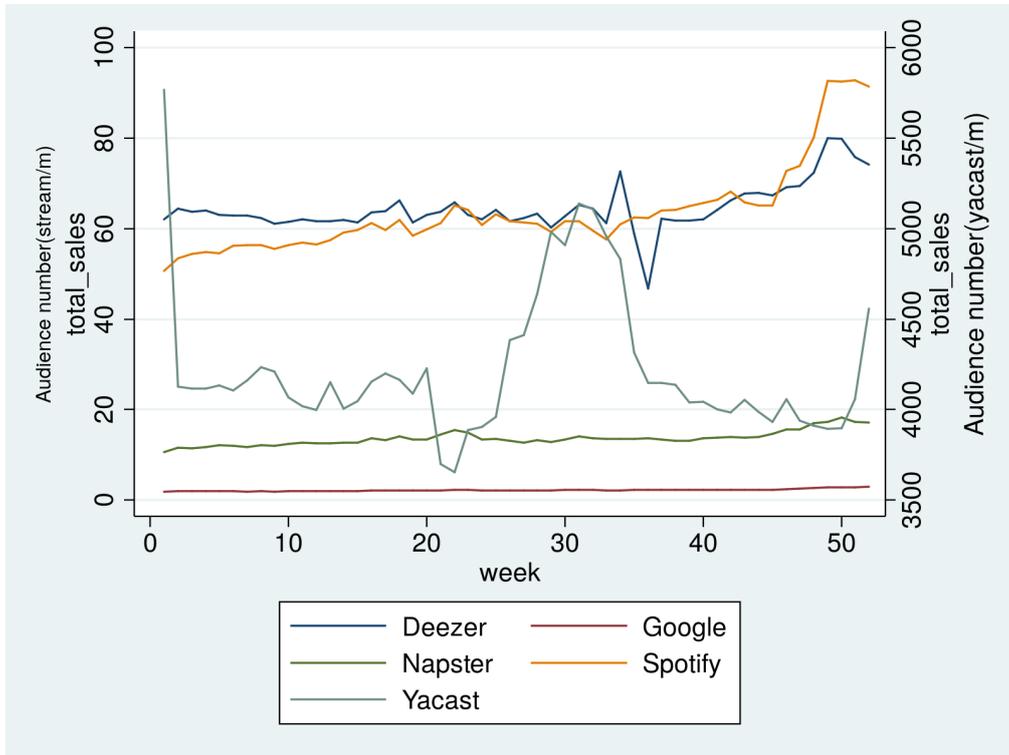


Figure 3.1: Evolution of streaming and radio, by week by year 2016

Note that the audience number is high for radio in the beginning of the year 2016, this may be caused by the listening peak around the new year.

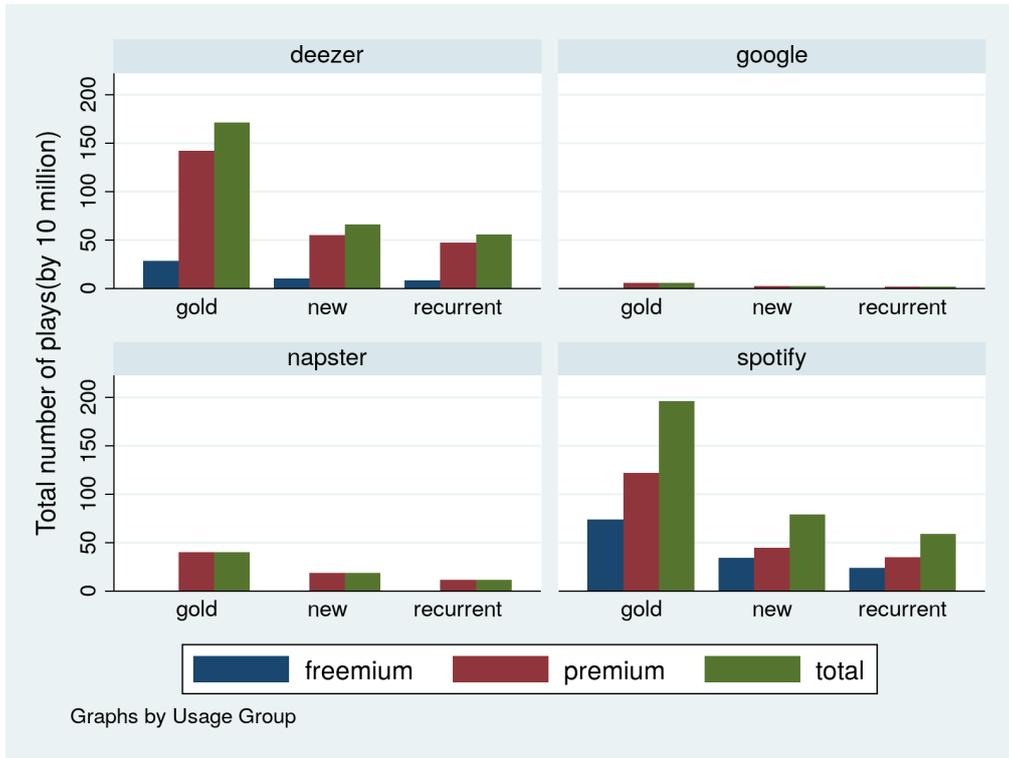


Figure 3.2: Diffusion of music age of streaming by types of consumptions in 2016

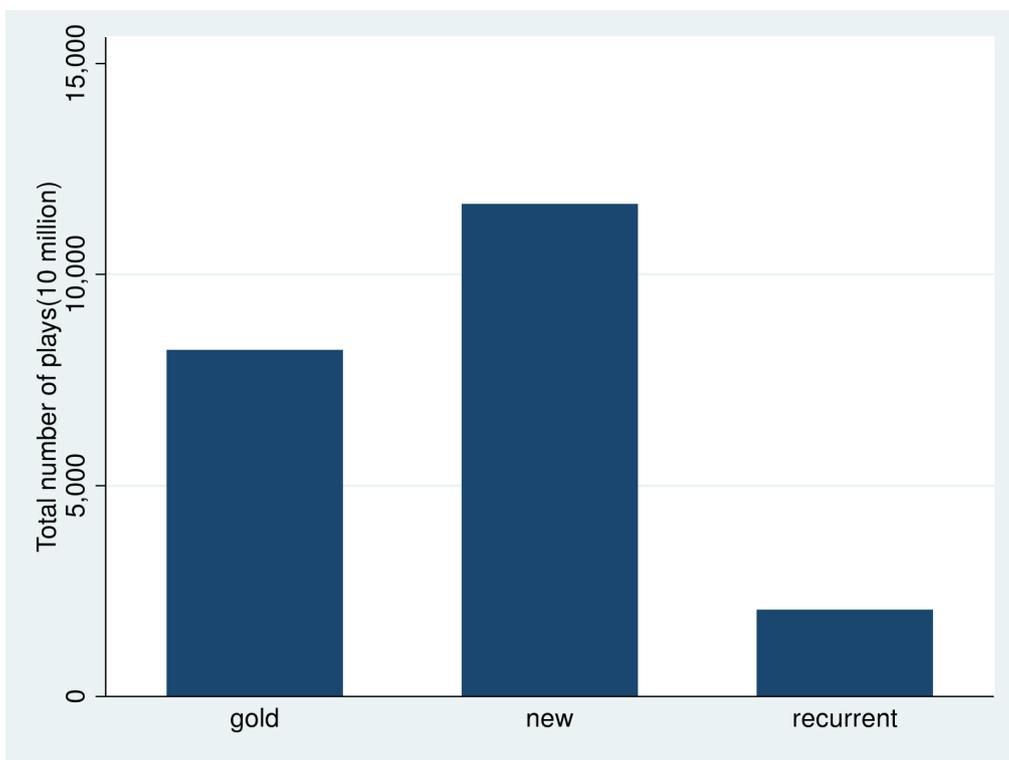


Figure 3.3: Diffusion of music age of radio by types of consumptions in 2016

Table 3.1: Summary statistics of No. distinct artists, and No. distinct titles between radio and streaming services in 2016

Media	N Artists	N Titles
Radio	6,707	11,348
Spotify	44,579	683,557
Deezer	41,498	649,516
Napster	26,333	266,252
Google	23,072	247,103

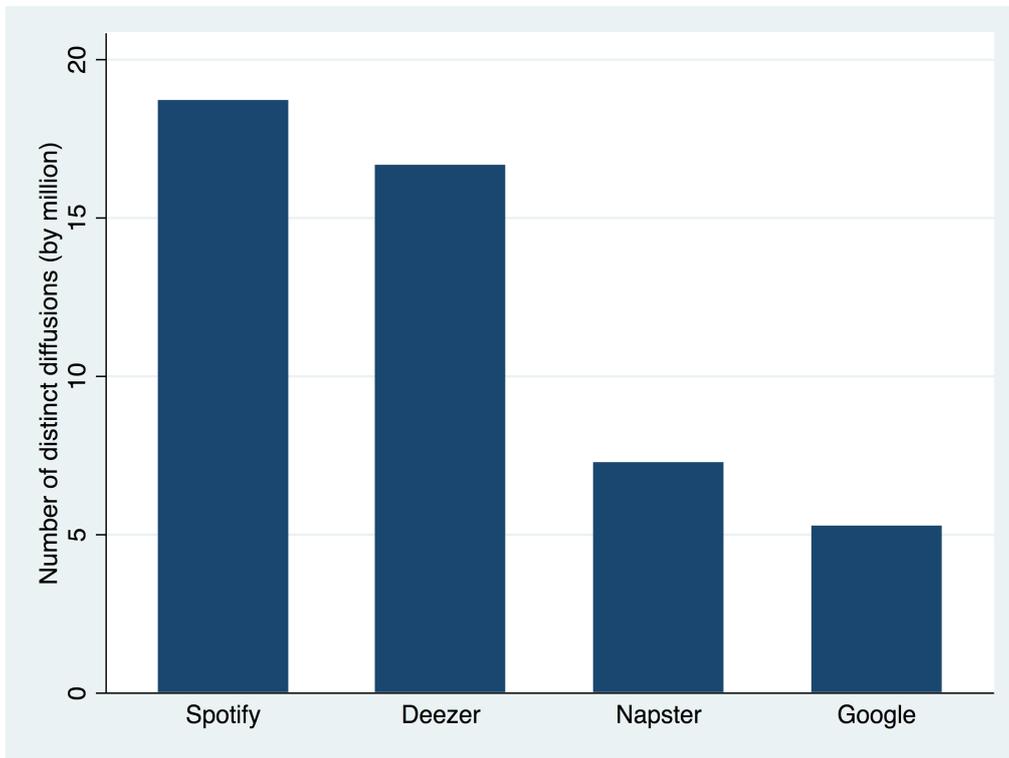


Figure 3.4: Number of distinct diffusion of streaming services in 2016

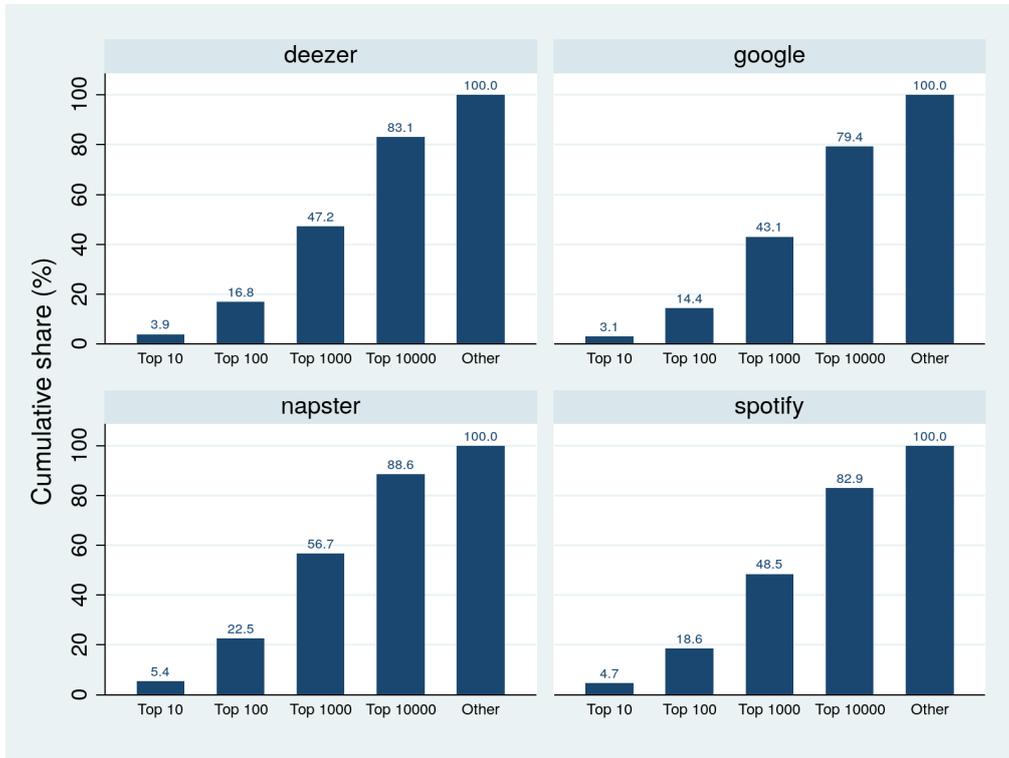


Figure 3.5: Distribution patterns for top songs of streaming in 2016

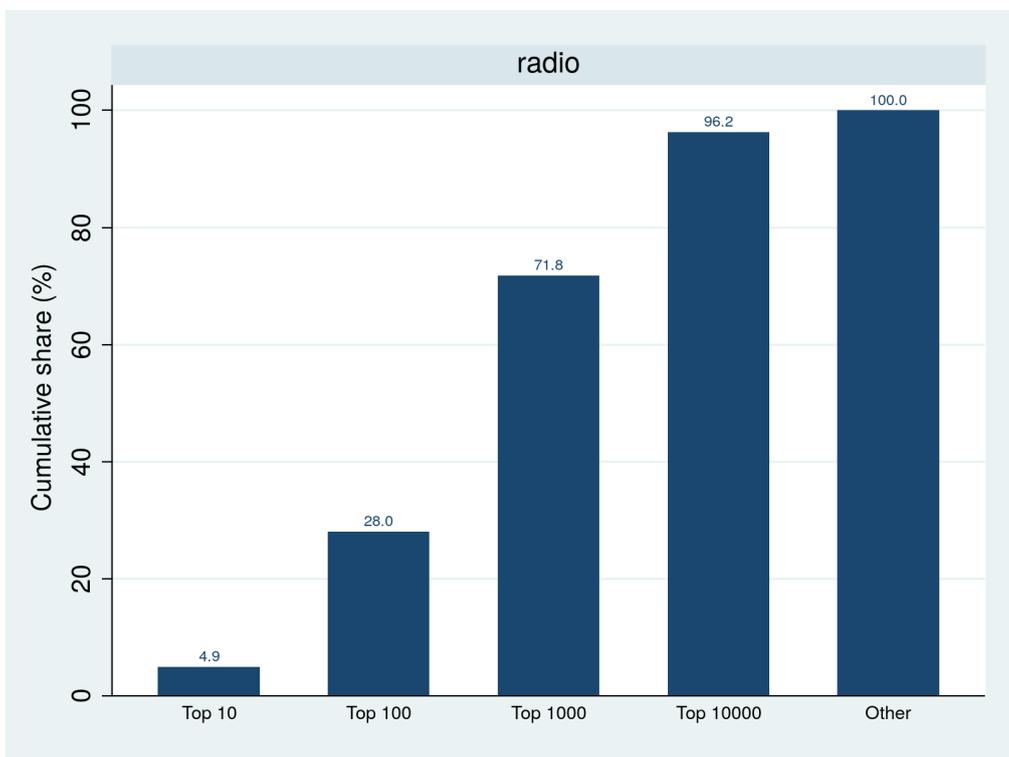


Figure 3.6: Distribution patterns for top songs of radio in 2016

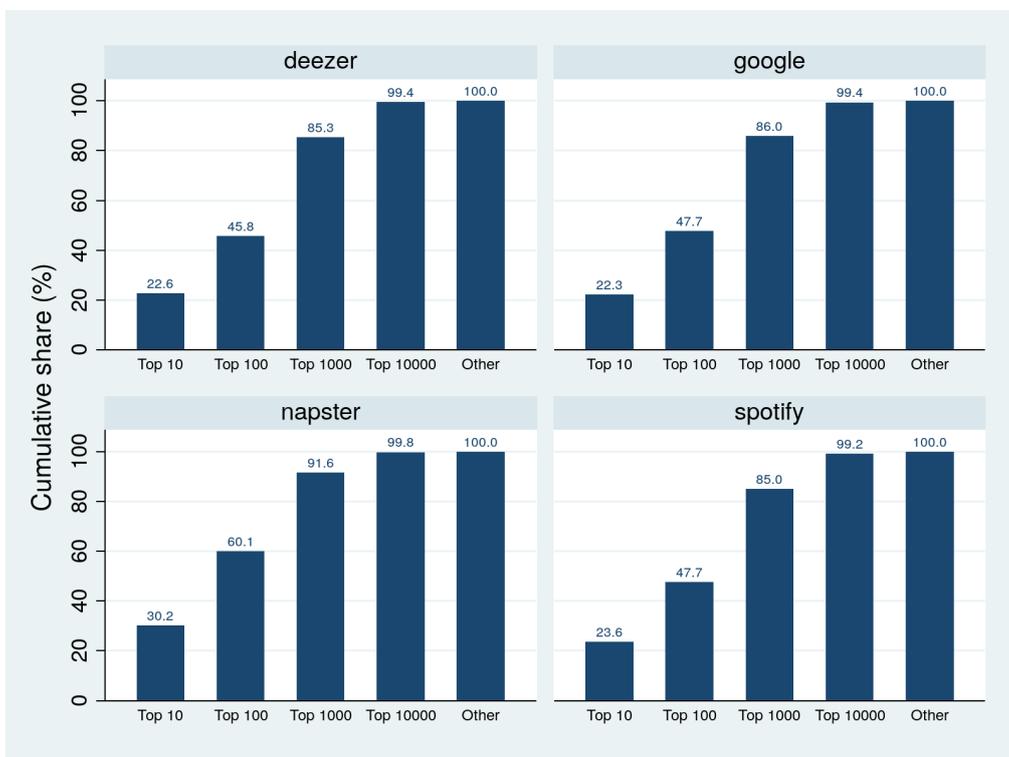


Figure 3.7: Distribution patterns for top artists of streaming services in 2016

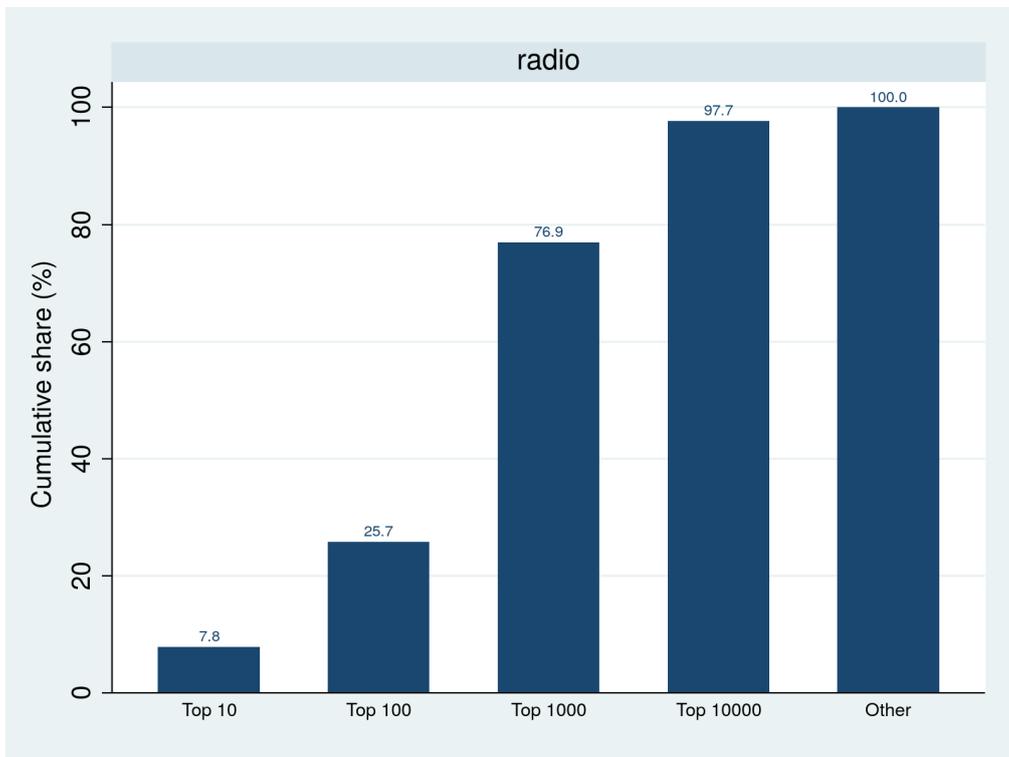


Figure 3.8: Distribution patterns for top artists of radio in 2016

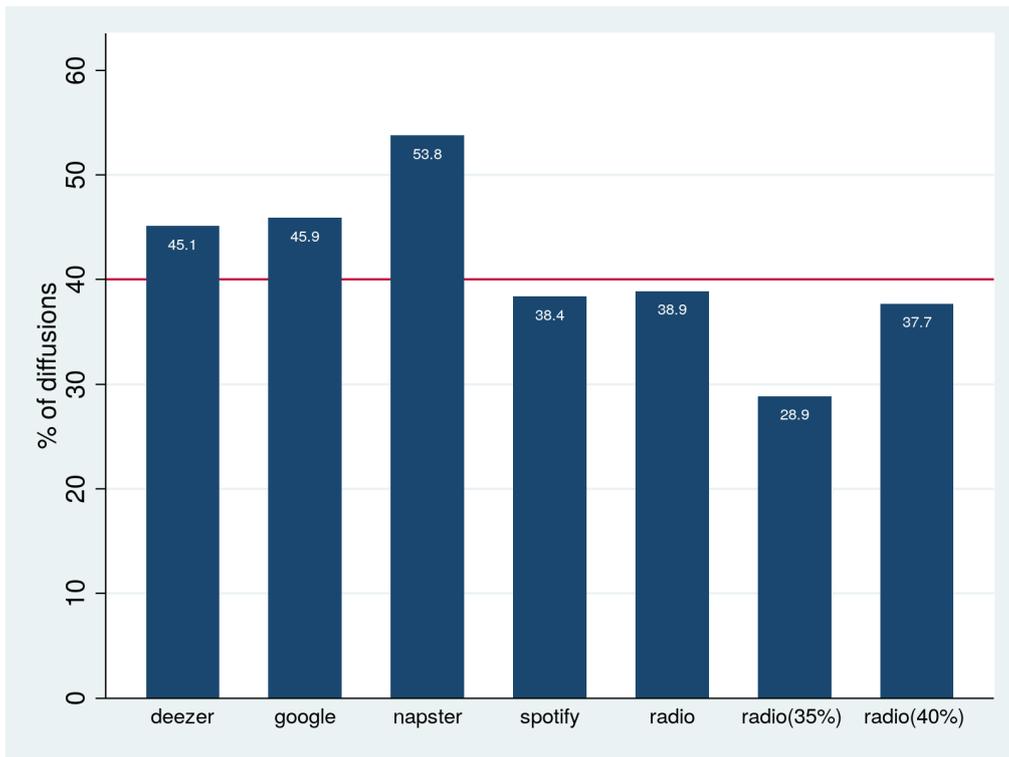


Figure 3.9: Diffusion of Francophone music of streaming and radio in 2016

Note that radio denotes the aggregate data by adding all station together, radio(35%) denotes radio stations that need to play at least 35% Francophone music, and radio(40%) denotes radio stations that need to play at least 40% Francophone music separately. I do not put radio stations belong to the 50% and 60% in this graph, since the 35% and 40% denote the main focus of the cultural quotas.

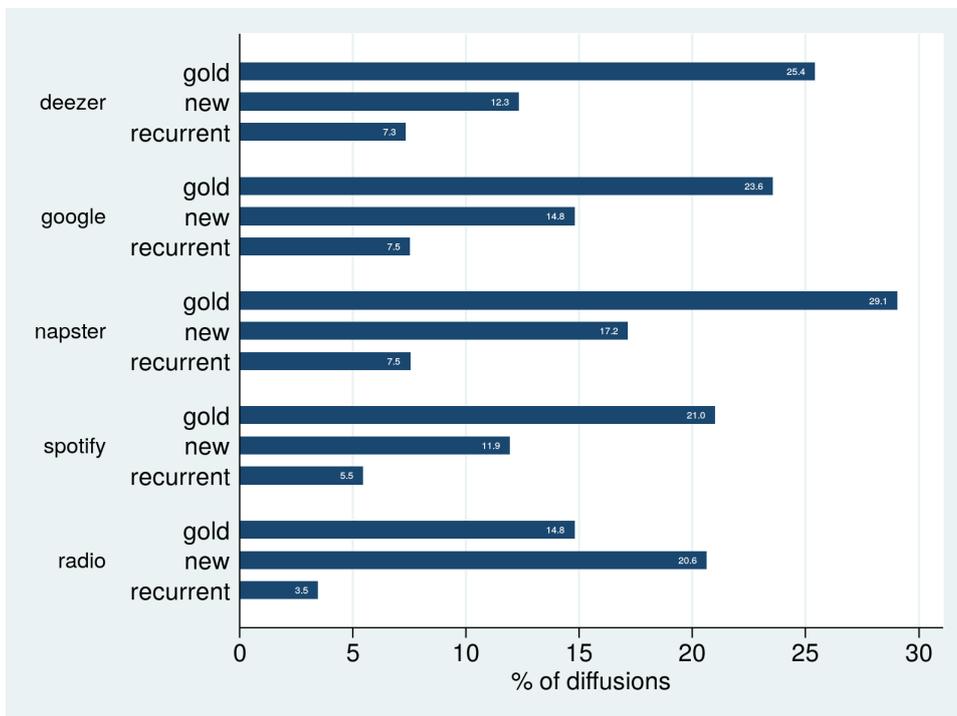


Figure 3.10: Diffusion of Francophone music of streaming and radio by music age in 2016

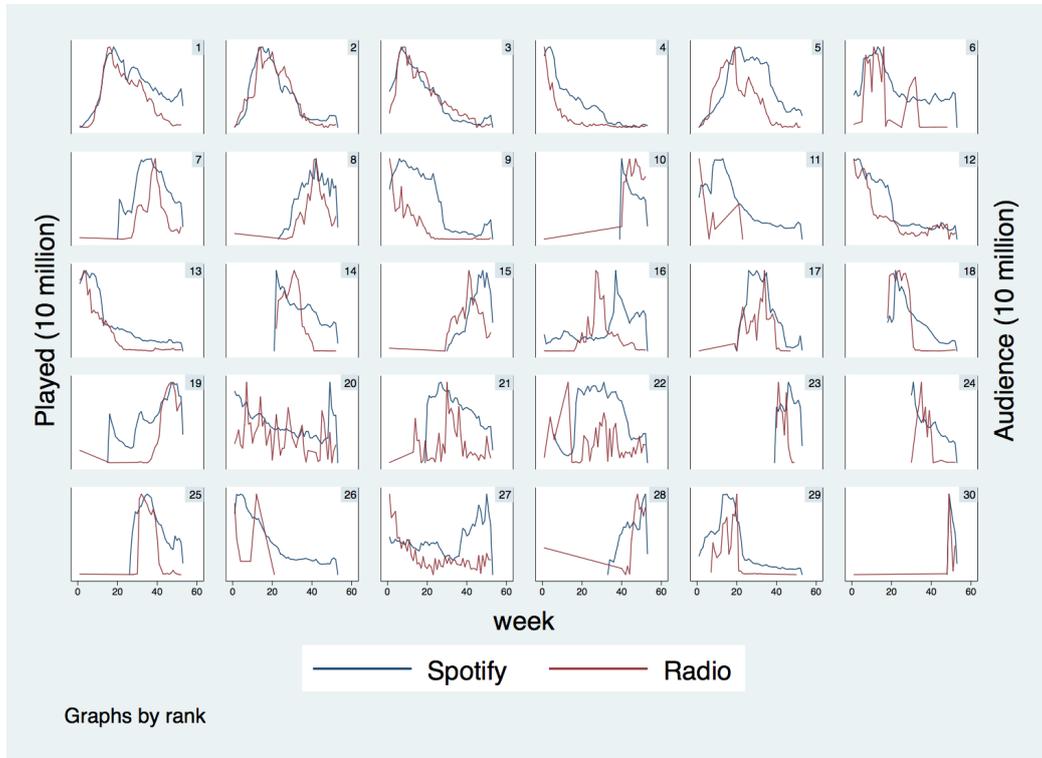


Figure 3.11: Top 30 songs played from matched data between Spotify and radio in 2016

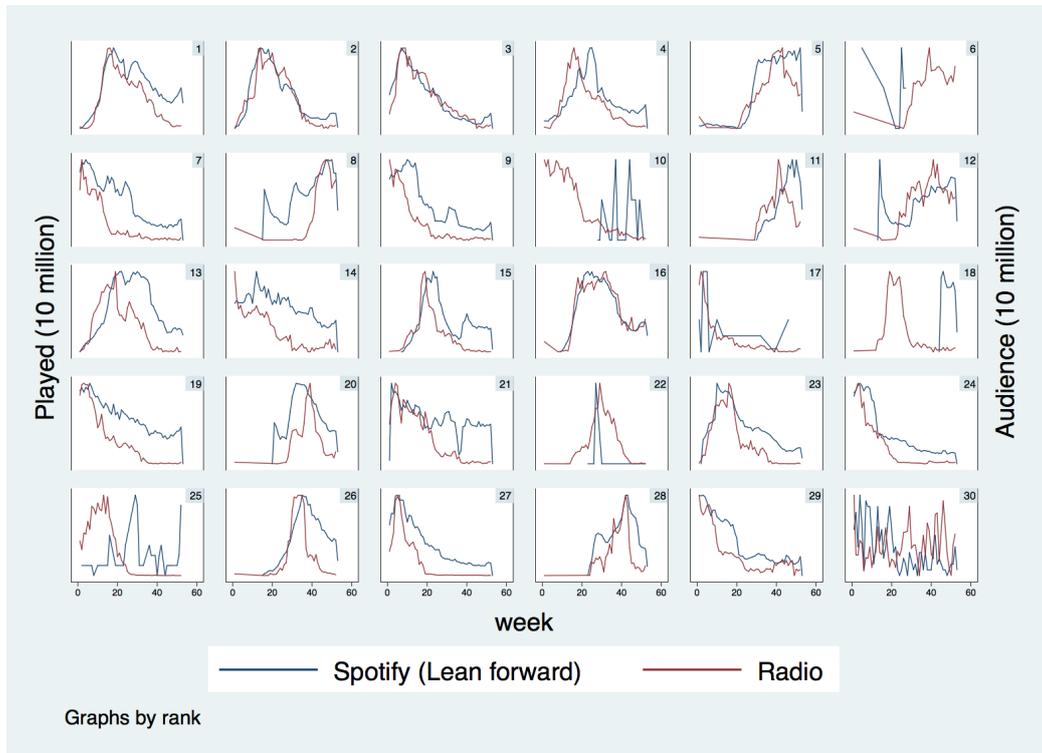


Figure 3.12: Top 30 songs played from matched data between Spotify(lean forward) and radio in 2016

### Chapter 3: Music Streaming: Effects on Variety and Types of Music Consumption

## Appendix

Table 3.2: A comparison of purchase model between major streaming services in France

Platform	Payment	Price	Note
Radio	Ad_fund		
Spotify	Ad_fund		
	Premium	9,99 €/month	30 days free
	Premium students	4,99 €/month	
	Premium family	14,99 €/month	
Deezer	Ad_fund		
	Premium	9,99 €/month	30 days free
Napster	Premium	9,95 €/month	30 days free
Google	Premium	9,99 €/month	30 days free

### Chapter 3: Music Streaming: Effects on Variety and Types of Music Consumption

## Conclusion

Dans cette dernière section de la thèse, je vais passer en revue les principaux résultats de cette thèse et leurs implications politiques, et conduire quelques idées pour la recherche future. J'applique des méthodes économétriques à des ensembles de réponses stratégiques bien identifiés pour mesurer les effets de la réglementation des quotas sur les stations de radio. De même, je développe des descriptions statistiques pour mieux évaluer la diversité musicale et la consommation musicale entre différentes plateformes musicales, avec l'intention de fournir aux régulateurs des outils permettant la comparaison entre stations de radio et services de streaming, et d'améliorer la compatibilité des quotas. dans l'écosystème de changement.

**Dans le chapitre 1**, j'insiste sur la nécessité de reconnaître et de traiter l'impact de la réglementation des quotas. J'utilise des données détaillées sur les listes de lecture des principales stations de radio en France pour montrer que les stations ont une certaine latitude pour ajuster leurs playlists soumises aux contraintes de quotas. D'abord, je trouve que les stations de radio jouent plus de musique exigée par quota quand le quota s'applique. Ceci est cohérent avec les objectifs des régulateurs des médias en France. Les quotas francophones augmentent la quantité de musique francophone diffusée, même si le respect des quotas est imparfait. Deuxièmement, je trouve que les réponses stratégiques des stations de radio sont présentes et prennent plusieurs

formes, y compris la sélection de chansons francophones plus courtes. Si une différence de 10 à 20 secondes par chanson peut sembler insignifiante, cela correspond à une diminution significative du nombre de minutes jouées au cours d'un mois et à une réduction correspondante du public exposé à la musique francophone. Troisièmement, je trouve que les stations de radio transposent leurs pièces de musique francophone à des heures où elles s'attendent à ce que la demande soit faible, de sorte que la musique francophone reçoit moins de temps d'antenne lorsque le nombre d'auditoires est élevé. Par conséquent, l'auditoire atteint par la musique francophone augmente de moins que le changement en minutes de la musique francophone jouée. Les stations avec des réponses stratégiques plus fortes sont également celles qui ont gagné de l'audience au cours de notre période d'échantillonnage. Enfin, je quantifie l'importance des réponses stratégiques en simulant des audiences contrefactuelles de chacune de ces réponses. Je trouve que les réponses stratégiques compensent en partie les effets attendus de ces quotas, réduisant davantage l'exposition du contenu que le quota est censé protéger.

Pour conclure, seul le quota linguistique semble être contraignant; une intervention réglementaire peut ne pas être nécessaire pour assurer le jeu des nouveaux talents. Les résultats suggèrent que les régulateurs en France sont confrontés à un défi lorsqu'ils imposent des quotas culturels qui ne sont pas conformes aux goûts du public.

**Dans le chapitre 2**, je construis un nouvel ensemble de données pour fournir des preuves descriptives sur les services de radio et de streaming. Ce sont des modèles économiques entièrement différents et ne sont pas comparables sans ajuster l'ensemble de données pour refléter les différences. Afin de comparer le nombre d'audience pour les titres musicaux sur les stations de radio avec le nombre de flux sur les services de streaming, je développe une méthodologie pour combiner les données radio avec les données en streaming en France en 2016. La digitalisation a permis de collecter de grandes quantités de données sur tous les types de plates-formes, permettant aux chercheurs d'intégrer de nouvelles méthodes et analyses. Ce chapitre contribue à la méthodologie d'appariement des mégadonnées de différentes plateformes et fournit un support pour l'analyse descriptive au chapitre 3. Pour chaque enregistrement de diffusion musicale, les données permettent d'accéder à plus de 5,5 milliards d'observations de consommation musicale. L'ensemble de données roman génère 1 113 588 correspondances entre Spotify et la radio dans le catalogue Universal Music, parmi lesquelles 6707 artistes et 11 348 titres sont appariés.

**Dans le chapitre 3**, en utilisant cette nouvelle base de données, je compare les modèles de consommation de musique et la variété musicale entre les services de radio et de streaming. En particulier, ce chapitre constitue un premier pas vers la mesure de la diversité musicale entre la radio et les services de streaming en France, et fournit un mécanisme d'analyse du contenu des deux principales plates-formes en début de transition de la musique numérique en France en 2016. Premièrement, je trouve que la radio a un nombre beaucoup plus faible d'artistes et de chansons distincts par rapport aux services de diffusion en continu. Cependant, les services de streaming ont plus d'émissions de chansons en or, tandis que les stations de radio ont plus de nouvelles chansons. La concentration de la chanson est plus élevée dans la radio que dans le streaming, tandis que la concentration de l'artiste est plus élevée dans le streaming que dans la radio. Deuxièmement, j'accorde une attention particulière à la manière dont les artistes peuvent distribuer des contenus musicaux à différents canaux au sein de Spotify et à la radio, en fonction de l'hétérogénéité de la consommation musicale. Néanmoins, ils offrent des contenus musicaux très similaires: les tubes à succès, le temps de jeu et la période de pointe sont très similaires. Spotify et la radio ont des pics similaires et des tendances parallèles après le pic. Troisièmement, je trouve que même si les services de diffusion en continu n'ont pas besoin de respecter les quotas, ils génèrent un pourcentage plus élevé de musique francophone que les stations de radio. Contrairement à l'argument des stations selon lequel les quotas francophones mènent à un faible auditoire, ces résultats soulèvent la question de savoir comment un quota réglementaire peut augmenter la diversité musicale, ce qui est l'objectif ultime des organismes de réglementation.

Cette thèse laisse de nombreuses questions sans réponse et ouvre des perspectives pour de futures recherches. Tout d'abord, il est toujours prioritaire de collecter des données sur la consommation musicale de toutes les plateformes musicales, non seulement au niveau français mais également au niveau européen, pour voir les effets des plafonds réglementaires qui changent avec la numérisation. L'analyse des données, y compris les plateformes de musique vidéo en ligne telles que YouTube, les ventes physiques, les ventes de concerts et la mesure de son effet sur les plateformes musicales pendant la période précédant ou suivant la réglementation des quotas. Il sera intéressant de tester si les changements technologiques et de marché ont rendu obsolètes les formes traditionnelles de quotas culturels, et de mesurer les conséquences de ces changements

pour la compensation des détenteurs de droits. Deuxièmement, l'analyse du déplacement des ventes de musique pourrait être poursuivie, en analysant les différentes consommations musicales associées à différents types de plateformes numériques au fil du temps. Comprendre la relation entre le streaming et les stations de radio sera crucial pour les chercheurs, les décideurs et les autres acteurs de l'industrie de la musique. Enfin, il est encore nécessaire de créer un régime réglementaire pour les nouveaux entrants tels que les services de streaming, et de comprendre quels instruments sont disponibles pour améliorer l'application de ces réglementations, s'il serait préférable de réguler les services de streaming avec les mêmes types de quotas , et quel serait le niveau optimal de réglementation pour ces services de streaming.

## Conclusion

In this last section of the thesis, I will review the main findings from this thesis and their policy implications, and drive some ideas for future research. I apply econometric methods to well identified sets of strategic responses to measure the effects of quota regulations on radio stations. Likewise, I develop statistical descriptions to better assess the music diversity and music consumption between various music platforms, with the intent of providing regulators with tools that allow the comparison between radio stations and streaming services, and to enhance the compatibility of the quota regulations in the in the change ecosystem.

**In chapter 1**, I stress the need to acknowledge and address the impact of quota regulation. I use detailed data on the playlists of major radio stations in France to show that stations have some scope for adjusting their playlists subject to the quota constraints. First, I find that radio stations play more quota-required music when the quota applies. This is consistent with the goals of media regulators in France. Francophone quotas increase the quantity of Francophone music aired, even if compliance with the quotas is imperfect. Second, I find that strategic responses by radio stations are present and take several forms, including the selection of shorter Francophone songs. While a difference of 10-20 seconds per song may seem insignificant, this corresponds to a meaningful decrease in the number of minutes of played over the course of a month and a corresponding reduction in the audience exposed to Francophone music. Third, I find that radio stations shift their play of Francophone music to hours when they expect demand to be low, so that Francophone music gets less airtime when audience numbers are high. As a result, the audience reached by Francophone music increases by less than the change in minutes of Francophone music played. Stations with stronger strategic responses are also those that gained audience during our sample period. Finally, I quantify the importance of strategic responses by simulating counterfactual audiences of each of these responses. I find that strategic responses partly offset the intended effects of these quotas, further reducing the exposure of content the quota is meant to protect.

To conclude, only the language quota appears to be binding; regulatory intervention may not be necessary to ensure play of new talent. The findings suggest that regulators in France face a challenge when imposing cultural quotas that do not conform to audience tastes.

**In chapter 2**, I build a novel dataset to provide some descriptive evidence on radio and

streaming services. These are entirely different economic models and are not comparable without adjusting the dataset to reflect the differences. In order to compare the audience number for music titles on radio stations with the number of streams on streaming services, I develop a methodology to combine radio data with streaming data in France in 2016. Digitalization has allowed for the collection of large amounts of data on all types of platforms, enabling researchers to incorporate new methods and analysis. This chapter contributes to the methodology on matching big data from different platforms and provides support for the descriptive analysis in Chapter 3. For each music diffusion record, the data provides the full access to over 5.5 billion observations of music consumption. The novel dataset generates 1,113,588 matches between Spotify and radio in the Universal Music catalog, among which 6707 artists and 11,348 titles are matched.

**In chapter 3**, using this novel dataset, I compare music consumption patterns and music variety between radio and streaming services. In particular, this chapter provides a first step toward measuring music variety between radio and streaming services in France, and provides a mechanism for analyzing how the main two platforms developed content in the early transition of digital music during 2016 in France. First, I find that radio has a much lower number of distinct artists and songs compared to streaming services. However, streaming services have more gold song broadcasts, while radio stations have more new songs. Song concentration is higher in radio than streaming, while artist concentration is higher in streaming than radio. Second, I pay particular attention to how artists may distribute music contents to different channels within Spotify and radio that vary with the heterogeneity of music consumption. Nevertheless, they offer very similar music contents: the hit songs, the playing time and the peak period of playing are very similar. Spotify and radio have similar peaks and parallel trends after the peak. Third, I find that although streaming services do not need to comply with quotas, they generate a higher percentage of Francophone music than radio stations. Contrary to the stations' argument that the Francophone quotas lead to a low audience numbers, these results beg the question of how regulatory quota can increase music diversity which is the ultimate goal of regulators.

This thesis leaves many questions unanswered and opens some perspectives for future research. First, it is still a priority to collect data on music consumption from all the music platforms not only at the France level but also at the European level, to see the effects of the

regulatory caps which are changing with digitalization. Questions related to quota regulation and its effects on the changing music ecosystem could be investigated further by analyzing data including online video music platforms such as YouTube, physical sales, concert sales, and by measuring its effect on the music platforms in the period of time preceding or following quota regulation. It will be interesting to test whether technological and market changes rendered obsolete the traditional forms of cultural quotas, and to measure the consequences of these changes for the compensation of rights-holders. Second, the analysis of music sales displacement could be pursued, by analyzing the various music consumption associated with different types of digital platforms over time. Understanding the relationship between streaming and radio stations will be crucial to researchers, policy makers, and other participants in the music industry. Finally, there is still a need to create a regulatory regime for new entrants such as streaming services, and to understand what instruments are available to improve the enforcement of these regulation, whether it would be better to regulate streaming services with the same types of quotas, and what would be the optimal level of regulation for these streaming services.



---

## Bibliography

---

- Acheson, K. and Maule, C. (1990). Canadian content rules: a time for reconsideration. *Canadian Public Policy/Analyse de Politiques*, pages 284–297.
- Aguiar, L. (2017). Let the music play? free streaming and its effects on digital music consumption. *Information Economics and Policy*.
- Aguiar, L. and Martens, B. (2016). Digital music consumption on the internet: evidence from clickstream data. *Information Economics and Policy*, 34:27–43.
- Aguiar, L. and Waldfogel, J. (2016). Even the losers get lucky sometimes: New products and the evolution of music quality since napster. *Information Economics and Policy*, 34:1–15.
- Aguiar, L. and Waldfogel, J. (2017). As streaming reaches flood stage, does it stimulate or depress music sales? *International Journal of Industrial Organization*.
- Alexander, P. J. (1997). Product variety and market structure: A new measure and a simple test. *Journal of Economic Behavior & Organization*, 32(2):207–214.
- Anderson, J. E. and Neary, J. P. (1992). Trade reform with quotas, partial rent retention, and tariffs. *Econometrica: Journal of the Econometric Society*, pages 57–76.
- Anderson, S. P. and Coate, S. (2005). Market provision of broadcasting: A welfare analysis. *The review of Economic studies*, 72(4):947–972.
- Aw, B. Y. and Roberts, M. J. (1986). Measuring quality change in quota-constrained import markets: The case of us footwear. *Journal of International Economics*, 21(1-2):45–60.
- Bala, V. and Van Long, N. (2005). International trade and cultural diversity with preference selection. *European Journal of Political Economy*, 21(1):143–162.

- Bernier, I. (2003). Local content requirements for film, radio, and television as a means of protecting cultural diversity: Theory and reality. *Retrieved January, 15:2007*.
- Bernier, I. (2004). A unesco international convention on cultural diversity. *GRABER, GIRSBERGER e BURRI-NEROVA (a cura di), Free Trade versus Cultural Diversity: WTO Negotiations in the Field of Audiovisual Services, Zurich*.
- Berry, S. T., Waldfogel, J., et al. (1999). Free entry and social inefficiency in radio broadcasting. *RAND Journal of Economics*, 30(3):397–420.
- Bomsel, O. (2016). Music ecosystem. Technical report, Mines ParisTech, PSL, Research University, CERNA, Centre for Industrial Economics.
- Bomsel, O. P. (2013). Copyright and brands in the digital age: Internalizing the externalities of meaning. *Contemporary Economic Policy*, 31(1):126–134.
- Bomsel, O. P. and Nègre, P. (2012). *Publier la musique*. Protocoles Editoriaux.
- Bruner, C. M. (2007). Culture, sovereignty, and hollywood: Unesco and the future of trade in culture products. *NYUJ Int'l L. & Pol.*, 40:351.
- Crampes, C. and Hollander, A. (2008). The regulation of audiovisual content: quotas and conflicting objectives. *Journal of Regulatory Economics*, 34(3):195–219.
- Danaher, B., Dhanasobhon, S., Smith, M. D., and Telang, R. (2010). Converting pirates without cannibalizing purchasers: The impact of digital distribution on physical sales and internet piracy. *Marketing science*, 29(6):1138–1151.
- Datta, H., Knox, G., and Bronnenberg, B. J. (2017). Changing their tune: How consumers' adoption of online streaming affects music consumption and discovery. *Marketing Science*.
- De Bens, E. and De Smaele, H. (2001). The inflow of american television fiction on european broadcasting channels revisited. *European Journal of Communication*, 16(1):51–76.
- Disdier, A.-C., Tai, S. H., Fontagné, L., and Mayer, T. (2010). Bilateral trade of cultural goods. *Review of World Economics*, 145(4):575–595.
- Epstein, G. S. (1998). Network competition and the timing of commercials. *Management Science*, 44(3):370–387.
- Ferreira, F., Petrin, A., and Waldfogel, J. (2012). Trade and welfare in motion pictures. *Manuscript, University of Pennsylvania, University of Minnesota and NBER*.
- Ferreira, F. and Waldfogel, J. (2013). Pop internationalism: has half a century of world music

- trade displaced local culture? *The Economic Journal*, 123(569):634–664.
- Fleder, D. and Hosanagar, K. (2009). Blockbuster culture’s next rise or fall: The impact of recommender systems on sales diversity. *Management science*, 55(5):697–712.
- Francois, P. and Van Ypersele, T. (2002). On the protection of cultural goods. *Journal of international economics*, 56(2):359–369.
- Gasher, M. (2000). Global television and film: An introduction to the economics of the business. *Canadian Journal of Communication*, 25(2).
- Helpman, E. and Krugman, P. R. (1985). *Market structure and foreign trade: Increasing returns, imperfect competition, and the international economy*. MIT press.
- Hervas-Drane, A. and Noam, E. (2017). Peer-to-peer file sharing and cultural trade protectionism. *Information Economics and Policy*, 41:15–27.
- Hiller, R. S. (2016). Sales displacement and streaming music: Evidence from youtube. *Information Economics and Policy*, 34:16–26.
- Hiller, R. S. and Walter, J. M. (2016). The rise of streaming music and implications for music production. Technical report, Fairfield University, Department of Economics; University of Wisconsin, Stout.
- Hong, S.-H. (2013). Measuring the effect of napster on recorded music sales: Difference-in-differences estimates under compositional changes. *Journal of Applied Econometrics*, 28(2):297–324.
- Hoskins, C. and McFadyen, S. (1991). The us competitive advantage in the global television market: Is it sustainable in the new broadcasting environment? *Canadian Journal of Communication*, 16(2).
- Hoskins, C., McFadyen, S., and Finn, A. (2004). *Media economics: Applying economics to new and traditional media*. Sage.
- Hoskins, C., Mirus, R., and Rozeboom, W. (1989). Us television programs in the international market: Unfair pricing? *Journal of Communication*, 39(2):55–75.
- Kretschmer, T. and Peukert, C. (2015). Video killed the radio star? online music videos and recorded music sales. Technical report, Ludwig Maximilian University of Munich, Munich School of Management); Universidade Catolica Portuguesa.
- Lee, B. and Bae, H.-S. (2004). The effect of screen quotas on the self-sufficiency ratio in recent domestic film markets. *Journal of Media Economics*, 17(3):163–176.

- Liebowitz, S. J. (2004). The elusive symbiosis: The impact of radio on the record industry. *Review of Economic Research on Copyright Issues*, 1(1):93–118.
- Liebowitz, S. J. (2006). File sharing: creative destruction or just plain destruction? *The Journal of Law and Economics*, 49(1):1–28.
- Machill, M. (1996). Musique as opposed to music: Background and impact of quotas for french songs on french radio. *Journal of Media Economics*, 9(3):21–36.
- Marvasti, A. (1994). International trade in cultural goods: A cross-sectional analysis. *Journal of Cultural Economics*, 18(2):135–148.
- Masood, M. (2015). Raising protection for less diversity? the side-effect of quotas on foreign imports. Technical report, University of Geneva Global Studies Institute GSEM.
- Messerlin, P. and Parc, J. (2014). The effect of screen quotas and subsidy regime on cultural industry: A case study of french and korean film industries. *Journal of international business and economy*, 15(2):57–73.
- Middleton, J. (2002). The effectiveness of audiovisual regulation inside the european union: The television without frontiers directive and cultural protectionism. *Denv. J. Int'l L. & Pol'y*, 31:607.
- Nelson, P. (1970). Information and consumer behavior. *Journal of political economy*, 78(2):311–329.
- Nguyen, G. D., Dejean, S., and Moreau, F. (2014). On the complementarity between online and offline music consumption: the case of free streaming. *Journal of Cultural Economics*, 38(4):315–330.
- Oestreicher-Singer, G. and Sundararajan, A. (2012). The visible hand? demand effects of recommendation networks in electronic markets. *Management science*, 58(11):1963–1981.
- Parc, J. (2017). The effects of protection in cultural industries: the case of the korean film policies. *International Journal of Cultural Policy*, 23(5):618–633.
- Perona, M. (2015). Radio competition and programming diversity. Technical report, Sciences-Po Paris.
- Puppis, M. (2008). National media regulation in the era of free trade the role of global media governance. *European journal of communication*, 23(4):405–424.
- Raboy, M., Bernier, I., Sauvageau, F., and Atkinson, D. (1994). Cultural development and the open economy: A democratic issue and a challenge to public policy. *Canadian Journal of*

- Communication*, 19(3).
- Rauch, J. E. and Trindade, V. (2009). Neckties in the tropics: a model of international trade and cultural diversity. *Canadian Journal of Economics/Revue canadienne d'économique*, 42(3):809–843.
- Ray, E. J. (1981). The determinants of tariff and nontariff trade restrictions in the united states. *Journal of Political Economy*, 89(1):105–121.
- Ren, C. (2011). *Protective Trade Policy and Global Film Market: A Cross-sectional Analysis of Regulatory Trade Barriers and Their Impacts on the Competitive Status of National Film Industries, 2000-2007*. PhD thesis, University of Georgia.
- Richardson, M. (2006). Commercial broadcasting and local content: cultural quotas, advertising and public stations. *The Economic Journal*, 116(511):605–625.
- Richardson, M. and Wilkie, S. (2015). Faddists, enthusiasts and canadian divas: broadcasting quotas and the supply response. *Review of International Economics*, 23(2):404–424.
- Ryan, S. P. (2012). The costs of environmental regulation in a concentrated industry. *Econometrica*, 80(3):1019–1061.
- Sonnac, N. (2013). L'écosystème des médias. les enjeux socioéconomiques d'une interaction entre deux marchés. *Communication. Information médias théories pratiques*, 32(2).
- Spence, M. (1976). Product differentiation and welfare. *The American Economic Review*, 66(2):407–414.
- Sweeting, A. (2007). Dynamic product repositioning in differentiated product markets: The case of format switching in the commercial radio industry. Technical report, National Bureau of Economic Research.
- Sweeting, A. (2009). The strategic timing incentives of commercial radio stations: An empirical analysis using multiple equilibria. *The RAND Journal of Economics*, 40(4):710–742.
- Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic management journal*, 28(13):1319–1350.
- Ulf-Møller, J. (2001). *Hollywood's film wars with France: film-trade diplomacy and the emergence of the French film quota policy*. University Rochester Press.
- Waldfoegel, J. (2010). Music file sharing and sales displacement in the itunes era. *Information economics and policy*, 22(4):306–314.

- Waldfogel, J. (2012). And the bands played on: Digital disintermediation and the quality of new recorded music. Technical report, University of Minnesota, Twin Cities, Department of Economics.
- Walter, J. and Hiller, R. S. (2017). Music consumption decisions with non-durable streaming options. Technical report, Department of Economics, Fairfield University.
- Willis, A. J. (1997). Forum. *Functional Ecology*, 11(2):268–271.
- Wlömert, N. and Papies, D. (2016). On-demand streaming services and music industry revenues—insights from spotify’s market entry. *International Journal of Research in Marketing*, 33(2):314–327.
- Yu, Y., Chen, H., Peng, C. H., and Chau, P. Y. (2017). The causal impact of video streaming on dvd sales: Evidence from a natural experiment. Technical report.
- Zentner, A. (2009). Ten years of file sharing and its effect on international physical and digital music sales. Technical report, University of Texas at Dallas, School of Management.
- Zhou, R., Khemmarat, S., Gao, L., Wan, J., and Zhang, J. (2016). How youtube videos are discovered and its impact on video views. *Multimedia Tools and Applications*, 75(10):6035–6058.



## Résumé

Pendant des décennies, la France a imposé des quotas pour la musique francophone. Les stations de radio doivent réserver un pourcentage minimum du nombre total de pièces de chanson pour les chansons de langue française depuis 1996. Le développement des services de streaming, qui ne fait face à aucun quota, a changé la façon dont nous écoutons de la musique et pose un nouveau défi pour les régulateurs. L'applicabilité des quotas est de plus en plus difficile dans l'industrie de la radiodiffusion et pose la question du désavantage concurrentiel. Dans cette thèse, j'essaie de répondre à trois questions principales sur le thème de la consommation de musique dans cet écosystème en mutation. Dans un premier temps, j'examine empiriquement les réponses stratégiques des radios françaises aux quotas de musique francophone. Les stations respectent-elles les quotas? L'audience réalisée pour la musique francophone est-elle inférieure à ce qu'elle serait en l'absence de ces réponses stratégiques? Pour répondre à ces questions, j'utilise des données détaillées sur les listes de lecture des principales stations de radio en France pour montrer que les stations ont une certaine latitude pour ajuster leurs playlists soumises aux contraintes de quotas. Deuxièmement, je construis un ensemble de données pour fournir des preuves descriptives sur les services de radio et de streaming. Ce sont des modèles économiques entièrement différents et ils ne sont pas comparables sans ajuster l'ensemble de données pour refléter les différences. Afin de comparer le nombre de titres musicaux sur les stations de radio avec le nombre de flux sur les services de streaming, je développe une méthodologie pour combiner les données radio avec les données en streaming en France en 2016. Troisièmement, en utilisant cette nouvelle base de données, la variété des motifs et de la musique sur les services de streaming se compare à celle de la radio. Je fournis également des preuves empiriques sur les externalités de consommation des deux marchés.

## Mots Clés

Économie culturelle, quotas, radio, streaming services, musique diversité, musique consommation

## Abstract

For decades, France has imposed quotas for Francophone music. Radio stations need to reserve a minimum percentage of total song plays for French-language songs since 1996. The development of streaming services, which faces no quotas, has changed how we listen to music and poses a new challenge to regulators. The applicability of quotas is increasingly difficult in the radio broadcasting industry and raises the question of competitive disadvantage. In this thesis, I try to answer three main issues on the topic of music consumption in this changing ecosystem. First, I empirically examine the strategic responses of French radio stations to quotas for Francophone music. Do stations comply with the quotas? Is the realized audience for Francophone music lower than it would be in the absence of these strategic responses? To answer these questions, I use detailed data on the playlists of major radio stations in France to show that stations have some scope for adjusting their playlists subject to the quota constraints. Second, I build a dataset to provide some descriptive evidence on radio and streaming services. These are entirely different economic models, and are not comparable without adjusting the dataset to reflect the differences. In order to compare the audience number of music titles on radio stations with the number of streams on streaming services, I develop a methodology to combine radio data with streaming data in France in 2016. Third, using this novel dataset, I look at music consumption pattern and music variety on streaming services compares to that of radio. I also provide empirical evidence on the consumption externalities of both markets.

## Keywords

Cultural economics, quota regulation, radio, streaming services, music diversity, music consumption