From Ownership to Access
The economics of music subscription services

Van eigen bezit naar toegang
De economie van muziekabonnementsdiensten

Thesis

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Foreword/Acknowledgements

This project is finally brought to an end. When I started my PhD in early 2012, streaming did not contribute all that much to the revenues of artists globally. Certain European markets, as well as South-Korea, were ahead, but paid downloads from services such as iTunes was, along with CDs, where the money were. Almost no research on streaming services existed, and I felt quite ahead of my time when I started to gain understanding and attempted to plan my analyses. Time has gone by. Revenue streams have shifted and research has been provided by many. This thesis has needed continuous rewrites and updates as the world changed. Sources of data for quantitative analyses are not readily available, and I have had to let go of good ideas as I simply could not get hold of the data.

In this thesis, I have tried to direct light to many dark corners as well as contributed new perspective to some much-debated questions. The canvas has been broad, and I have applied paint to a lot of it. Somewhere with spray can, other places with obsessive detail. Everywhere with effort, honesty and more humility than what may appear from the text.

I was not led into this project by a strong determination to explore the industry to begin with. It was rather a result of a series of happenstance. It was also happenstance that I, at just the right time, found myself directly behind Christian Handke in a line for coffee at a conference in Kyoto in 2012. The line was long, thankfully. So we got a nice chat. That was the beginning of a supervision that has been on and off, frequent and sporadic, for a grand total of nine years. Christian has all along provided feedback on what should be expanded upon, and what should be left out, what are important insights and what is plain wrong. He has directed me towards literature and helped me get in touch with interesting people. His thorough reading and plentiful comments are more than I could expect. The conversations with Christian have been highly valuable for the thesis, but even more for me as a researcher and a person.

Arjo Klamer has been an inspiring promotor. To be invited to his home, to seminars he has hosted, and to attend courses he has initiated, has been a great privilege. His input to the thesis has been very valuable, especially in the late stages of this long process. His skills at reading and interpreting my work, and his suggestions on how to emphasise the running theme and the presentation of the thesis, have benefited the end product immensely.

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1   Introduction

Twenty years ago, we bought CDs. That is physical goods to own. Ten years ago, we bought paid downloads from iTunes. Those were still something we owned, sort of. Now, we subscribe to music streaming services. Recorded music is no longer carried by goods to own, but instead by services to access. Discussions on digitisation tend to emphasise the conversion of previously tangible products into intangible products. Economically, that is possibly not the most important thing that has happened to reproducible cultural products in this century. Arguably, the transition from purchasing units of goods to paying for access to services is even more fundamental. Why did this happen? Is it for better or for worse?

With a few clicks or swipes, people have access to large parts of all music that has ever been recorded. Music streaming services make all this music available at the cost of a fixed monthly fee, or even for free if one can tolerate advertising in between the music. At the other end of the revenue stream, composers, artists and record companies are paid through a small payment per play.

Music streaming services have conquered large fractions of most music markets. The first services appeared in 2001, without making much impact.[1] *Deezer* and *Spotify* were released in 2007 and 2008 respectively, and soon became dominant within this new niche. The internet giants have since joined the battle for consumers. *Google Play Music* was launched in 2011, *YouTube Music Key* entered the field in 2014, *Apple Music* in 2015[2] and *Amazon Music Unlimited* in 2016. Other examples are *Rhapsody*, *Rdio*, *Tidal, JOOX, KKBOX* and *QQ Music*. Subscription services entered the fray where download services and illegal file sharing battled physical sales and each other. Streaming services – subscriptions and ad-supported services – now accounts for more than half of global revenues from recorded music, even when performance rights and synchronisation revenues are included. The new business models have led to redistribution of revenues. Some have gained, others lost.

It is unclear how the revenue streams from recorded music have changed with the introduction of streaming services. Consumers spend a lot of money on the services, but how these revenues are divided among the providers of the services, the record companies and the various music artists and songwriters is not fully known. Claims in media indicate that certain record companies gain at the

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[1] Rhapsody, Pressplay and MusicNet all launched in 2001.

[2] *Beats Music* was launched in 2014, was acquired by Apple Inc. the same year and was discontinued with the launch of *Apple Music* in 2015.

expense of music artists, as the contracts do not entitle the artists to the same share of digital revenues as they do of revenues from physical formats. Another explanation to the claim, apart from the contracts, is that some of the revenues paid from streaming service providers to record companies have not been for streams per se, but unspecified "black box" revenues, for instance payment for access to the company's catalogue in the first place (Harris, 2012). Shares in Spotify have supposedly also been used to pay the major record companies (Lindvall, 2009). The details of contracts remain obscure.

Artists, composers, music listeners, media commentators and academics have all discussed streaming services up and down during the last decade. Some of the questions might have been answered while others have not. I believe that some of the most important questions have not even been asked yet. Identifying the most fundamental questions relevant for this topic has been my main motivation for this thesis. I believe I might have found new questions, new angles to view development from and I also believe I have found some important, if preliminary, answers. My perspectives are mostly from the field of economics. It has been challenging to identify the relevant theoretical frameworks. Existing perspectives needs to be combined in novel ways in order to find the right tools.

The transition to music streaming, both subscriptions and ad-supported, is essentially a transition from purchasing copies of recordings one will own indefinitely to renting access to music for a limited time period. This has some very important implications. As revenues are now accrued upon play instead of upon sale, the new model has introduced a lag in income for the artists and publishers. New recordings receive less than they used to. Old recordings receive more. This redistribution is similar to that which inevitably occurs in relation to *any* technological change. Overall, technological change is more often advantageous for the majority of people, than it is a disadvantage. Complaining about the consequences of change may therefore be seen as reactionary and just an act of protecting one's self-interest. However, this is not just about technological change. Selling things is not old fashioned. Paying artists only based on the number of replays they can stack up, is just one of many possible remuneration models, given the new technology.

Remuneration to rights holders from recorded music rests on government intervention in the form of copyright legislation, and it is far from self-evident that this legislation should remain unchanged in light of the now dominant business and remuneration model. Revenues that are taken from new recordings are distributed as an unexpected benefit to old recordings that have already earned their share of revenues through traditional record sales. The new business model, in combination with the old copyright system, may weaken incentives to create. The business model has strong implications

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for how copyright law should be mended to best serve its purpose. This thesis does not discuss the copyright system in much detail. I hope, however, that this thesis can contribute to the foundations for such discussions.

In addition to the effect of the changes in payment models, changes in patterns of listening may cause redistribution. It is possible that people listen more to music from other countries than before, while music of that same country may perform better as an export to other markets. People may listen to a greater diversity of music than before, they may listen more to old music or more to new music and they may listen more to music outside of the genres they normally identify with. These are changes that may potentially create winners or losers or that may cancel out so that no one gains or loses.

Subscription services may also have closer connections with live performance than previous formats of recorded music have had, in the sense that it is much easier for people to investigate artists that will perform on upcoming concerts in the local area (Kjus, 2016). Thus, streaming may help in making informed decisions.

Streaming music over the internet is now a technology that is familiar to billions of people worldwide, and subscriptions are an established business model that appears to be here to stay. Yet, the current state is not an equilibrium. The situation is not stable. Services do not produce profits, and creators are unhappy with their revenues. There have been motions towards increasing revenues received by rights holders, and especially songwriters. An increase in songwriter royalties would have to either be taken from the owners of the recordings or add to consumer price. Streaming services have no profit to take the money from.

Songwriters, artists and streaming services are all dissatisfied with the current situation. The subscription price is too high for many listeners. Where does the money go? How can this be solved? Those are two of the questions that I will attempt to answer in this thesis.

1.1 The questions

The aim of this thesis is to understand the implications of the transition from sales of music recordings to the subscription model of music access. There is a long list of questions that have triggered both curiosity and strong opinions among people: Does the transition benefit the superstars or the long tail of less known artists? Will listening preferences become homogenised globally? Why do the new services take the shape of fixed-fee subscriptions? Why do we not pay per play? Among the different possible ways that revenues could have been distributed among rights holders, why are

they distributed in the specific way they are? Once music listeners have grown accustomed to, not to say dependent on, subscriptions. What options do we have? If income is reduced, we can cancel our subscription and use a free, ad-supported service instead. How likely is it that the free tier will remain flexible and convenient while also being free? As streaming conquers the world market, we grow increasingly dependent on the services. Prices are likely to increase as a consequence. Then what? Will file-sharing come back?

Old music is much more accessible than before. And so is new music. We can freely explore the fringes of music genres or indulge in the top of the pops, whether it is new or old. What choices do people make in this situation? When artists steadily complain about meagre royalties, while the subscription services fail to turn a profit, and while consumers actually spend a fair bit of money on subscriptions, what is going on? Where do the money go?

A thesis can never be completely comprehensive, so I must select some questions among the many. As an economist, I am drawn by qualifications and by inclinations towards certain questions rather than others. Data availability has also been a limiting factor. There are many relevant questions concerning streaming services that can be better addressed by others than by me. I take responsibility for some of those questions that economists may be able to handle better than others.

People that have an interest in the questions raised and answered in this thesis are probably of a more various composition than what is the case for many other topics addressed by economists. I have tried to accommodate different readers in parts of this thesis, but many will find several chapters being mostly out of reach. I mostly interpret streaming services in light of economic theory, something which is not always straightforward. One will not come far in understanding the economics of streaming services, with economics 101 alone. I have delved into various corners of economic theory to contextualise streaming services. This is an inquiry into what are old phenomena in new wrapping, and what are genuinely new phenomena.

While this thesis touches upon many questions raised above, the central research questions that I attempt to answer are the following:

1. *What characterises the early adopters of music subscriptions?*

Question 1 is interesting as the answers may enlighten us on how technological change takes place more generally, and which market segments must be courted first by innovative sellers.

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2. To what degree do subscription services substitute for traditional formats of consumption, and to what degree does it complement them?

Question 2 is part of a long-running discussion of how different formats cannibalise or complement each other. This is an important, although possibly restrictive, perspective on transition from one technology to another.

3. What are the welfare implications of subscription services?

Question 3 lifts the perspective and provides a discussion of the overall benefits of subscription services, both to groups of stakeholders and to society at large.

4. How likely is it that one single subscription service will emerge as strongly dominant?

Question 4 is a very important question for regulators and will also be useful for representatives of the rights holders when weighing their options.

5. How does the transition from unit sales to rented access affect the distribution of revenues between stakeholders?

Question 5 can be considered a key subquestion to question 3, but with more emphasis on equity than efficiency.

I will use global and local statistics to enlighten some of the questions asked, while others will be subject to rigorous theoretical analysis. The analysis will end up in conclusions that include recommendations to various stakeholders.

Not every part of the thesis will be suited for every reader. Some parts are very technical and a challenge even for economists. In the following section, I provide an overview of the contents of the thesis, and some hints towards who might want to skip certain parts.

1.2 Structure of this thesis

Part I – The music industry and the revenue streams

Part I of this thesis (chapters 2-4) will provide an analysis of the music industries, the economic structures and revenue streams. Both the permanent features and the more fluid consequences of new technology will receive treatment. This section does not directly answer any of the research questions

laid out above, but provide context for the specific research questions, it may answer questions the reader might have already, and might help the reader raise new questions.

Chapter 2 maps out characteristics of cultural goods and music in particular, and it describes the most important organisations and functions related to production and distribution of recorded music. It also discusses how rights holders can appropriate their share of the consumers' willingness to pay. Copyright is obviously an important factor. In chapter 3, I briefly go through the various stages of digitisation in the music industry. Chapter 4 is where I provide an analysis of what streaming services are, how revenues are distributed and also where I provide some statistics concerning streaming services and recorded music in general.

Part II – Consumer demand for music subscriptions

Part II (chapters 5-7) investigates the consumer side of the market. Chapter 5 will provide economic interpretations of how and why music is acquired and consumed. Cultural goods in general, and music in particular, feature some specificities that may differentiate them from many other goods. A range of interpretations are referred to, and their applicability to music and streaming services are discussed. People are different and prefer different types and quantities of music. They are also different in their willingness and ability to pay. Such heterogeneity is important to take into account when analysing music consumption. I also refer to many models that in various ways try to explain what we call *demand interdependence,* the phenomenon that one person's consumption affects the demand from other people. This phenomenon may be crucial in explaining differences in popularity, and especially the existence of global superstars.

Chapters 6 and 7 constitute empirical contributions. Both chapters utilise data from a Dutch survey conducted in 2013. I study various aspects of music consumers and the media they consume. The survey was conducted at a time when streaming services were still in their commercial infancy in most of the world, and this survey gives a unique possibility to study this early transitional period. Chapter 6 poses the overarching question *Who are the music consumers?* Research question 1 above is an important piece of this puzzle: *What characterises the early adopters of music subscriptions?* The answer, put briefly, is that subscribers consume more music, more books and more films through any mode (legal and illegal, tangible and intangible) available. Subscribers are on average more than ten years younger than non-subscribers are, and they are slightly more often men. They tend to either have high education or to follow an educational path that leads to academia. I attempt to cluster consumers, and the one important division is that between consumers and non-consumers. Other

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clusters are mostly not robust. Specifically, I find no support whatsoever for an often made distinction between *omnivores* and *univores* at this level of analysis.

Chapter 7 explore how and to what extent different modes of accessing music substitute for each other. This is research question 2 above. The fact that some people are much more interested in music than others, and therefore consume more of everything, creates an *unobserved heterogeneity* among the respondents, and this is methodically difficult to disentangle. Through two approaches, an instrumental variables approach and a more experimental one involving factor analysis, I estimate substitutability between the different modes of consumption. The results that concern subscriptions are the core interest of the thesis, but only part of the picture. I find that subscriptions are a substitute for physical formats. They have an unclear relationship with piracy and, surprisingly, appear to be complementary to paid downloads. This last result seems counter-intuitive, but it is possible that subscriptions and downloads are compliments at any given point in time, and that the observed decline in paid downloads is a result of preferences changing over time. In that case, the binary perspective of complements/substitutes may not be all that relevant when interpreting technological change. It is also possible that this result only is true in the Netherlands during this exact time period. It is difficult to know which results are generalisable across time and territories, and which are not.

Part III – Welfare economics – redistribution and efficiency

Part III of the thesis (chapters 8-9) ventures into welfare economics and industrial organisation. The section will discuss the last three research questions above. The section has been challenging for the author, and will be very demanding to most readers. Chapter 8 maps out the relevant considerations concerning welfare and efficiency in the context of music subscription services. I follow up by reviewing economic literature on vertically related markets and two-sided markets. The relevance that the different research contributions have to music subscription services is discussed. Research question 4 above is *How likely is it that one single subscription service will emerge as strongly dominant?* I believe this is only likely if the major rights holders own at least a considerable share of this subscription service. If a subscription service *not* owned by the rights holders emerges as dominant, I believe it is in the best interest of rights holders to keep that service's market power in check, and I believe the rights holders have the means to do that. The chapter ends by discussing the welfare implications of the all-you-can-eat-subscriptions specifically. This prepares the ground for chapter 9.

Chapter 9 is an original contribution that compares the subscription business model with the traditional model of selling copies of recorded music. For this purpose, I have constructed a formal model that incorporates the most important factors for explaining and evaluating the differences between the business models. This model is used to study the allocative efficiency and distributional characteristics of subscriptions and sales respectively. I find that suppliers of music collectively are likely to capture a slightly larger piece of the pie with subscriptions. Consumers have a slightly narrower slice, while the deadweight loss due to price being above marginal cost is larger. The total size of the pie (consumer surplus and producer surplus added) increases with a negligible 2.8% with the transition to subscriptions. This last result is less general than the other results, as it depends more heavily on certain strong assumptions. The model is also used to estimate the share of revenues captured by the head and the tail of the popularity curve respectively. I estimate that the most popular artists will capture a smaller share of revenues under the subscription business model than they would under the sales model, for unchanged consumer preferences.

Part IV – Final discussions, conclusions and recommendations

Part IV consists of four brief chapters. Chapter 10 sums up the core discussions of the thesis. Chapter 11 presents the implications that my findings and interpretations should have for the policy of governments, platforms and rights holders. Chapter 12 suggest areas and questions for future research. Finally, in chapter 13 I round off the thesis with some *final remarks*. While the subscription model has many advantages, there are certain issues with the business model itself, and with the copyright framework the business model works within. The various stakeholders, including governments around the world, should consider revising some of the rules of the game.

PART I
The music industries

2 Economic characteristics of the recording industry and the music markets

Recorded music is produced, distributed and monetised within a vast and complicated network of stakeholders. Cultural goods in general, and music as a case in point, has certain characteristics that distinguish them from most other goods. This chapter gives a brief description of the most important systems and agents associated with music industry, as well as the characteristics of music markets.

2.1 What is a cultural product?

2.1.1 Definition and delineation

No definition of cultural products is agreed upon internationally, and nor is there likely to ever be an agreement. Artistic and cultural goods must carry some artistic and cultural values, but what those values are, how much such value a good must carry to qualify and whether or not any such value is present is mostly impossible to measure or even define. From a production point of view, the supply of a cultural good rests on a creative process where some informational content is subsequently turned into a marketable good by more normal industrial principles. Cultural economics has its origins in studies of the traditional fine arts: performing arts and visual arts. While *the fine arts* can be delineated fairly easily, it becomes more difficult when the broader term *cultural sector* is used. In addition to the arts, museums and heritage, this will include the *cultural industries*: mass produced recordings of audio, video and text. It will overlap with the *media sector* and some wish to include fashion, advertising, architecture, musical instruments, tourism, sports and food. While *food* may certainly be *culture,* it is not reasonable to include every part of the food industries into the cultural industries. Supermarkets, McDonald's and industrial-scale farmers should certainly not be included. UNESCO defines cultural and creative industries as "sectors of organised activity whose principal purpose is the production or reproduction, promotion, distribution and/or commercialisation of goods, services and activities of a cultural, artistic or heritage-related nature" (UNESCO, 2017). This is not an operable definition until *cultural, artistic or heritage-related nature* receives an operable definition. Lacking a proper definition, one can at best agree on *lists* of what is classified within the category.

The concept of *the creative industries* is commonly used synonymously with cultural industries (Towse, 2010, pp. 376-377), but the delineation may also differ. Hartley (2005) claims that *Creative*

industries unites the *creative arts* and the *cultural industries.* The concept "moves beyond the elite/mass, art/entertainment, sponsored/commercial, high/trivial distinctions that have bedevilled thinking about creativity in policy as well as intellectual circles". Computer software is commonly considered a product of the creative industries, but not the cultural industries.

Yet another concept is *copyright industries*, which categorise industries according to their dependence on copyright. The *core copyright industries* according to the World Intellectual Property Organization (WIPO) are press and literature, music, theatrical production and operas, motion pictures and video, radio and television, photography, software and database, visual and graphic arts, advertising services and collective management societies (UNESCO, 2012).

Other terms that are applied to sectors of the economy that overlap strongly with the cultural industries are *experience industries*, *content industries* (UNESCO, 2012), *media industries*, *information industries* and *entertainment industries* (Hesmondhalgh, 2013, p. 23). The differences between the concepts are more in the point of view than in the actual sector of the economy. Lorentzen (2013, p. 45) states "culture economy focuses on final culture products and producers, while creative economy focuses on creative processes preceding innovation and production. […] the experience economy concept enables a view from the consumption side, placing the consumers together with the producers in a stage from which valuable experiences may emerge in complex innovation processes."

The concepts are many and the delineations diverse. We will proceed without a clear definition or delineation. The emphasis of this thesis is on recorded music. I will draw insights from research on related goods, and insights emerging from this thesis may to varying degree be hypothesised to also be applicable to other parts of the creative industries and markets for cultural products.

2.1.2 **Some basic characteristics of cultural products**

Some characteristics are common among cultural products while others are specific only to some of them. Some characteristics are shared with goods that are generally *not* considered cultural products. Cultural goods are supplied through processes that in much resemble those of other industries and traditional tools of economics can therefore be applied to the analysis of cultural products. The contribution of cultural economists is not only to apply such general tools to the cultural sector, however. One must also take into account the special characteristics of cultural products (Towse, 2010, p. 6).

Much of this section is based on the introduction of Caves (2000), Ringstad (2005), and chapter 4 in C. Handke (2010a). Some characteristics will be mentioned briefly while those with most relevance to this thesis will be more thoroughly discussed.

Demand is uncertain

Before a new creative product is brought to market, it is very difficult to foresee its success. Some low-budget products may succeed beyond anyone's expectations, while a film with A-list cast, a high budget and extensive marketing may be a box office flop. Cultural goods often have substantial sunk costs of production before consumers can give any feedback on the product (Caves, 2000, p. 3; Ringstad, 2005, p. 22). This is especially true for mass produced products like recordings or books. The risks associated with the provision of cultural goods is therefore very high, and some sort of risk sharing or spread of risk is essential for long term survival (Ringstad, 2005, p. 135). This can be accomplished through large corporations supplying a variety of products, through government subsidy, insurance, or partnership.

Quality is uncertain

Cultural goods are commonly *experience goods* which implies it is difficult to assess their quality without experiencing them first hand. Some concerts and theatre performances will be disappointments. Some books will be left alone midway. Some records rarely played. This uncertainty leads consumers to be more likely to buy products they already know or have had recommended to them buy people they trust. Quality uncertainty may be an advantage to incumbent musical superstars, film studios and authors and an obstacle for new artists. We will return to this uncertainty in sections 5.5 and 5.6.

Creative workers care about their product

It is common in economics to assume that that workers do not care about the product they contribute to bring about, but care only about payment and working conditions (Caves, 2000, p. 3). This is a simplification. Contributing to a popular or high quality good can make workers feel proud. They find value and meaning in working as scientists rather than alternative jobs with a higher pay. Social workers find happiness in providing care for the needing. Still, the simplification can often be justified as pay and working conditions are indeed the most important factors in most industries.

Creative workers are generally strongly motivated by such non-material rewards, they have an *intrinsic motivation*. Creative workers care about the quality of the product they supply. Not only such qualities as are rewarded with higher sales, but also qualities that are first and foremost appreciated by their peers within the industry, or even only by themselves (Caves, 2000, p. 4). A comprehensive analysis of art (labour) markets must take this into account.

Differentiated products

There are many books in the market, and different titles appeal to different readers. There are many different films and many different music recordings. Rights holders hold a monopoly on their specific recording, and although close substitutes may exist, none is the same. This trait is not at all exclusive to cultural products. It exists everywhere where intellectual property rights, trade secrets, or first mover advantages play a role: goods are not homogeneous. Heterogeneous goods lead to market power and important deviations from perfect competition. We have instead a situation of *monopolistic competition.*

Goods that are *different* but without one good being generally excepted as better than the other are called *horizontally differentiated.* When one good is considered by all consumers to be superior to another, we have *vertically differentiated goods*, which implies that if the goods are offered at the same price, then no one would buy the inferior good without also buying the superior good (Caves, 2000, p. 6). If they are also perfect substitutes no one would buy the inferior good. Most common is something in between horizontal and vertical: many but not all consumers prefer one good to the other. While a large pizza is preferable to a small pizza, and a high-end computer preferable to a low-end computer, the preferences of consumers differ much more when it comes to cultural products. However, vertical differentiation can be used by a supplier to better exploit consumer valuation. An example would be to price attractive seats in a concert higher than less attractive or to provide a music subscription with few restrictions at a high price and one with severe restrictions at a low price.

Generally, if goods differ in many dimensions it is more likely that differentiation is horizontal: one consumer puts emphasis on one trait, another consumer on another trait. Cultural goods are certainly multidimensional. Variety is therefore more important than what is the case for most other goods.

Externalities and public good properties

If a cost or a benefit affects someone who neither made the choice, nor can be blamed for the event, that incurred that cost or benefit, then that person is subject to *externalities.* One example of externalities is how one consumer's consumption may affect the utility other people have from consuming the same good. Consumption may also affect the utility *non-consumers* have from the good. *Positive externalities* imply that consumption or provision of a good also benefits people not involved in the trade, and this is commonly assumed to be the case for (some) cultural goods. The receiver of the positive externalities is essentially a *free-rider*, one who cannot be excluded from enjoying a public good. Public good properties and positive externalities are very similar.[3]

Public goods are characterised by being non-rivalrous and non-excludable. In many cases people can be easily excluded (either physically, technically or by law) but the good may still be non-rivalrous, implying that if more people consume it (listen to the music, tap into the cable network, download the e-book) it will not affect either other consumers or the sellers. In such cases, cultural goods can be considered *club goods.*

It is common to assume cultural goods have positive externalities in the sense that the knowledge and sense of identity they feed to artists and audience spills over to those not present (Ringstad, 2005, pp. 32-34). We will return to externalities in chapter 5.

Cultural goods are merit goods

Cultural experiences, such as theatre, classical concerts or good literature is by many assumed to be *good for you.* It may be better than consumers are aware of themselves, and thus willingness to pay is too low. In conflict with the principle of consumer sovereignty, authorities may subsidise cultural goods or informational goods they consider good. A close parallel is subsidising greens and taxing sweets, alcohol, and tobacco with the argument that they are either good or bad for you. This type of argument is controversial, especially among economists, but it is widespread nonetheless (Løyland & Ringstad, 2009, pp. 34-35).

It takes time to consume cultural products

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[3] According to Holtermann (1972), public goods (which may be good or bad) is a subset of externalities. If the externalities experienced by one agent are the same whether or not other people experience the same externalities, then it is a public good property. If externalities are rival goods, they are not public goods.

Many cultural products take considerable time to consume. If you wish to attend a theatre, you must travel to the location, attend the show, and get back home. That is a full evening or more. It is not difficult to find books you can get for free, but to read the book usually takes many hours of your time. You have no time to read all books, and will have to prioritise your time. Your most important budget constraint may not by your financial budget, but your time budget. This also goes for music: You can only listen to so much, and most people enjoy listening to some favourites many times. No matter what your enthusiasm for music, your budget, and your willingness to pay looks like: There just is not time to listen to it all! Many applications of consumer theory on cultural goods will be of little worth without somehow incorporating time as a scarce resource. Paradoxically, time to consume cultural products may become even more scarce as income increases and technology brings new leisure activities to market (Ringstad, 2005, p. 66). More on this in section 5.1.

Fads and fashions – interpersonal aspects of demand

Some artists stand out as superstars for reasons that might be difficult to comprehend fully. New genres gain traction, or old ones re-emerge, in an ever-changing musical landscape. New technologies are launched, some eagerly adopted by users while others never get proper foothold in the markets. People tend to move in some synchronisation from one fad to the other. On the other hand, some people also like to distinguish themselves from others through their consumption. And preferences differ between subcultures and between countries and cultures. Such individual and collective behaviours have been analysed a lot in the fields of sociology and economics, and there are different ways of interpreting them. They have in common that they lead to *non-additivity of demand.*

The value people attach to a good may depend on other people's demand. People may want to stand out from the crowd, or to keep up and blend in. They may attach value to the good for reasons that are not inherent in the good itself, such as a sense of belonging to a collective, they may feel part of some narrative, or the good may be more useful if more people have it, such as a telephone.

To jump on the bandwagon means to follow the mood of the moment, to do what other people do, wear what other people wear, listen to what other people listen to. People will be *one of the boys*, they will *keep up with the Joneses.* They will *fit in.* Such socio-psychological effects work alongside, and can easily be confused with, technological network effects and provision of information. I will return to such *external effects on utility* in section 5.5.

Reproducible and non-reproducible cultural products

A major distinction among cultural goods is that between reproducible and non-reproducible goods (C. Handke, 2010a, p. 109). Artists may perform many musical or theatrical performances that are similar to each other, but they are not exactly identical and the possible number performances is finite. A recorded reproduction of the event does not have the same value as the live performance. Visual arts provide an even stronger example: a painting or a sculpture is unique or reproduced in a limited number (ignoring mass-produced wholesale art). These goods are unique and not reproducible. On the other hand, reproducible goods can be mass-produced to without loss of quality. Musical recordings, films, books, and video games are created with mass production in mind, and the initial cost of investment can be divided on a large number of copies. They can be made available to consumers globally, at any later point in time, at low cost. This is arguably the main reason why consumers spend much more time on consuming reproducible cultural goods than on consuming the traditional arts (C. Handke, 2010a, p. 109).

Production of non-reproducible goods and services are generally labour intensive, something that makes the organisations within these fields potentially vulnerable to *Baumol's cost disease* (due to cost of labour increasing more than cost of other inputs). Reproducible goods, on the other hand, experience rapid growth of the productivity with which they are produced and distributed. Thus, the relative price of reproducible and non-reproducible goods will continue to shift in favour of the former.

The topic of this thesis is recorded music, a reproducible information good. Although recorded music is traditionally supplied on physical carriers that may be attractive to consumers in their own right, and may end up as collector's items (which are *not* reproducible goods), the recorded music itself is information that can be perfectly captured by bits and bytes and infinitely reproduced.

High fixed costs

Most cultural goods are characterised by considerable fixed costs (Caves, 2000, p. 223). This is true in particular for easily reproducible goods like music and film recordings, books and printed graphic art. But it is also true for many non-reproducible goods. Theatres have high fixed costs on several levels: They must acquire an expensive, central location and build an expensive, purpose-build structure on top of it. At another level, fixed costs of staging a show are high. It takes costumes and scenery and actors must rehearse their lines and movements. Each subsequent performance is less costly and, given available seats, the marginal cost of an extra person in the audience is next to zero. Reproducible goods, and in particular digitally distributed goods, takes this to another level. While

fixed costs associated with creating the good may be high, digital distribution may have marginal costs that approaches zero.

Durable products and durable rents

Art can exist in durable form or less durable form. Sculptures made out of bronze or stone can continue to exist for thousands of years while an installation in a gallery will only last as long as the temporary exhibition of which it is a part (Caves, 2000, pp. 271-272). Vinyl records and CDs will last a long time if treated carefully, as will books and paintings. The consumers may build collection throughout their lifetime and their property may be passed down through generations.

Cultural goods that are less physically durable may also continue to exist perpetually due to reproducibility. A concert performance is not durable, but the composition behind is. It can be perpetually reproduced through new performances. It may also be durable to the consumer in a sense: the experience may create lasting memories and provide new knowledge and understanding. Consumption of cultural goods may therefore be considered an investment as well as an indulgence.

Recorded music can be copied onto a new carrier (music cassette, CD, DVD, hard drive, memory stick) without any loss of quality. This makes reproducible cultural goods very durable (C. Handke, 2010a, p. 113). Durable goods are subject of its own strain of literature within economics. The relevance of this literature for cultural goods may be challenged by two facts: Although music may be durable in the sense that it does not disappear, it may however not be culturally durable: Fads, fashions, changing tastes and an individual's taste for variety may imply that the consumer attaches a decreasing value to the good. Second, the transition from unit sales to an access model implies that consumers forgo durable copies in exchange for wide-ranging *access* through subscriptions. To the consumers, the good is perishable. They must pay for it repeatedly. The rights holders can continue to extract a durable rent, mandated by copyright law, as long as there is interest in their work. This transition is the core of this thesis.

2.2 Organisations and functions in the recorded music industry

The music industries are all about connecting creators with the market of fans in various ways. While the industries have always evolved, gradually or abruptly, certain elements and functions remain, and will always be indispensable. In this section we will discuss fundamental functions in provision and

consumption of recorded music, and the organisations that fill these functions. While artists and songwriters are commonly not considered part of the music *industry*, they are included here.

2.2.1 Artists and songwriters

Function

Composers and songwriters compose the music and write the lyrics. They are the creators of the music. While composers and songwriters as a group are strongly overlapping with artists, writers of a given recording is often not the same as its performing artist. Artists perform and record music made by themselves or others and are the instrument that takes music off sheets and into the ears of consumers. Songwriters and artists perform consecutive functions in the value chain: songwriters creating the work of art that earns *author's rights* and artists are performers that create the sound recording that only earns *related rights*.

Organisation

Songwriters can be employed by music publishers or work independently. Their work may be written with one particular artist in mind, or may be written centuries before the artists were born. Just as an artist may transfer all or some of his IP rights to a record company, a songwriter may transfer rights to a publisher, depending on legislation. Artists generally release their recordings through a record company, although there are many exceptions from this.

2.2.2 Record companies

Function

The basic function of record companies is to refine the creative works of songwriters and artists into marketable goods and distribute them into the market. This process includes recording, manufacturing, distribution and promotion. To varying extent, labels plan and invest in artist careers. Record companies perform a vital role in spotting and developing talent as well as acting as tastemakers and gatekeepers (Barr, 2013). Record companies most often own the rights associated with the music recording ("master tape"), depending on who paid the studio time. The importance of record companies remains strong, even though artists increasingly own the copyright themselves, and may thereby take more decisions when it comes to licensing (Ingham, 2016).

Organisation

The organisations of "record companies" differ. Some artists choose to self-publish and avoid the record company intermediaries entirely. Others release their recordings through independent labels, of which there are thousands. However, most markets, and also the global market, are dominated by the "Big three" (also called *the majors*): Universal, Sony and Warner. It is estimated that in 2018, 69.2% of revenues are from sales and streams of artists signed to labels under the big three (Mulligan, 2019). These companies today are huge corporations consisting of many of those labels one can see stamped on the recordings. They also act as distributors for many independent labels. While the labels mostly act as independent units, certain strategic and overarching budgetary decisions are handled by the parent company. These huge record companies are themselves part of larger corporations.

As an example of the complex structure of labels and corporations, take Universal Music. Universal owns, or has a joint share in, a very long list of labels that are organised under different umbrella companies. Among the umbrellas are *Interscope Geffen A&M Records*, *Capitol Music Group*, *Universal Music Group Nashville*, and *EMI*. The total number of subsidiary labels is way too extensive to be listed here, but can be found in the Wikipedia article *List of Universal Music Group labels.* [Reading date October 24th 2019].

Universal Music Group is in turn only a small part of the French multinational mass media conglomerate Vivendi.[4] In addition to music, Vivendi own (wholly or partially) companies involved in TV-channels, film production, video games, live entertainment ticketing, online video-on-demand, concert venues, telecommunications and more. Just to underline the complex structure and history of such multinationals, it is worth mentioning that Vivendi traces its roots to a water company created by Napoleon III in 1853 in order to supply water to Lyon! Only in 1976 did they diversify into other sectors. In 1998 they changed their name from *Compagnie Générale des Eaux* (General water company) to *Vivendi* (Vivendi, Not dated). Figure 1 shows a simplified organisation chart of Vivendi SA.

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[4] Vivendi sold shares of Universal Music Group from 2019. Universal Music Group went public on the Euronext Amsterdam stock exchange in September 2021, between the writing and the printing of this thesis. Vivendi sold most of its remaning shares in connection with this.

vivendi

100%
Universal Music Group

100%
Canal+ Group

100%
Vivendi Village

90%
Dailymotion

100%
Vivendi Content

Affiliates

Recorded Music **UMG** 100%

Music Publishing **UMPG** 100%

Merchandising **Bravado** 100%

Société d'Édition de Canal Plus (SECP) 100%

Free-to-air Channel (iTélé, D8, D17) 100%

nc+ (Poland) 51%

Canal+ Overseas 100%

VSTV (Vietnam) 49%

Studiocanal 100%

Vivendi Ticketing 100%

MyBestPro 100%

Watchever 100%

Radionomy Group 64.4%

L'Olympia 100%

CanalOlympia 100%

Banijay Group 26.2%

Flab Prod 100%

Mars Films 30%

Studio+ 100%

Telecom Italia [1][3] 24.90%

Telefonica [1][2] 0.95%

Gameloft [1][2] 29.86%

Ubisoft [1][2] 15.90%

(1) Listed company.
(2) Of the share capital (% of interest).
(3) Based on the total number of common shares with voting rights.

Figure 1: Simplified organisation chart of Vivendi SA as of March 2016. (Source: Vivendi, 2016)

Record companies have pretty much the same functions as they had before the digital revolution. Although no physical product is produced and distributed, the music must be recorded, mixed, mastered and marketed as before. Technological developments on recording technology and distribution of music has arguably made record companies less indispensable, but they are still of importance in selection and quality improvement of artists. Their role as gatekeepers has diminished

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somewhat, as artists can reach audiences directly through various online platforms with recordings made in home studios or even just with a web camera.

Reproducibility of recorded music allows suppliers to distribute fixed costs over many copies of the product supplied. As marginal costs are low, with digitisation approaching zero, total costs do not increase much as output increases. Average cost will be perpetually decreasing and scale is therefore crucial. There is more profits to be made from selling a million copies of one recording than from selling 1000 copies of each of 1000 recordings. Large multinational companies may exploit economies at several levels: They may be more efficient at pushing the same recordings to consumers globally, concentrating sales on fewer recordings. There is also economies of scope between different recordings: It is more efficient to record, market and distribute and otherwise administer many recordings through the same organisation.[5] This might not be an overwhelmingly strong argument however, as most such tasks are taken care of by each of the separate labels that the multinationals consist of. The strongest incentives for concentration may be market power in relations with the technology and media multinationals that distribute music to the global audience. In these sectors, economies of scale and scope on a broader basis are likely strong forces towards concentration, something that demands counteracting, strategic decisions from the record companies.

Globalisation of demand, digitisation of distribution, and concentration of market counterparts may all be part of the explanation of the observed concentration of record companies and rights administration in recent years.

2.2.3 **Publishers**

Originally, music publishers were very much like other publishers: they published and printed sheet music. Copyright gave them monopoly on reproduction of the sheets, but copyright did not give rights of any royalties from performance of the music. As emphasis of music went from printed to recorded music, the role of music publishers changed. Their primary function is now to help rights holders collect the royalties they are entitled to from various sources. One would think digitisation would lead to tools that automatically would remunerate the rights holders and made these intermediaries superfluous. When that has not happened, it is likely in parts because they have not been willing to contribute their databases to a *global repertoire database* which could be utilised by

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[5] The distinction between economies of scale and economies of scope may be a bit blurred in the case of many varieties of a differentiated good. Supplying many different varieties may be considered utilising scope or utilising scale (C. Handke, 2010a, p. 142).

all to distribute royalties correctly. If they wanted to, publishers as well as collecting societies could probably make themselves redundant. Meanwhile, various copyright related royalties make up a steadily greater share of revenues for artists as well as composers and songwriters.

2.2.4 **Collecting societies**

Copyright collecting societies license works on behalf of composers and authors for the use of works in various contexts. The context may be recording, performance, broadcast or replays in restaurants, hotels, clubs and so forth. Without collecting societies, transaction costs of clearing rights and remunerating rights holders would be prohibitive. Music copyright was initially about licensing copies of sheet music. Performance revenues from concerts and broadcasting, and mechanical revenues from recording, came later.

Ownership of radio receivers grew fast during the 1920s, and by the 1950s 95 per cent of US households owned a radio receiver, with Europe gradually catching up (Towse, 2010, pp. 462-463). Broadcasting was considered an important line of communication from authorities to people. In most countries, broadcasting has been subject to public ownership, financing and/or regulation. Due to its public goods characteristics, it is non-rival and non-excludable, broadcasting is usually either financed by state subsidies or commercials. With digitisation, radio can be broadcast over the internet, and electromagnetic waves through air is no longer essential. The internet also allows for on-demand listening through podcasts or online streaming.

Right from the start, music has been an important part of the content provided by radio. At first, music was provided by musicians playing live in studio. As recording equipment improved, replaying of recordings became the norm. As television came along, radio experienced hard competition, but music was just as good through radio as through television. Arguably, music became more important for radio stations after ownership of TVs became commonplace.

Performance revenues from broadcasting

Through copyright legislation, and agreements with the rights holders' representatives, creators and performers receive royalties from replays (subject to national legislation). Songwriters and publishers receive *performance revenues* from all public performance, including broadcasting. Legislations commonly also give artists and labels their share through *recording performance revenues.* The importance to rights holders of this source of revenues has been increasing. (See section 4.3 below.) Music streaming is considered a form of public performance, so rights holders get copyright revenues

from these. While revenue from sales and copyright revenues used to be distinct, they are now intertwined.

Synchronisation

Music is extensively and increasingly used in film, TV-productions and computer games. Adding music to visuals is called *synchronisation,* and songwriters and publishers get paid *synchronisation royalties.* If a specific recording of the music is used, then the label will also get a share.

2.3 Complementary sources of revenue

Musicians and rights holders do not only earn their money through sales of music recordings. Since the turn of the century, there has been a shift in the importance of markets. While revenues from sales of recordings plummeted, revenues from concerts, publishing and synchronisation increased (Nordgård, 2017, p. 36). Any comprehensive treatment of the music industry must include all the markets with the weight they deserve. This thesis is *not* comprehensive, and I will only briefly describe these sources of revenues as a relevant backdrop.

2.3.1 Live performance

Live performances have been an increasingly important source of revenues to artists since the turn of the century. This is due to both the plummeting revenues from record sales and increasing revenues from live. For many artists, the increased revenues from live may have counteracted the impact of decreasing record sales. However, due to the skewed distribution of these revenues, it might be a limited comfort for the vast majority of artists (Nordgård, 2017, p. 40). Evidence is mixed when it comes to the development in distribution of revenues. Connolly and Krueger (2006) find that the most popular artists grab an increasingly large slice of the pie. This is the case throughout their dataset, which ranges 1982-2003. Mortimer, Nosko, and Sorensen (2012) find the opposite: the most popular artists have not seen much change in revenues while lesser artists have seen an increase.

One question is whether revenues from live compensate the majority of artists or not. A different question is *why* total revenues from live has increased. When income from recorded fails, artists may compensate by touring more extensively (Mortimer et al., 2012). Two predictions comes from this hypothesis: there should be more concerts and lower remuneration per concert as competition intensifies. On the other hand, a major function of holding concerts used to be to promote new

records. Thus, artists might have been willing to hold concerts for lower direct payments as they also received indirect remuneration through increased record sales. They might also have received tour-support from their record companies (Nordgård, 2017, pp. 38-39). Thus decreasing record sales might have weakened incentives to tour (Krueger, 2005). If direct and indirect remuneration from concerts have decreased, some artists may no longer bother with, or indeed afford, extensive touring. The predictions that comes from this is that there should be *fewer* concerts while remuneration may increase as artists become a more scarce resource. However, other factors also affect payments to artists, such as the surge of festivals during the last few decades, changes in public support, more globalised market for artists and so on. It is outside the scope of this thesis to analyse the development within the live market.

Certain agents of the music industry are not satisfied by making money from one sector of the music industry. They may enter so-called 360-contracts with artists. This implies that they will organise most practicalities around the artists: recording of music, organising concerts and tours, produce and distribute merchandise, deal with licensing and sponsors. They may replace not only record companies and tour organisers, but also management. The formerly distinct industries of recordings and live may be melting together.

Live performance royalties

Live performance is the original music experience. Performers may perform music they have made themselves, or music they have learned from others before them. Copyright law commonly mandate a licence to be paid for concerts. The money are distributed among rights holders of music performed. Artists should also report when playing their own material, as this may trigger revenues paid from a collecting society.

2.3.2 Merchandise

Sales of merchandise has been an important source of income, and to many artists it still is. A large part of sales of merchandise takes place in connection with concerts. Thus it is an indirect remuneration for holding concerts. T-shirts and other physical objects provides revenues to the artists while fans can show their fondness for the artists. Merchandise strengthens the ties between fans, and between fans and artists. It also works to promote the artists to the public. Although the revenue streams from merchandise may not be overwhelming for most artists, it serves several purposes.

Crowdfunding of projects is a more recent phenomenon. The beginnings of crowdfunding as we know it was can be found around 2000. It has mostly been used by start-ups, but also more established bands. Artists may receive help from fans to realise projects that would otherwise be too costly. Crowdfunding was initially for artists, but in recent years the platforms also support everything from new gadgets, new businesses and charities. There are various forms of crowdfunding. Most common among artists is the donation based and the reward based, where supporters may receive a CD or o t-shirt in return. While Kickstarter is often about preselling a product, *Patreon* is about "subscribing" or giving monthly donations. The latter is not so much about start-ups, but more about covering operational costs of businesses that generates few other revenues, such as YouTube channels. The fastest growing, and economically most important segment of crowdfunding is now *equity based.* This form of crowdfunding gives the supporter some form of ownership to the business. This model is not very common among artists, but it has happened. For instance, several artists have offered stakes in their future revenue in return for people investing into the cryptocurrencies or Ethereum tokens they have launched.

2.4 The economics of appropriability

Appropriability in economics can be defined as the capacity of an agent to retain the added value it creates. Who benefits from the added value of the service or good being provided, depends on the decisions of the firm, the structure of the market, legal restrictions, the technology through which the service or good is being provided and traits of the good itself.

Belleflamme and Peitz (2010, pp. 506-507) identifies three sources of market failure leading to the *appropriability problem.* First, the *uncertainty* of technological and commercial success of a product. Second, the *indivisibility* of costs, meaning that a very large fraction of total costs are sunk before the first copy is produced; High fixed/sunk costs and low marginal costs implies that the industry is subject to *economies of scale.* That is, if output increases then cost increases less than proportionately. Average cost of the units produced will be diminishing as production increases. Information goods – goods that derive their value from the information they contain rather than some material quality – are among the foremost examples of a broad range of such goods. The third source identified by Belleflamme and Peitz (2010) is the previously mentioned public good nature of information goods, meaning that they are non-rival and more or less non-excludable. *Non-rivalry* means that one person's consumption of the good does not prevent another person's consumption of the same good. This can be rephrased as the marginal cost of providing the good to one more

consumer being negligible. This is an inherent trait of certain goods. *Non-excludability* means that it is difficult to exclude a person from consuming or utilising the good. Excludability depends among other things on the legal framework permitting exclusion, e.g. through copyright law. Taken together, these three sources produce a problem of appropriability implying that creators are unable to reap sufficient yields of what they sow. If the incentives to create are weak, it leads to a *dynamic inefficiency* in the sense that supply is too low. Goods with considerable potential consumer demand never reach market in the first place.

Perfect competition is not sustainable in markets with economies of scale. If markets are perfectly competitive, that implies that competition between agents lowers the price to the optimal level where price equals marginal cost and there is no *deadweight loss.* The only way to ensure sustainability and dynamic efficiency is through *im*perfect competition. Economist have always been aware of economies of scale, increasing returns to scale and the attached imperfect competition, but the difficulty of uniting economies of scale with static equilibria yielding unambiguous solutions has been troubling for mainstream economics. The market clearing intercept between demand and supply does not necessarily exist when marginal cost of production does not increase in output. Monopoly theory can be traced back to Thales of Miletus who managed to construct a monopoly on olive pressing for a season. Supposedly, he not only arrived at a monopoly by accident, he planned strategically in order to get there to prove a point he had made in advance (Gabrielsen, 2011). Oligopoly theory was formalised mathematically already in the first half of the 19th century. Further progress was made when Edward H. Chamberlin introduced the concept of *monopolistic competition* in 1933. Monopolistic competition was fully modelled to its current form by Spence (1976a) and Dixit and Stiglitz (1977).

The issues mentioned above, and the models used to understand them, are highly relevant to the music industry. The competition between artists and between recordings can be modelled as monopolistic competition. The competition between subscription services may better be modelled as an oligopoly. It is still unclear whether economies of scale are strong enough for this market to constitute a natural monopoly. One would not think the fixed costs of running an established subscription service need to be excessively large, but in addition to the supply side economies of scale, there is also network effects, sometimes called demand-side economies of scale. Each new consumer adds to the network, and the value per unit increases. Big is better both on the demand side and the supply side. Furthermore, a monopoly reduces the need to market the service, something that might reduce variable cost to a sustainable level. A monopoly also strengthens the power in

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negotiation with rights holders. While consumers value music highly, the various stakeholders on the supply side needs to face sufficient opportunities for appropriability.

2.5 Copyright

The fundamental purpose of copyright, as perceived by economists, is to solve the *appropriability problem*, the problem of creators not being able to capture profits from their efforts. Copyright goods are subject to high costs of the first copy and low cost of subsequent copies as they are easily reproducible, and it would cost very little to provide the good for everyone who wanted it. The goods are thus non-rival. If no copyright protection was present, any competitor could supply identical copies of goods such as newspaper articles, books, photographs and recorded music as soon as they were made public. In order to avoid a competitive situation were price would be forced below a viable level, there must be something that restricts competitors from entering this market and some form of excludability that entails consumers actually having to pay for the good in order to enjoy it. Otherwise, revenues will not suffice to cover costs, and the goods will not be provided in the first place. This would be a *market failure.* Thus, copyright constructs a monopoly and legal excludability in order to solve the appropriability problem, the market failure.[6]

As governments assign a monopoly to the creators or their agents to utilise works, copies of such works can be sold at a price far above marginal price without competitors (legally) undercutting them. A price above marginal cost will create an artificial scarcity that leads to a deadweight loss. On the other hand, restricting others from freely making copies is necessary to provide incentives to create in the first place. This provides a trade-off between underprovision of goods and underutilisation of goods. Striking the correct balance between access and incentives, between static inefficiency and dynamic inefficiency, is the central problem of copyright law (Landes & Posner, 1989). We will return to this is chapter 8.

Music streaming services are not the rights holders. They are services that depend completely on licensing music from rights holders. This may potentially put them in a difficult situation. According to the analysis of Richardson (2014), streaming services may struggle with ever

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[6] Use of the term "monopoly" in this context is debated. Copyright owners have a monopoly on making copies of the work, but substitutability between different works by different creators are usually strong enough to limit economic monopoly power. Market power is arguably not stronger than for goods protected by design laws, patents or trademarks or goods that are geographically fixed such as housing, office space, newsagents or cafés. Likewise, all firms and all workers with some element of unique skills have a certain market power. In general, perfectly homogeneous goods with perfect substitutes hardly exist.

getting profitable as the costs of licensing are apt to rise along with income. He goes on with an interesting perspective that I have not encountered elsewhere: *"In effect, the way in which copyrights are structured with respect to digital media allows content owners to free ride – in some ways – upon upstart distributors; by allowing these platforms to create a sustainable business model, and then enjoying the profits established by that model, with little capital input. Content distributors have little in the way of recourse."*

2.6 Non-copyright solutions to the appropriability problem

In non-copyright industries that suffer from the appropriability problem, other policy measures must be employed if such are needed. Such policies can be regulation, subsidies or public provision. These are also alternatives in copyright industries. Public provision is certainly normal for some cultural goods, such as institutional theatres and symphony orchestras, and for research and education. It is also very common for certain types of information goods such as statistics and public reports. Subsidies are used in different forms in a broad range of markets for cultural goods, and subsidies have traditionally been the main topic of discussion within cultural economics, while copyright is a more recent addition (Towse, 2008).

The economic deadweight loss caused by high prices on music, compared to free access, may be as large as the revenues of the record industry taken together (Romer, 2002). Music off the internet has properties like a public good, and it should possibly be financed as just that. Some suggest musicians can receive payment funded by ordinary taxation or specific levies, rather than the type of taxation that monopoly prices imply. Håkonsen and Løyland (2009) suggest that copyright protection may not merit the position it has. Markets may not be able to adapt well to an abolition of copyright, but artists may be compensated through public channels of support. To find an optimal distribution of public resources is a challenge, but the various collection societies that exist may serve as possible models. Boldrin and Levine (2008) make an argument against the institution of copyright itself. In their view, the agents of the market will learn to adjust to new terms. Artists, authors and middle-men like publishers and record companies can still make money in a free-market economy without copyright. A seminal paper by Landes and Posner (1989) actually appears to provide prescient answer to the visions of Boldrin and Levine (2008). Landes and Posner (1989) are much less optimistic about the proposed (market based) alternatives and claims that the direction of technological change suggests that only copyright regulation can solve the challenges. Varian (2005)

presents a range of interesting proposals on how copyright holders can survive in a world without *effective* copyright protection. For some of the points made, it is a condition that there are copyright laws, but that these are difficult to enforce. Indeed, unlicensed use of copyrighted goods may be a good thing as it provides the good at low cost to many consumers while rights holders may still generate enough revenues to recoup their investment (Boyle, 2000).

The rights holders and service providers can themselves reduce the negative impact of monopoly by applying price discrimination. This allows the rights holder to capture significant revenues from those with high willingness/ability to pay, while they can also provide it at a lower price to less keen/privileged consumers at a price closer to marginal cost.

Within the framework of copyright, but in partial contrast to current copyright laws, *alternative compensation systems* are discussed as methods of more efficient facilitation of production, dispersion and consumption of works (C. Handke, Balazs, & Vallbé, 2016; C. W. Handke, Quintais, & Bodó, 2018).

2.7 Non-legal sources of appropriability

Excludability, and thus appropriability, can also be strengthened by technological means, such as Digital rights management (DRM). Such measures make it difficult for consumers to make copies of information goods for their own consumption or for others'. DRM has commonly been employed on DVDs. Software and computer games may demand a unique licence code in order to function.

If there is imperfect competition, and at least a certain level of excludability, appropriability can be increased through alternative business models such as renting or bundling goods. Renting durable goods or housing goes back to prehistoric times. But more and more goods are made available through renting: Digital games and computer software may, instead of demanding a one-off payment, require an annual fee in exchange for updates, support and/or a working licence. Thus, excludability increases and the software cannot be resold when no longer needed. Market saturation does not occur in the same sense: if no *new* consumers need the product the *existing* consumers will still provide a constant source of revenue. Bundling several goods together in one transaction may increase the share of consumer valuation that the seller is able to appropriate. We will explore this thoroughly in chapter 9.

The subscription model for media consumption have become common during the last ten years with companies such as Netflix and Spotify as prime examples. There are several explanations for and

consequences of this emergence: it is more convenient for consumers, it remedies the problems of unlicensed copying and it affects the appropriability in other ways.

An entirely different strategy for music artists to increase appropriability is by switching emphasis towards a non-reproducible product, namely live performance. Extensive touring may be in direct conflict with writing and recording new music.

3 Technological shifts in the industry

The technology of the last two decades have made a greater variety of music available to consumers than at any point before in history. Current creators must deal with increased competition, not (only) from an increase in new music creations and other leisure activities, but from cultural heritage that might have been all but forgotten, or at least difficult to obtain. Transaction costs of accessing the past are lowered. History is effectively unearthed.

This chapter gives a rough outline of the history of digitisation and copying in the music industry, leading up to the streaming services that the next chapter will be all about. Legal and illegal downloading, as well as streaming services, are aspects of digitisation and the internet. For a decade, unlicensed copying appeared to threaten the recorded music industry, but it appears that streaming services are effective at "competing against free". I.e. consumers prefer licensed streaming services to unlicensed downloading. Thus, sanctions against unlicensed use may be less important than in the previous decade.

3.1 Value chains in the record industry

The topic of this thesis is mostly limited to the chains of delivery of recorded music from artists to consumers. The music industries are much more than the record industry. I will mostly limit myself to study the record industry, the consumers of recorded music and the necessary intermediaries to deliver recorded music. This choice is not arbitrary but justified by the fact that the recording industry has experienced the most dramatic changes during the last two decades.

Recorded music reaches consumers through different channels. The traditional sales of recorded music on physical carriers is waning, and so is the unit sales of digitally downloaded copies. These channels are being replaced by access-based streaming services. Recorded music also flows through radio transmissions, terrestrial as well as over the internet. Between traditional broadcasting and on demand streaming services are specialised digital radio "stations" that resemble the playlists that are available with streaming services. There has been a convergence of the services provided (radio, music subscriptions, download stores, cloud storage), and in the technologies to access these services (computers, televisions, internet radios tablets and telephones have increasingly overlapping areas of application). Digital services pay different royalty fees, some negotiated and some compulsory set by law, to rights holders. Digital revenues are in parts categorised as *digital revenues* and in parts

performance rights. One must consult the documentation of the specific statistics to compare them properly, as definitions differ between sources, over time and across territories.

Hotels, restaurants, stores, taxis, hairdressers, gyms, pubs and clubs replay recorded music for hours on end. For this, they commonly pay a fixed rate through compulsory licensing. This source of revenues will turn up among *performance revenues* or *performance rights* in IFPI statistics along with revenues from radio airplay and certain revenues from digital channels

3.2 First steps of digitisation

The first steps of the digital revolution came at the production end of the value chain. In the 1950s computers produced digital sound. Digital tapes, digital recorders and synthesizers were developed in the following decades and the first digital recordings took place in the 70s. These were only distributed in the analogue format, however. The first CDs were sold in Japan in 1982.

The CD format alone did not affect copying. Music had to be copied onto tape as before. Rewritable CDs and computer drives made their way into the market in large numbers from 1996. Thus, loss-less copying was both possible and relatively simple. Throughout the 90s internet connections became more common, and modems and connections got faster. The second half of the decade also brought with it proliferation of the compressed mp3-format and portable mp3-players. Napster was launched in 1999 and started the trend of peer-to-peer file sharing. In the following decade, broadband connections started to take over with its vastly superior capacity. Only with these technologies, online copying of music reached a scale that was of concern to the rights holders.

3.3 Digitisation as we think of it

During pretty much the same period that illegal file sharing became common, legal downloading of music files *also* developed, especially through iTunes. The scale of paid downloading increased slowly and was at a much lower level than unlicensed downloading, although some countries reached high levels before they started to decline faced with the competition from streaming services.

The consequences of digitisation have been analysed from several directions. There is a considerable literature on the determinants of, and the consequences of, illegal, digital copying. Handke (2011) provides an overview. Waldfogel (2014) and Liebowitz (2016) include more recent reviews of existing literature. Dellyana and Simatupang (2013) provide a review of the extensive research on

business innovation in the music industry. The internet has been credited for improving availability of niche products, which will affect patterns of consumption.

The transition from physical recordings to digital downloads has been studied by many (Bourreau, Gensollen, Moreau, & Waelbroeck, 2013; Danaher, Dhanasobhon, Smith, & Telang, 2010; George & Bell, 2008; Styvén, 2007). The most economically fundamental shift in music distribution due to digitisation is arguably *not* the transition from tangible formats to intangible. It is rather the transition from purchasing units to paying for access. From the rights holders' point of view, transition to streaming subscriptions represents a transition from one-off payments to pay-per-play.

Through reduced transaction costs, digitisation paved the way for unbundling of goods that were previously sold bundled in the album format. Download services allow songs to be purchased separately. Altinkemer and Bandyopadhyay (2000) investigate the conditions under which bundling is profitable for the seller. It was a common prophecy that digitisation would lead to increased use of micropayments (pay-per-play). Unbundling was very important in those few years that digital downloads became an important source of revenues, and consumers bought single tracks instead of albums. Micropayments is in use for renting digitally distributed films and it is especially important in various digital games. But as subscriptions for music and video has become more important, micropayments have become less so. A very relevant question is why bundling seems to be winning over *un*bundling. Paradoxically, it seems that while payments are bundled, actual listening is *un*bundled. The music album is becoming less important while popular single tracks are becoming more so (Eliassen, 2020). People differ in terms of how much streaming has changed their ways of listening (Hagen, 2016). Some prefer to stream albums from beginning to end, as if they were listening to CDs. Some listen to playlists consisting of thousands of tracks, shuffled in random order. That resembles a radio station. It appears to be increasingly common to use music more as a background music while doing other things.

3.4 Unlicensed copying

When a product is easily reproducible for the legitimate owners or rights holders, it is usually also easily reproducible for others. Unlicensed copying is not a recent problem that only surfaced with the proliferation computer networks. *Music piracy* has been an issue ever since commercial printing of sheet music started. Vinyl records in the 50s and 60s could be copied onto tape using open reel-to-reel recorders. The compact music cassette was introduced in 1962, and gradually gained popularity. It was very convenient for recording music from radio and records. The music industry saw this as a

threat to their revenues, and launched slogans like "home taping is killing music". Similar concerns have been voiced in connection with other reproducible cultural goods, for instance the film studios' fear of video cassette recorders.

3.4.1 Digital copying

With digitisation, things got worse for the industry. Making copies of digital, intangible products is very much easier than making copies of material goods. It is also faster, easier and cheaper to copy a CD onto a large capacity digital storage than to copy music albums onto individual tapes. Reproducibility increased strongly with digitisation, and with that came stronger economies of scale for the rights holders, but also increased competition from non-licensed copies.

Through the first decade of this century, revenues plummeted in the record industry. The development was dramatic in many countries. Suspicions are strong that the main explanation for the downturn has to do with unlicensed online copying of music that started for real with Napster in 1999. Napster was shut down in 2001, but new agents were ready to take over. The trial in itself took 19 months, and through this, the p2p-technology received a lot of attention. In a way, the shutting down of Napster might possibly have accelerated file sharing. Most researchers believe file sharing has at least part of the blame for the decline in revenues from recorded music, but there may also be other factors. This thesis will not go into this literature, although we will return briefly to topic in section 5.3. For a review, see Handke (2011).

Unlicensed downloading from sites such as *The Pirate Bay* has receded strongly. Through the last decade, unlicensed streaming services as well as stream ripping off radio or licensed streaming services has been more of a concern.

3.4.2 The flow of new recordings

Mortimer, Nosko and Sorensen (2012) presents simple statistics of the entry of new artists and new recordings in the USA for the period 1995 to 2004, based on data from MusicBrainz. The data shows a steady increase in both new artists and debut albums, with no sharp breaks in trend. Joel Waldfogel (Waldfogel, 2012b, 2014) finds that illegal file sharing has not hurt the number of releases in the USA, and that quality of recordings appear to have increased in the period 2000-2010. Handke (2012) analyse the number of new releases in Germany in the period 1984-2006, and finds no evidence that the supply of sound recordings grew less rapidly after Napster than it did before. This is consistent with a combination of decreasing revenues on the one hand and either decreasing

production costs, or that a larger percentage of revenues are directed towards marginal recordings, on the other. Handke also finds no indications that quality has deteriorated.

Visual inspection of the number of phonographic productions in Norway in the period 1987-2018 indicate that File sharing might possibly have had a short-term negative impact on releases, as can be seen from Figure 2. After a blip from 1999, numbers picked up from 2004. However, numbers peaked in 2009, as if Spotify might have had a negative impact on the number of releases. This seems highly unlikely, however, as it took several years before revenues from streaming had much of an impact. A backdrop for this figure is that file sharing hurt sales of international recordings much more than it hurt domestic Norwegian recordings, while streaming led consumers to listen more to international recordings than before. Diminishing revenues to rights holders came from 2007 and was continuous in the period 2010-2014. To my knowledge, it is not investigated whether lower revenues led to fewer Norwegian releases or the other way around.
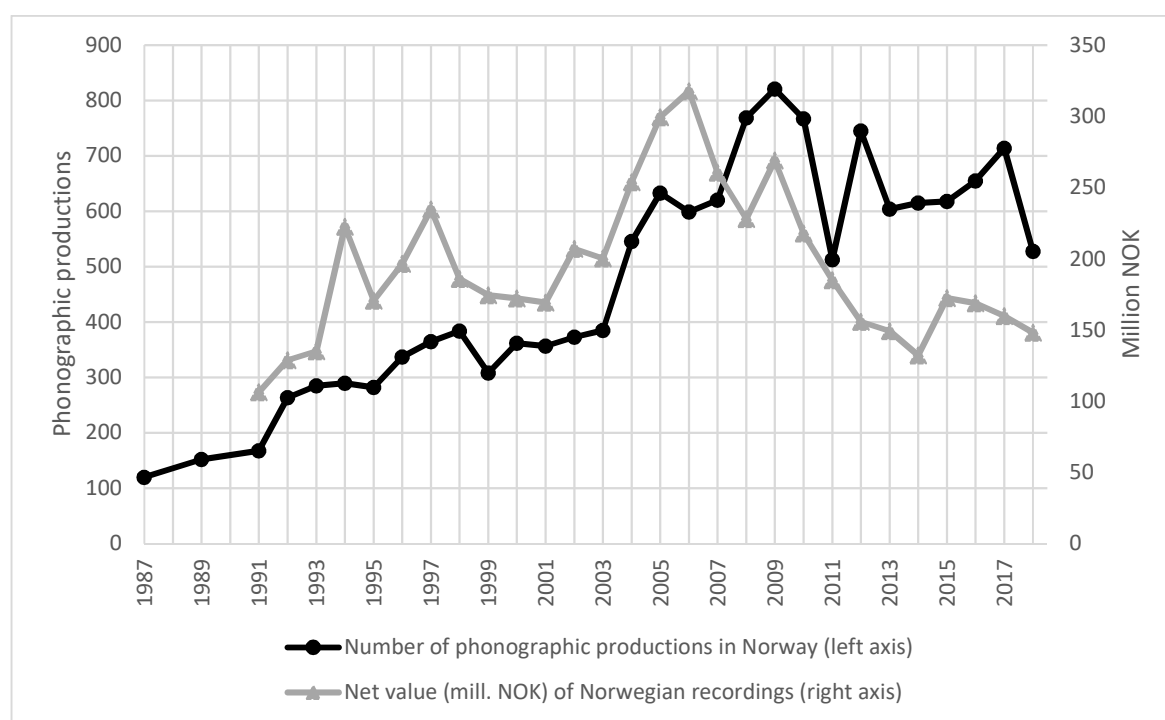
Figure 2: The number of phonographic productions in Norway (Data from Medienorge /Kulturrådet)[7]

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[7] The number of recordings is based on processed applications for financial support. Processing of applications happens after release, so there is a lag. The low number in 2011 is due to many applications for that year not being processed before 2012. The low number in 2018 is due to more processing than usual at the end of 2017. Net value based on Hjelmbrekke (2017) and updated.Data on number of productions accessed from: https://www.medienorge.uib.no/statistikk/medium/fonogram/85

Statistics published by RIAJ (The Recording Industry in Japan) presented in Figure 3, show that the number of Japanese debut artists plummeted through most of the nineties and reached the bottom in 2001.[8] The number increased strongly until 2009, before it retracted again. As streaming did not make up as much as 1% of value until 2013, that can certainly not explain the downturn. Numbers for digital revenues do not exist prior to 2005, "*which is recognized as the initial year of delivery of digital music services*" (RIAJ, 2007).
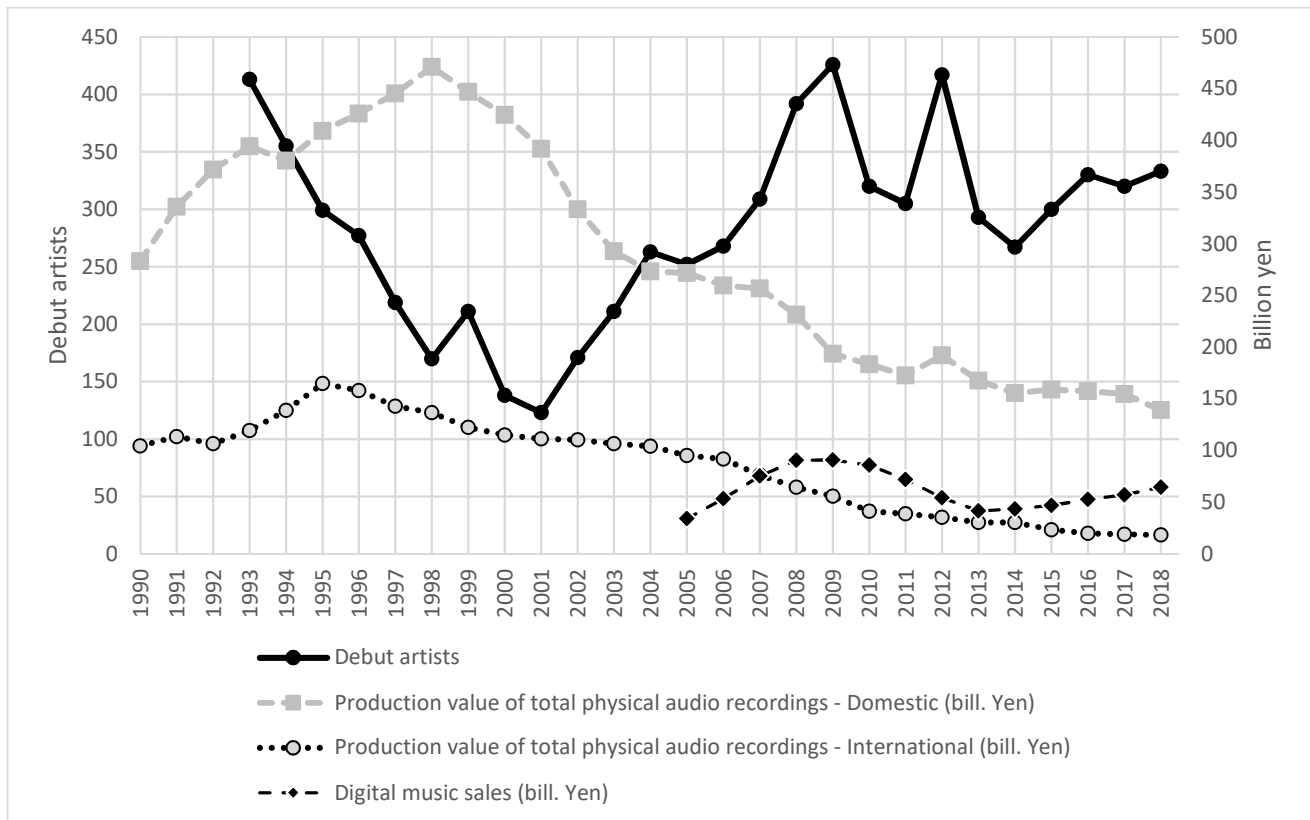
Figure 3: The number of Japanese debut artists. (Data from RIAJ)

The evidence considered, there is no reason to believe piracy at any point in time has harmed the flow of new recordings much. Worsened prospects for revenues may affect how much is invested in a recording (e.g. studio time and advertisement) or it may lead to record companies signing less artists, and/or that artists release recordings more rarely. Decreasing costs associated with recording music may counteract the effect, and obscure the substitutional effect of piracy. The fact that recorded music is a complementary good to live music may lead artists to use recorded music as a loss leader, i.e. that they use live revenues to subsidise recordings. This will make the flow of new recordings much less responsive to changes in revenues that it otherwise would have been. On a slight side note, Bourreau et al. (2013) find that record companies that have adapted to digitisation release more

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[8] Data collected from RIAJ yearbooks (RIAJ, 2000, 2003, 2009, 2014, 2017, 2019).

albums without having higher overall sales (based on data from 2005-2006). This is consistent with the long-tail hypothesis (which we will return to in chapter 5).

3.5 User-generated content

With the arrival of the interactive internet, there has been a strong increase in supply of content that has not passed through the traditional gatekeepers. This is the case for music as well as other content. YouTube, Bandcamp, SoundCloud and MySpace are prime examples of channels where music artists have been able to reach audiences. User-generated content (UGC), or user-created content, can be original works of music or literature, recordings of other people's works, works that include samples of other recordings, podcasts or video streams that talk about and cite other works. It can also be humble contributions such as comments to an edited article. It is common for UGC to utilise other works in the creation of a new work, not always with proper attribution or remuneration. While no exact definition of UGC is agreed upon, OECD provides three pillars on which UGC stands: i) Content is made publically available over the internet; ii) a certain amount of creative effort is involved; and iii) the content is created "outside the professional routines and practices" (Wunsch-Vincent & Vickery, 2007).

To creators of UGC copyright is commonly a barrier to creation. They may not intend to infringe on copyright, but copyright law is complicated for non-professionals to navigate. YouTube has its own very strict enforcement, which for instance does not automatically accept normal exceptions such as citation or parodies. Copyright not only limits consumption but also creation of derivative works, fan fiction, parody, criticism or unrelated content that utilises music for intros, background music or sound effects. Getting permission to use previous works in your own content, and to document the permission sufficiently to YouTube, can be a very tedious process. Hu (2017) reports interesting reflections around this from music industry delegates participating at the Kristiansand Roundtable Conference.

Jason Potts (2014) emphasises the difference between cultural industries and other industries in this respect. While pharmaceuticals and cars are produced with increasingly sophisticated technologies, cultural goods are produced with tools that are more and more accessible for anyone. While division of labour has increased in society for hundreds of years, cultural industries are in some respect less dependent on professionals than what has been the case since the beginning of recorded music.

4   From ownership to access

The fundamental interpretation underlying this thesis is that the rise to dominance of streaming subscription services constitute a very significant transition from purchasing music to renting access to music. The payment for access may be a monetary subscription fee, or it may be in the form of being exposed to advertisement.

The technologies of delivery are somewhat overlapping: Subscription services may allow downloading for local storage, but the consumer gains no ownership of or permanent access to these files, and access is lost if subscription stops. "Digital downloads" can also utilise streaming technology, as several services provide cloud storage of the files the consumer has purchased. Thus, one can stream files one owns and one can download files one rents. While the modes of distribution are overlapping and rapidly changing, the models of payment are more fundamental and therefore a more relevant categorisation of services. This thesis is not very much concerned with digitisation or technology per se. It revolves around the choice of business models. I will therefore mostly discuss *subscription services*, but may use the term streaming services collectively about subscription services and free streaming. In contexts where precision is not important, or no ambiguity is possible, I might still use the term *streaming* which is more commonly used.

Streaming services have in a short period of time grown into the dominant means of music distribution and consumption in a steadily increasing number of markets. Eric Harvey (2014) provides an interesting review of the history of streaming and of developments in the delivery of music to consumers. From his account, it is obvious that subscription streaming services are no recent revolution, but the logical, until now last step in a long series of technological, legal and economic developments. Jeremy Silver (2013) makes it clear that both the basic technology and suggested business models for streaming subscriptions have been with us for decades. However, the willingness of the rights holders is a more recent addition. Although the beginnings of online music streaming subscription services can be traced back to the 1990s, it was a very marginal phenomenon until *Deezer* and *Spotify* were released in 2007 and 2008 respectively.

Some characteristics differentiate music streaming services from other ways of accessing music:
- Direct streaming that requires internet connection (local storage of favourites also possible).
- Paid for by a monthly fee (or being exposed to advertising and reduced functionality).
- Rights-holders are paid-per-play.
- Consumer has unrestricted access to "everything".

- Services include various recommendation options: playlists made by friends and strangers, playlists and recommendations curated by Spotify employees, automatic recommendations based on algorithms and past consumption. The service is more than the musical content.

A distinctive feature current streaming services is that they aim to supply *all* music through their services. No service is quite there. But the important point is that there are many services that compete for customers while supplying *the same content*. This stands in contrast to the dominant subscription services for film and TV-series, which compete with mostly different content. It also stands in contrast to the first big attempts at establishing music subscription services: the unsuccessful services of *Pressplay* and *MusicNet*, services provided by the major record companies themselves.

Pressplay was established in 2001 as a joint venture between Sony Music Entertainment and Vivendi Universal's Universal Music Group, and distributed the catalogues of these companies. MusicNet was also launched in 2001 and had the backing of EMI Recorded Music, Bertelsmann's BMG Entertainment, AOL Time Warner's Warner Music Group and streaming media company RealNetworks. In the limited market for digital music at the time, these constituted something of a duopoly.[9] Kelly Donohue (2001) writes "*The Big Five are using their copyrights to control an entire distribution channel – something that is unheard of in the physical world – and are locking up an entire market in an arguably inefficient, subpar manner.*" They received harsh criticism and attracted antitrust probes, although they were acquitted (Pate, 2003). This duopoly did not only compete on services, but was a competition between two agents which each had an effective monopoly on their content. Thus, consumers might very well wish to subscribe to both services, as they were two separate goods with relatively low substitutability between them.

It should be noted that while the present order of the day is more or less fully assorted services with relatively few reservations, we cannot be sure that this will be so in the future. Subscription services of TV and video are *not* fully assorted, but gives access only to certain catalogues of material. This tendency of restricting content to many different services is spreading rapidly, with content owners withdrawing content from Netflix in order to supply it exclusively through their own services (Heritage, 2019). Music services may also return to such divisions.

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[9] Contenders soon arrived. From July 2002, Rhapsody supplied access to the material from all five major labels of the time. It should be added that catalogues were very far from complete. The total number of tracks available through Rhapsody was 175 000 in those early days (Evangelista, 2002), compared to Spotify's present catalogue more than 30 million tracks (Spotify-Press, 2017).

There are three main types of exclusives (Mulligan, 2015):

1. Service window: The recording is first released on one service only, e.g. Apple Music or Tidal, and is exclusively available there for a period.

2. Tier window: Recording is released on one type of service first, e.g. Only CD/download before streaming or only paid subscriptions before ad-supported streaming services.

3. Service exclusive: A single service acquires exclusive rights to offer the song indefinitely.

As Mark Mulligan (2015) points out: the *service exclusive* blurs the lines between record labels and music service. The first two are less disruptive. All three have been put to use. The popularity of each has been up and down, and it appears artists, labels and services all are rather ambiguous to the practice. Bidding for exclusive content may be a dominant strategy for the service providers. Providing exclusive content might be profitable for rights holders, at least in the short run. Consumers will have to pay for many different subscription services if they want access to a wide variety of content. If this goes too far, and it will be prohibitively expensive for consumers to access what they want, then it is highly likely that unlicensed services will get a renaissance.

While services free of charge based on advertising are popular, they contribute relatively little to the income of rights holders. Subscription services are a more promising source of revenues for creators. According to IFPI's Global Music Report (IFPI, 2020) subscription services generated 8.5 billion USD to rights holders and investors of music from their 341 million subscribers, while ad-supported services generated 2.9 billion USD. In the case of Spotify, during third quarter of 2020, each paying subscriber generated €4.19 per month to *the service,* while each active user of the ad-supported tier generated €0.33 per month. Roughly 70 percent of these revenues where paid to rights holders.[10]

Streaming services struggle to make a profit. This is due to high, and possibly increasing, costs related content acquisition and substantial marketing costs. In the case of video subscriptions, Netflix have had strongly increasing content investments, and the investments have been catching up with the revenues (Trefis Team, 2020). The cost of content and the cost of constant innovation of services, seem to preclude economies of scale. Video streaming services like Disney+ and HBO have a problem that music streaming services may not have: their services cannibalise other revenue streams their owners have (Handley, 2019). Spotify has all along claimed to be in an expansive phase, and

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[10] Some numbers of reported directly, others are calculated by me from Shareholder letter Q3-2020 (Spotify, 2020c).

that profits would result when a certain scale was reached. In 2017 Spotify paid € 3.2 billion on royalties and distribution costs, 79 percent of revenues. Sales and marketing took another € 567 million (Spotify Technology S.A., 2018). Investors still believed the company could turn into profits. The reception Spotify got at its initial public offering on the New York stock exchange in April 2018 is clear evidence of this, as shares rose above their assumed opening price (Bris & Wade, 2018). In the fourth quarter of 2018, Spotify could report positive profits (operating income) for the first time. Their next profitable quarter was third quarter of 2019. At time of writing, 3rd quarter of 2020 is the last Spotify has reported on, and they have still not had more than two profitable quarters in their history, and never an annual profit. In 2019, streaming for the first time was responsible for more than half of global recorded music revenue for the first time (IFPI, 2020).[11] That implies that the room for further expansion is steadily shrinking, and one may start questioning if subscription services will ever become profitable.

Even if the market for music subscriptions may approach saturation, there are a few alleys where growth is still possible for the individual service. The first is a consolidation of services where a few grow at the direct expense of its competitors. Another is by expanding into new content, such as Spotify turning towards podcasts. Daniel Ek of Spotify believes that Spotify may thus not only compete with sales of recorded music, but also with traditional broadcast radio (Ingham, 2020). As reaching new consumers becomes less important, the room for increasing price increases. This implies that the revenues may grow even if the number of subscribers do not.

Turning a profit is less of a concern to companies that have their music service as a part of a larger whole. A company like Apple has been able to treat their music services as loss leaders, a sub-section of their commercial activities that has been subsidised because it has helped the company to sell more hardware. They have thus not depended on an ability to produce profits from music services in isolation. Apple hardware also comes preloaded with *Apple music*, which means consumers that buy hardware from Apple are led into Apple music *and vice versa.* The situation is similar with Amazon, which sell both Kindle and Alexa speakers. This creates a strong synergy that Spotify lacks (Estes, 2018; Towse, 2020). It must be noted, however, that the different "ecosystems" do mostly not exclude each other's applications, so the "walled gardens" do not have as high walls as some have feared.

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[11] This is when synchronisation and performance is included. Physical and downloads combined make up only 28.8 percent of revenues, compared to 56.1 for streaming. So streaming is responsible for two-thirds of direct consumer expenditure of recorded music.

I am able to identify a few paths for streaming services to start produce profits.

1. Some services may be able to earn enough from complementary goods and services to sustainably treat music as a loss leader.

2. Services may collude to reach higher consumer prices, reduce "selling costs", such as marketing costs, and to reduce "cost of revenue", such as royalties.[12]

3. Elimination of competing services will allow the winners to increase consumer prices, reduce selling costs and reduce cost of revenue.

4. Services may possibly be able to earn significant sums from selling user data.

These paths can be represented by the following figure:
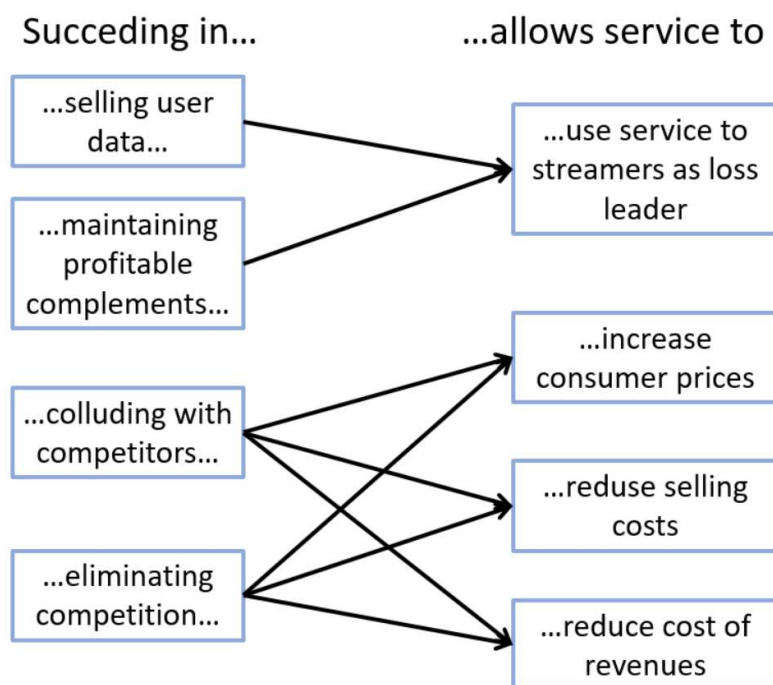
Figure 4: Paths to profits

User data may be valuable for other subscription services as well as record companies and possibly others. I will not discuss this further within this thesis, however. The other paths will be discussed in chapter 8.

4.1 Economic viability of subscription services

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[12] "*Selling costs are defined as costs incurred in order to alter the position or shape of the demand curve for a product.*" (Chamberlin, 1949, p. 117)

Music subscriptions give consumers unrestricted access to a vast catalogue of music in exchange for a monthly fee. The economic sustainability of the subscription streaming model is debated. Although such services have been in place for almost a decade, and there is an increasing number of them with an ever-increasing stream of revenues, it seems services still struggle to make a profit.

The success of subscription services rests on their ability to convert non-payers to payers. They must be more practical, more attractive than the free alternatives, and they do indeed show some sign of being so. Traditional unlicensed file sharing has plummeted, in parts because of new legislation (Adermon & Liang, 2014; IFPI, 2012, p. 23) but apparently also because new services are more attractive (Ingham, 2015; Page, 2013; TNS Australia, 2016).
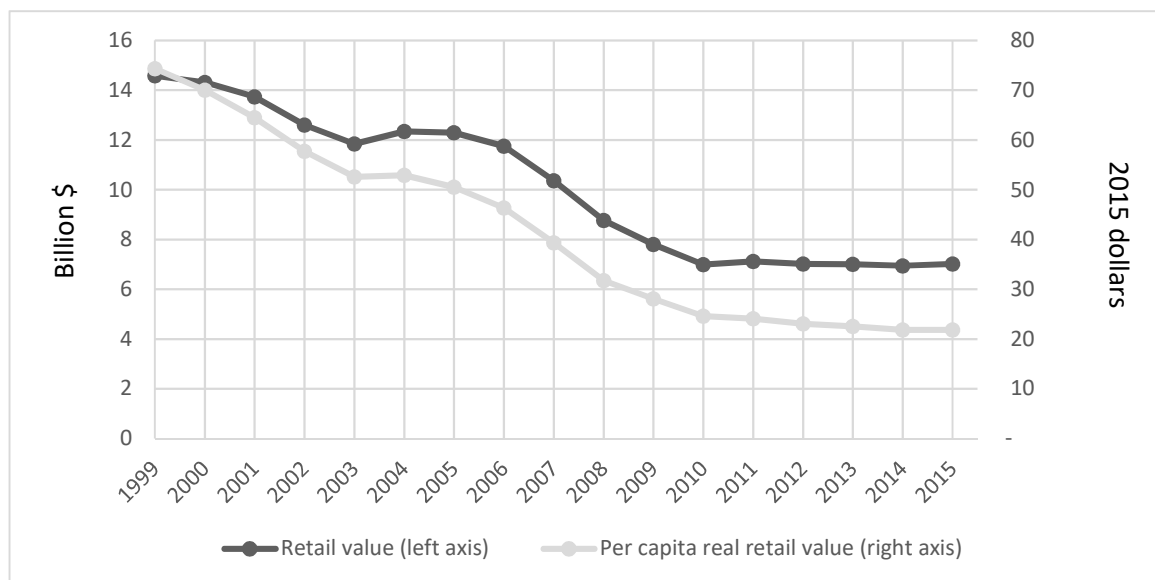
Figure 5: Annual retail value[13] of US recordings 1999-2015, total and per capita.

Subscription services have a considerable potential to generate revenues to rights holders. Figure 5 shows how US retail value of recordings has developed since its top in 1999 until 2015. The figure also shows the same retail value divided by population[14] and adjusted for inflation.[15] 1999 was an all-time high when it comes to annual per capita spending on music with $74 compared to $22 in 2015. A paid subscription to a music service is commonly priced at $9.99 per month, or $120

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[13] Retail Value is the value of shipments at recommended or estimated list price. Formats with no retail value equivalent are included at wholesale value. Data comes from the Recording Industry Association of America (RIAA)

[14] Resident population estimated per July 1, data from US Census bureau.

[15] CPI-U, data from US Bureau of Labor Statistics, Series Id: Cuur0000SA0

annually. The distribution of spending has likely always been heavily skewed, with some people spending very much more than average while many have spent nothing. For some consumers, the transition from unit sales to a subscription implies that they can trim their budget spent on music considerably. For the majority, however, spending 10 $/£/€ a month on music is much more than they have spent in recent years, and it surpasses average spending in the golden years at the end of the nineties with a solid margin.

Subscription services mostly experience growth in their user bases. The competition for subscribers is tough, but the services also try to find their niches so that they will not be perfect complements, and that price competition will be less aggressive. To some degree, the different features and compatibilities may appeal to different consumers (IFPI, 2017, pp. 16-20).

Product differentiation not only accommodates adoption among consumers. It also allows the services to potentially make profits. Consumers subscribing to services are not only paying for the access to music in itself, but also for curated playlists, expert advice and social interaction. Such features differentiate services, effectively reduces competition, and allow the service providers to charge more than marginal cost. This point is stressed by Patrick Wikström (2012, 2013). Such features also contribute heavily to network effects associated with the different platforms, and may determine the probability of a winner-takes-it-all outcome of the current turmoil. This will be discussed in chapter 8.

4.2 Economic viability of ad-supported services

Legal streaming services are fundamentally of two different types: subscription services and ad-funded services. The economic viability of the ad-funded model is uncertain at best.

Payment-per-play to rights holders from ad-funded services is much lower than from subscription services (see below), but in spite of that, the ad-funded section of Spotify appears to be at great loss for the company (Presencer, 2013). Not even YouTube may ever have turned a profit, although that is undisclosed (Leskin, 2020; Winkler, 2015). Spotify appears to view their ad-funded service only as a recruitment ground of potential subscribers. Consumers are allowed to try out streaming and are expected to acquire a preference for this mode of consumption. As they do, they will, if their budget allows them to, convert into paying subscribers. That said, recent shareholder letters from Spotify indicate that ad revenue per active user is increasing. As people grow increasingly dependent on streaming services, the existence of ad-supported alternatives may continue to be a relevant means

for segmenting the market according to willingness to pay. Those that have used YouTube for some time will also have noticed how they expose users for much more advertising than only a few years ago. This serves to increase monetisation while also forcing people into the ad-free *YouTube premium* subscription service.

I do not consider ad-funded streaming a separate business model, but it is certainly *part* of a business model as a loss leader of subscription services or larger hardware/software ecosystems. It serves a purpose in the dynamic perspective of making consumers familiar and comfortable with a new model. A meaningful economic modelling of ad-funded streaming would have to include paid subscriptions as well, and study the implications of market segmentation and taste formation. This would be very demanding, and rest on many unknown parameters. Ad-funded streaming services may or may not be a transitory phenomenon. Personally, I find ad-supported streaming much less important than subscriptions, and I will in this thesis mostly focus on subscriptions.

If ad-supported streaming were to be analysed as a standalone service, it would in many respects resemble traditional commercial broadcasting. It is a multisided market were the service deals in three markets: the market for listeners, the market for advertisement and the market for content. To site Barr (2013) *«There are striking similarities between the ad-funded service of Spotify and commercial radio, where advertising revenue is also used to pay rights holders.* […] *The fundamental difference between the two services is the interactive nature of streaming.»* An important *economic* difference between commercial radio and (on demand) free streaming is that streaming services must pay much higher royalties per listener to rights holders. The market for advertisements may also differ, specifically that ads in streaming services can be more targeted towards a specific consumer group.

4.2.1 YouTube

By far the most important service for ad-funded music streaming is YouTube. YouTube was launched in November 2005 as a video sharing website intended for user-generated content, but soon enough the site contained copyrighted material uploaded by others than the rights holders. The site became a huge platform for copyright infringement. Google acquired YouTube in 2006 and began solving infringement claims in 2007. YouTube is today dominant globally in music streaming, but contribute rather modestly to rights holders' revenues. User upload services are exempt from normal conditions for music licensing due to the so called *safe harbour* rules (IFPI, 2016b, p. 5). YouTube pay considerably less to rights holders per view than other streaming services. This is currently a

main concern for IFPI, for rights holders globally and for competing streaming services. The discrepancy between the extent of distribution and the size of remuneration for rights holders is termed *the value gap.*

YouTube Key was a music subscription service launched in 2015. It was essentially bundled with Google Play Music (Wikipedia: YouTube_Premium). The service was relaunched as *YouTube Red* in 2015. The service subsequently expanded from music into videos in general, and it relaunched again as *YouTube premium* in 2018, while YouTube simultaneously launched the new music subscription service *YouTube Music* (Wikipedia: YouTube_Premium). The increasing amount of advertisement in the free tier, combined with, the launch of *YouTube Premium*, may increase monetisation and reduce the conflict with rights holders.

4.3 Some statistics on streaming and recorded music

The data used in this section mostly comes from IFPIs *Global Music Report* – full report 2016 (IFPI, 2016a). The data cover 49 countries worldwide. Extensive documentation of the data can be found in the IFPI report. These data are supplemented with data from various sources as will be noted below.

Figure 6 shows how sales revenues have developed since 1969. Data for the period 1969-2005 have been given to me by Christian Handke and are the same as are documented in his PhD-thesis (C. Handke, 2010a). The years after 2005 are mostly from the Recording Industry Association of Japan (RIAJ, 2015). Included in the figure is also a rough estimate of the value corrected for inflation. See further documentation and discussion of calculations in Appendix 1.
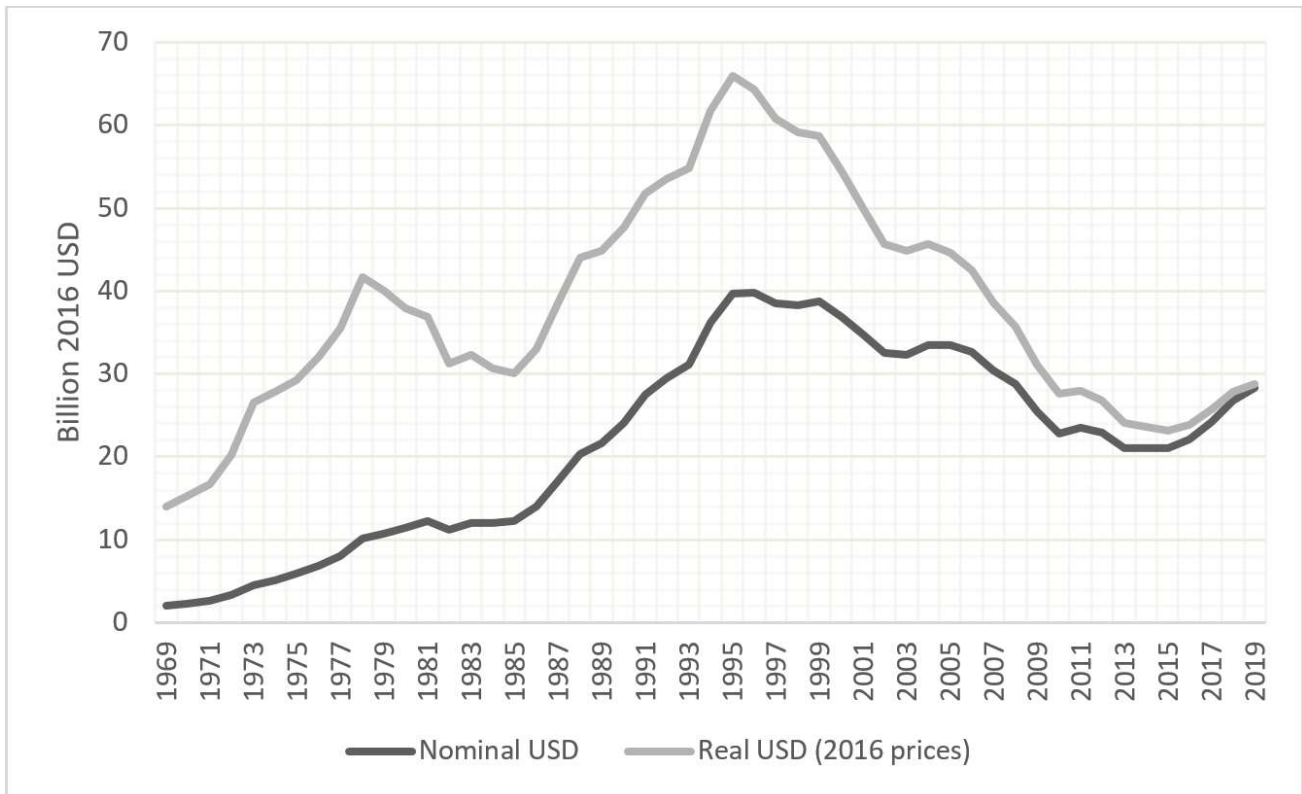
Figure 6: Global recorded music sales/revenues 1969-2019. (USD billion, retail value, current exchange rate)

Although there are global trends in revenues that we can recognise in many markets, there are also substantial differences between them. In Figure 7, we compare the development of revenues between 2011 and 2015 in the ten largest markets and the 39 remaining added together. Brazil and South Korea have had a very strong growth lately, while Canada, Japan and France are in 2015 significantly below their 2011 revenue level. The segments that grow are different between the markets. Paid subscriptions, ad-supported streaming, performance and synchronisation generate increasing revenues in most markets. In Brazil, revenues from mobile have also seen a strong growth in this period, while it has stagnated in most other markets.
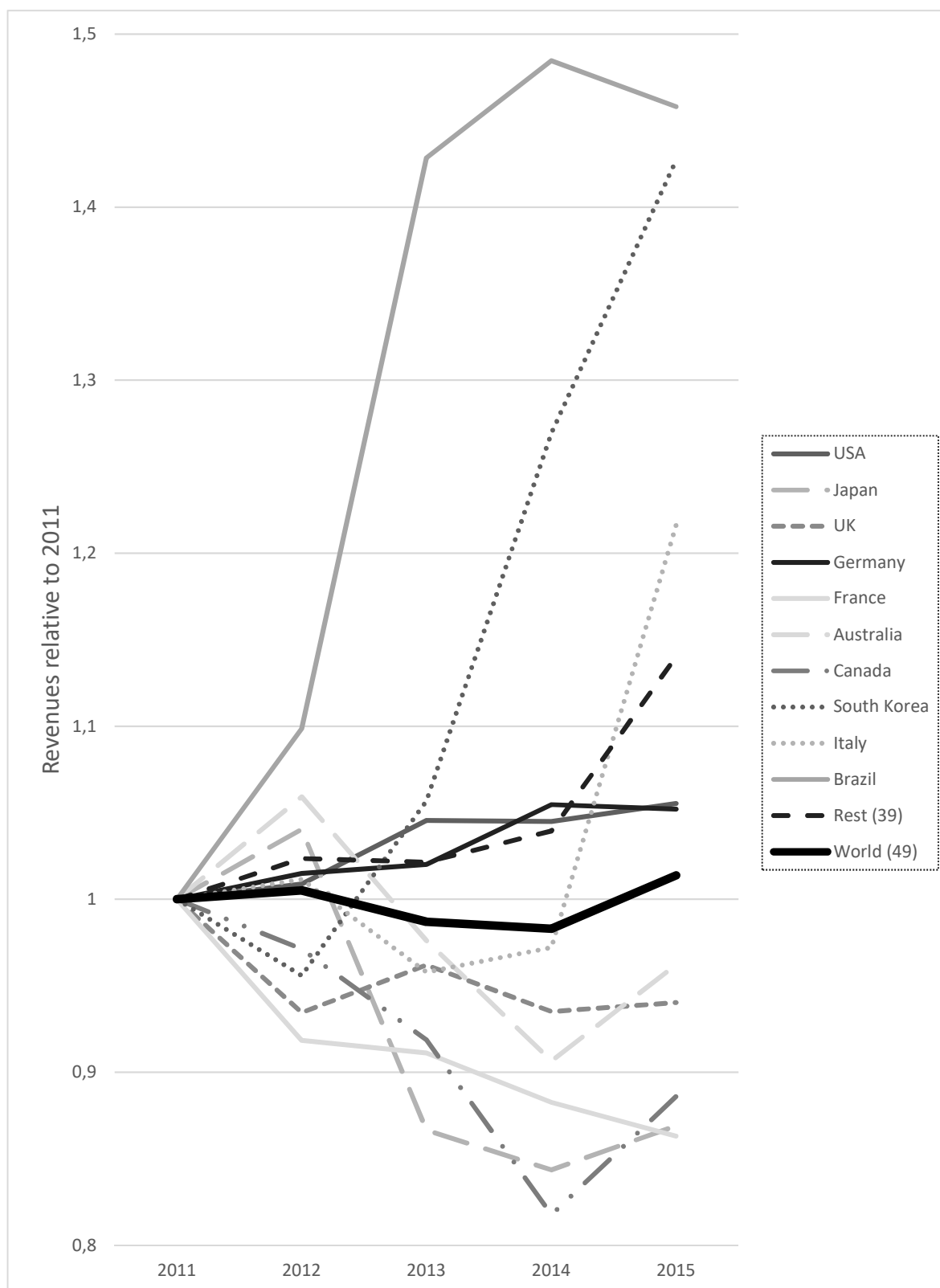
Figure 7: Development of revenues to the music industry

Nominal values (performance rights and synchronisation included) in the ten largest markets (as of 2015); in the 39 remaining markets combined; and in the world (49 markets). Source: IFPI (2016)

Paid downloads reached its peak globally in 2012 and has since decreased globally, as seen in Figure 8. But there is a long list of markets where paid downloading has continued to grow: Argentina, Bulgaria, Central America[16], Hungary, Peru, the Philippines, Poland, Singapore, Slovakia, South Africa and Taiwan. Whether these countries just lag behind, or if they are genuinely different, is an interesting question for future research.

Vinyl records have been growing in popularity in many important markets in recent years, but from a very low level. Globally vinyl grew from a low of 3.1 million units in 2006 to 32 million units in 2015 (IFPI, 2016b). This was the highest level since 1995 (IFPI, 2012). Growth has continued, and in 2018, vinyl experienced growth for the thirteenth consecutive year, and revenues made up 3.6% of the overall market (IFPI, 2019). Predominant among the physical formats are still CDs, which have been headed towards obsolescence for a decade. In some of the digitally most advanced countries, recent years have seen a revival of physical formats. In South Korea sales of CDs has increased from the bottom values of 2007 (Mulligan, 2013). Norway saw sales of CDs increase strongly from 2014 to 2015, although they fell somewhat in 2016.[17] The combined sales of physical increased from 2017 to 2018 in India (+21.2%), South-Korea (+28.8%) and Japan (+2.3%) (IFPI, 2019).

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[16] Includes: Barbados; Costa Rica; Dominican Republic; El Salvador; Guatemala; Jamaica; Panama

[17] IFPI (2016) reports an increase from 1.1 to 1.5 million CDs sold and an increase from 0.5 to 0.7 of other physical (36% and 40% respectively). IFPI Norway similarly reports an increase from 83 to 108 million NOK (30%) (trade value, no taxes). IFPI (2016) reports an increase in value of all physical of only 1.5%. There are also other discrepancies between national Norwegian statistics from IFPI and GMR. I requested a clarification, I have received a reply, but no real clarification. It might possibly be some inconsistencies in application of exchange rates. This is a reason for concern regarding the quality of the IFPI data in general.
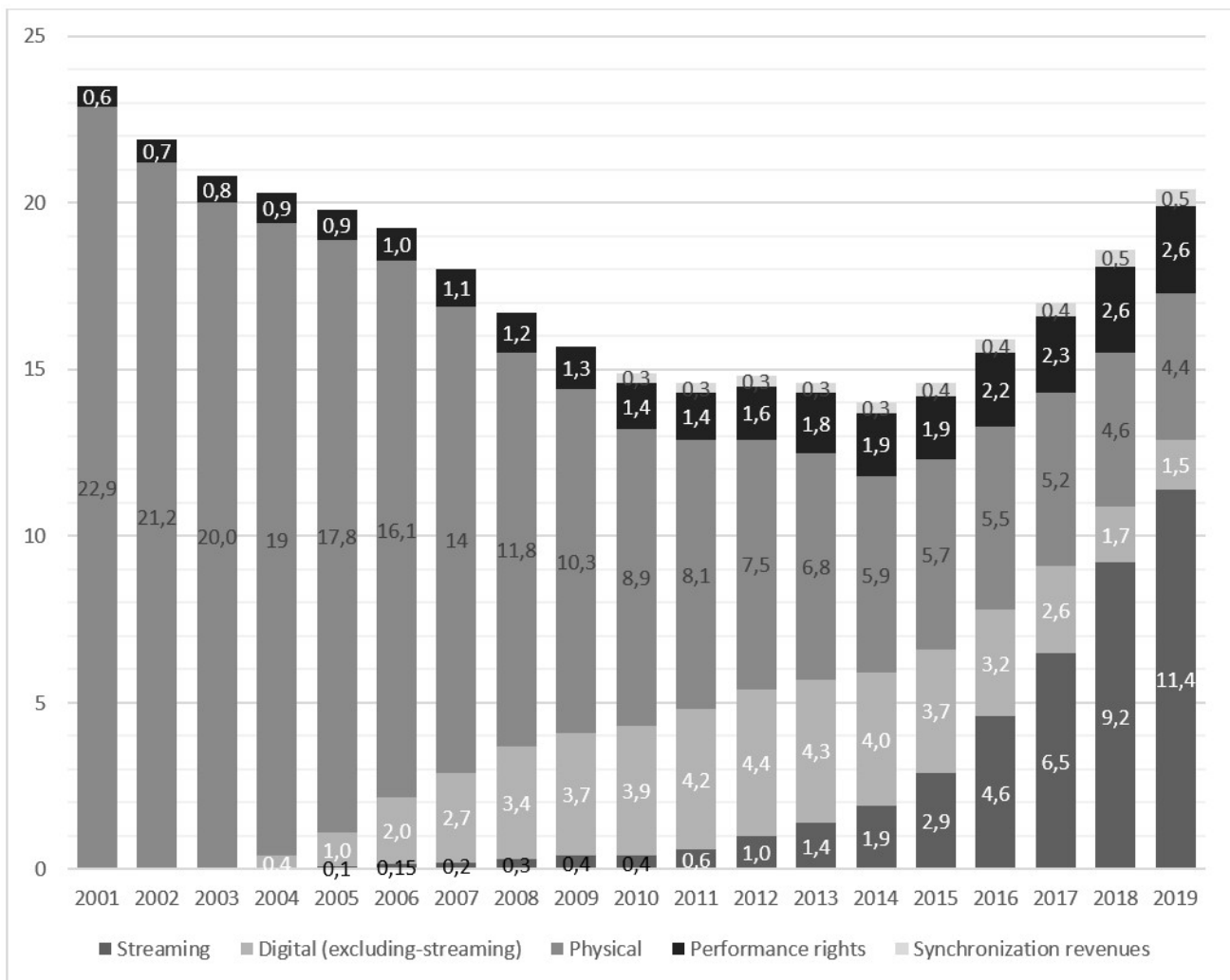
Figure 8: Global industry revenues by format and source, $US billions. Data from Global Music Report (IFPI, 2020)

Streaming

My prime interest is streaming. The reliability and/or validity of the data varies. According to the data from the IFPI 2016-report (IFPI, 2016a), many markets saw declines in the adoption of streaming services in the period covered, something that I find no trace of in news reports. When studied separately, both the variable *(revenues from) paid subscriptions and freemium streams* and the variable *(revenues from) ad-supported streams* display this somewhat erratic pattern. When the variables are added together, the phenomenon is mitigated, although not removed. One likely source

of error is the distinction between *freemium* and *ad-supported*.[18] This distinction may not be handled the same in all markets at all times.[19] We will therefore only study *total* streaming in the following.

In Figure 9 I have divided the 49 markets into one group with those 34 that display the expected non-decreasing share of revenues from the new technology and one with those 15 that do not.

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[18] The ad-supported freemium tier of streaming services such as Spotify is categorised under *paid subscriptions and freemium streams.* That appears to leave little else than YouTube and possibly Pandora for the category *ad-supported streams*.

[19] In 2013, 2014 and 2015 there is a negative correlation between the market shares of the two products. When differences between years are calculated, there is a strong, negative correlation in growth for every year. This *may* only indicate substitutability, but it certainly substantiates the hypothesis that the distinction is not properly imposed.
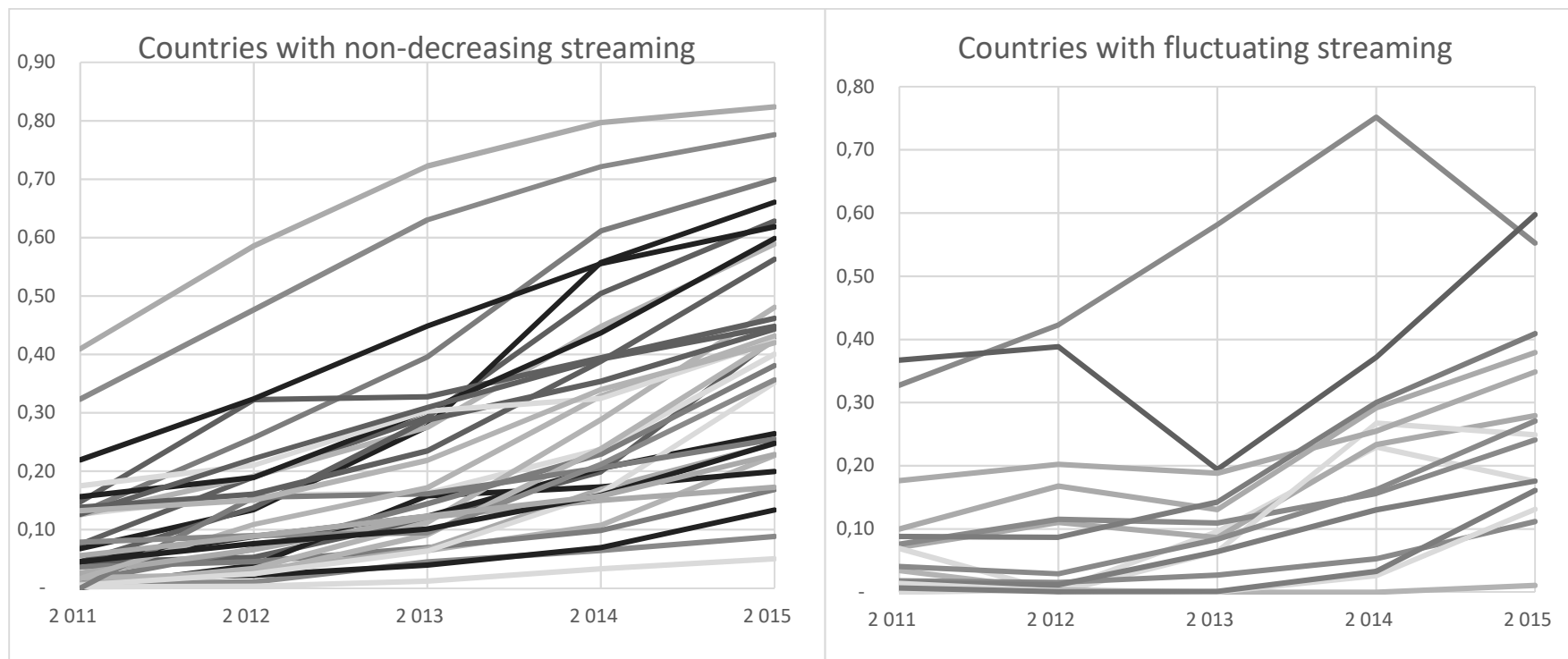
Figure 9: Share of total revenues from paid, freemium and ad-supported streaming.

Worldwide (49 markets) share of total revenues. Performance rights and synchronisation revenues are not included in the total of which shares are calculated.[20] Streaming revenues as a share of total revenues (synchronisation and performance revenues not included in total) – two groups of countries[21]

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[20] Performance royalties come from "broadcasting" or "public performance" of a work. Among other things this includes certain types of online streaming services. In the table I wished to include "sales" and its successor, interactive access. Not radio. Excluding performance is thus less wrong than including it. When excluded as is done here, the importance of "streaming" in a broader sense is slightly underestimated.

[21] Countries with non-decreasing share of revenues: Argentina; Australia; Austria; Belgium; Brazil; Canada; Central America & Caribbean; Chile; Colombia; Denmark; Finland; Germany; Hungary; India; Italy; Japan; Malaysia; the Netherlands; New-Zealand; Norway; Peru; Philippines; Poland; Russia; Singapore; Slovakia; South Korea; Spain; Sweden; Taiwan; Thailand; Turkey; UK; US
Countries with fluctuating share of revenues: Bulgaria; China; Croatia; Czech Republic; Ecuador; France; Greece; Hong Kong; Indonesia; Ireland; Mexico; South Africa; Switzerland; Uruguay; Venezuela

As can be seen see from Figure 9, the most maturing markets show transition to be decelerating. The key question is towards which level of adoption development is heading and if this level is sufficient to replace lost revenues from other formats.[22] Once markets are saturated, further growth will have to come through price increases. Whether such increases are possible depends on complex market conditions.

4.4 Compensation to rights holders and royalties per stream – a case study

Streaming services typically pay around 70 percent of revenues to rights holders (Kafka, 2015; Nicolaou & Hook, 2016). These revenues are distributed among rights holders according to many variables, such as how much an artist is listened to, which country the listener resides in, which tier (free/premium) the listener adheres to and which service the listener uses. In this section I will present and discuss some numbers that have become publicly available.

4.4.1 Compensation to rights holders

Data from US compulsory mechanical royalty statements presented by Audiam show that US revenues from subscriptions increased month by month through 2014 (Data accessed from Price, 2015). Revenues from the freemium tier was more volatile, but there was an overall increase through the year. The number of streams increased with approximately the same rate for both tiers.[23] In the following, I will present the numbers for Spotify only.

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[22] Data for every country is available to me only for the period 2011-2015. In 2018 streaming has passed 89 percent in Norway, and is still growing. In Sweden, the percentage has been stable at 88 percent for several years (IFPI Norge, 2019; Musiksverige, 2018).

[23] The dataset has a missing value for the number of streams in February 2014. For February 2015 the number is 88% higher than in January 15 and 66% higher than in March 15. On several variables data for February are either missing or a clear outlier. This is unexplained but, might be related to annual re-calculations or negotiations of terms.
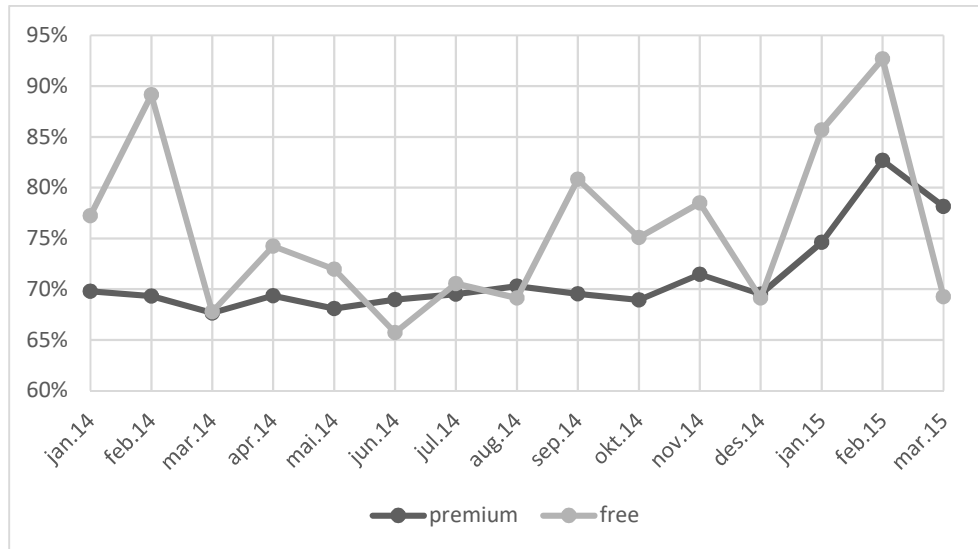
Figure 10: Share of US revenues of Spotify that are paid to rights holders 2014-2015

Source: (Price, 2015)

The share of gross revenues that were paid to rights holders is shown in Figure 10. For the premium tier, the share was stable through 2014 with a minimum of 68% in March and a maximum of 71% in November 2014. However, it was considerably higher in the first quarter of 2015 with 83 % in February. For the free tier the numbers vary more, from a low of 66% in June 2014, down from a peak of 89% February 2014. It went as high as 93 % in February 2015. There is no obvious trend in the development, and these data can be said to support the 70 percent rule of thumb.

Spotify have announced the global number of paying subscribers and "active users" on several occasions. I have not come across a definition of "active" in this context, but we can hope the definition is the same across time. In Figure 11 I present numbers I have collected (directly or indirectly) from announcements from Spotify. Both the number of paying subscribers and the total number of active users appear to have increased steadily. The share of active users that are paying subscribers was very low, or indeed zero at the start-up of Spotify. It increased gradually up to 25 percent, were it was stable for a few years before increasing further to a new level of 45 percent. The increasing trend might reflect Spotify's effort to make the free tier steadily less flexible and attractive. Spotify's strategy of providing a free tier as a lure to get people addicted to the service, but being ultimately dissatisfied with the restrictions, appear to work well.

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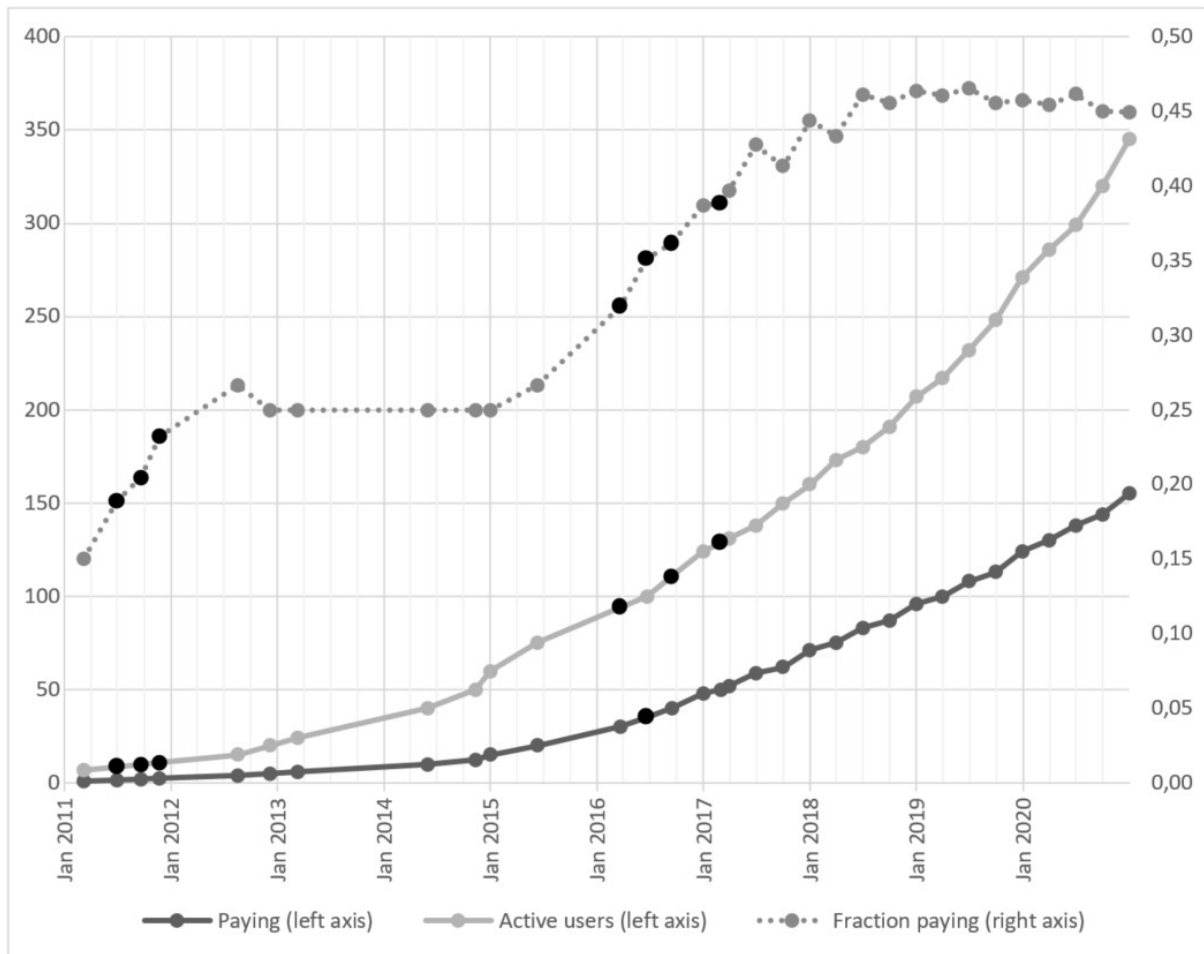
Figure 11: Growth in the global number of subscribers and total (active) users of Spotify

Growth in paid subscriptions and total number of "active" users globally. Black dots are interpolations or calculated from one variable observed and one interpolated. Sources of data: (Barnett, 2011; Gartenberg, 2017; Grove, 2011; Kahn, 2016; Murgia, 2016; Sanburn, 2012; Singleton, 2016; Sloan, 2013; Spotify-News, 2011; Spotify-Press, 2011; Spotify, 2014, 2015a, 2015b, 2018a, 2018b, 2018c, 2019a, 2019b, 2019c, 2019d, 2020b, 2020c, 2021; Weber, 2012).

4.4.2 **Revenues per stream**

There is a lot of public debate around royalty rates per stream. Hesmondhalgh (2020) provides a thorough discussion of the criticism towards what is considered low royalty rates. He explains how comparisons between services can be misleading, and why what sounds like low numbers can amount to perfectly reasonable remuneration. It is not sufficient basis for arguing that subscription services provide unfair terms for musicians.

Subscription services do not pay a fixed rate per stream to rights holders; they pay a more or less constant share of revenues as royalties. Thus, revenues per stream is not a fundamental

variable in any way, but as a measure of the average level of remuneration, it has gained a lot of attention.
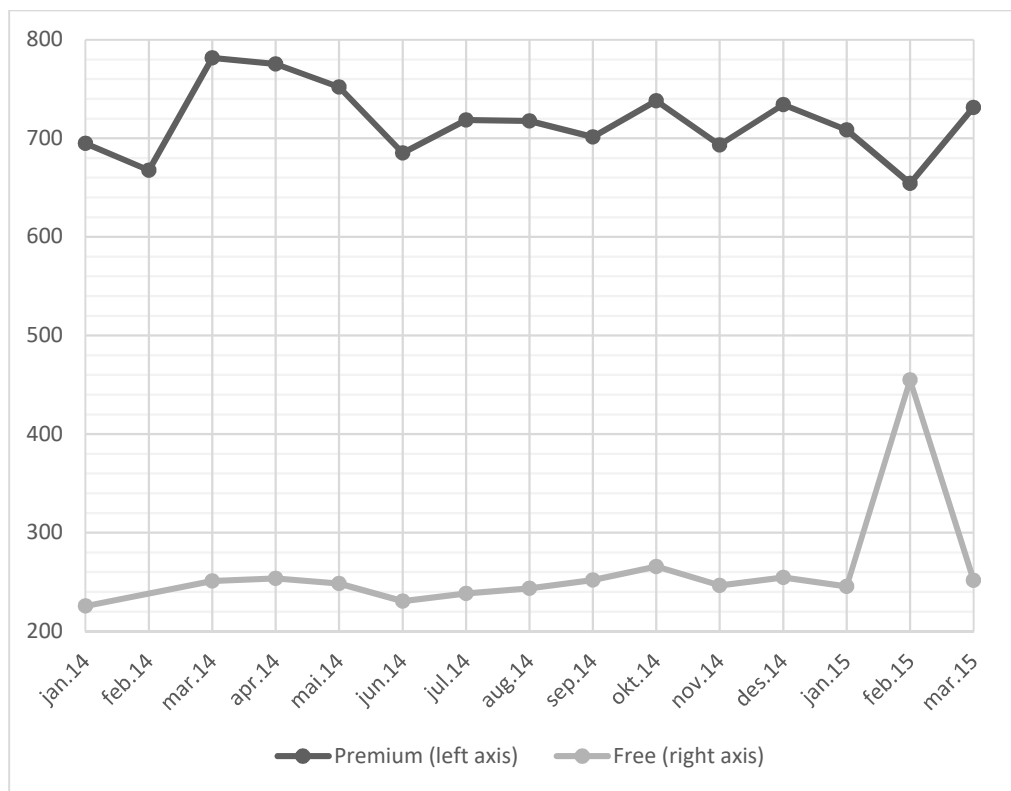
Figure 12: Average number of streams per user for each tier, USA only. Source: Price (2015)

As subscription prices are more or less fixed, a key determinant of revenues per stream is *how much* users stream. Again, we use the data from Audiam to study the period January 2014 to March 2015 in the US market. Figure 12 shows average number of streams per user during the period for which we have data. Except for the suspicious outlier in February 2015 for the free tier, not much happens. There is a slight falling trend in streams per paying subscriber, but this may be seasonal. Unfortunately, I do not have access data covering earlier or later periods.

Spotify (and similar services) pays three different royalties to US rights holders. The composer/song writer and the composer's publisher receive the first two types: The songwriter/publisher is entitled to mechanical royalties when their work is recorded and sold. They are also entitled to performance royalties when a song is publicly performed. Replays from subscription streaming services count as public performances. When a recording label records music, and owns the master tape, it earns copyright to the *sound recording* and are entitled to a separate share of royalties from streaming services.

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Royalties per stream through Spotify subscriptions went up and down through the year, starting at $0.0091 in January and ending at $0.0075 in December. Royalties per stream from the ad-supported freemium tier showed no sign of decreasing through the period. Figure 13, Figure 14, and Figure 15 show how the three types of royalties developed.
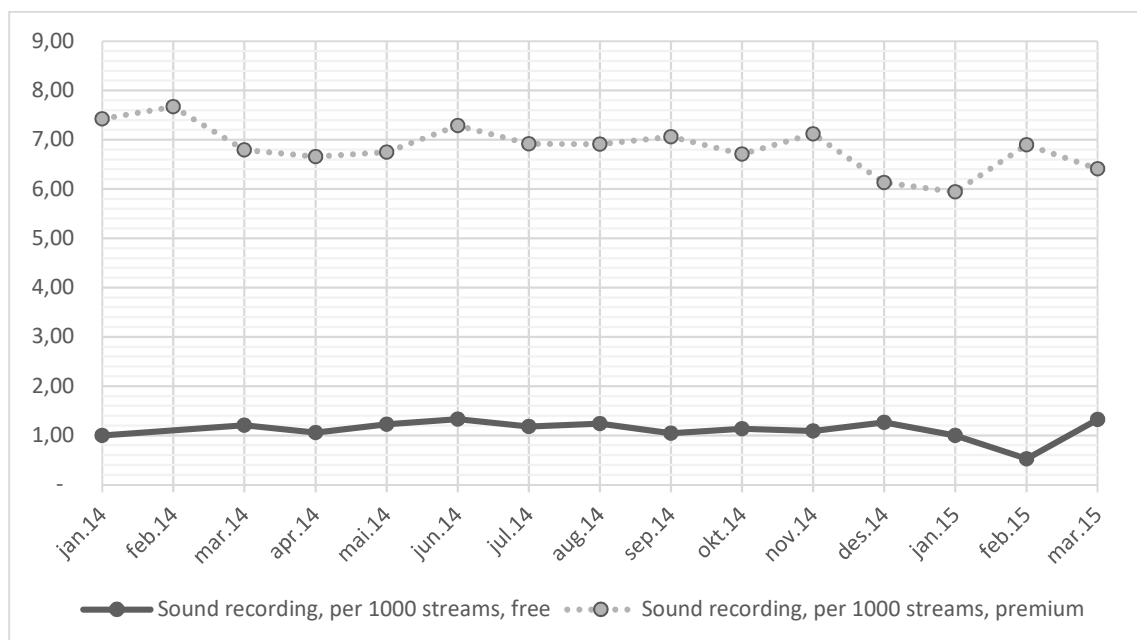
Figure 13: Royalty to owners of recordings, USD per 1000 streams from Spotify premium (left axis) and Spotify free (right axis), USA only.
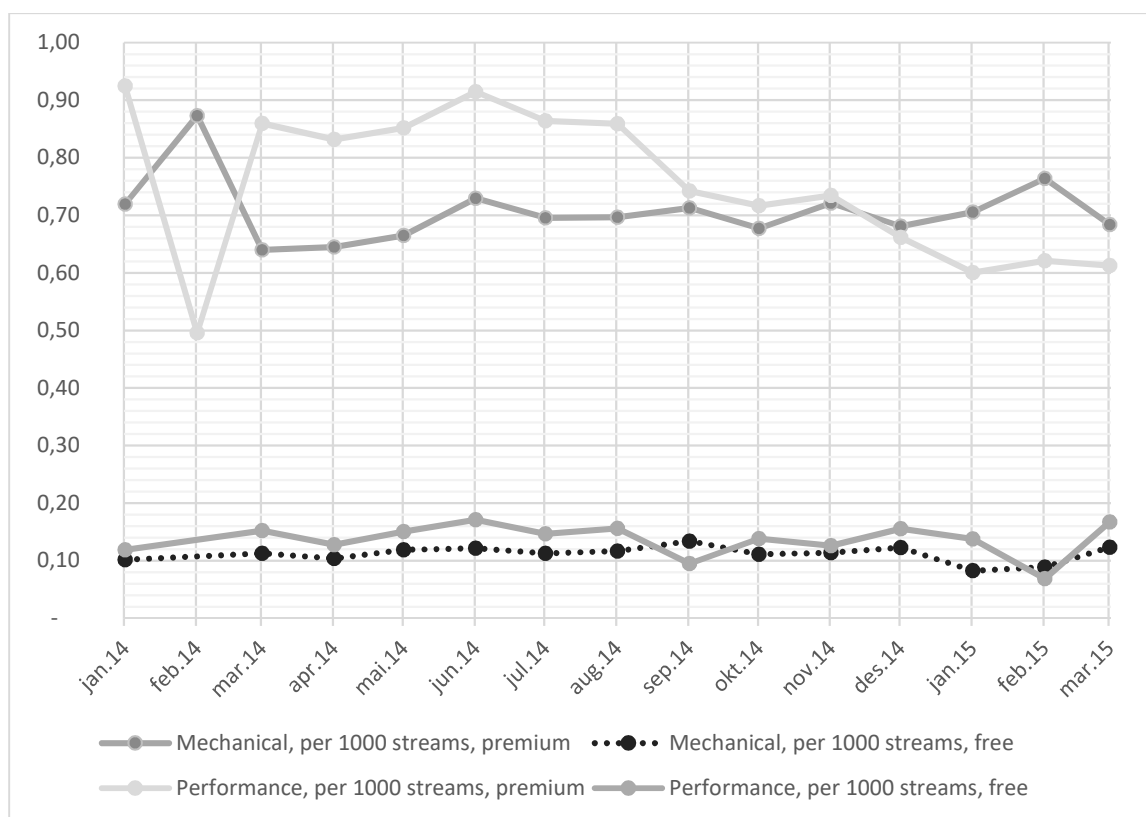
Figure 14: Royalty to songwriters (mechanical and performance) per 1000 streams from Spotify premium and Spotify free, USA only.

In the case of mechanical royalties, we can supplement with more recent data to get the longer time frame shown in Figure 15. The extended time series is from Audiam (2020).
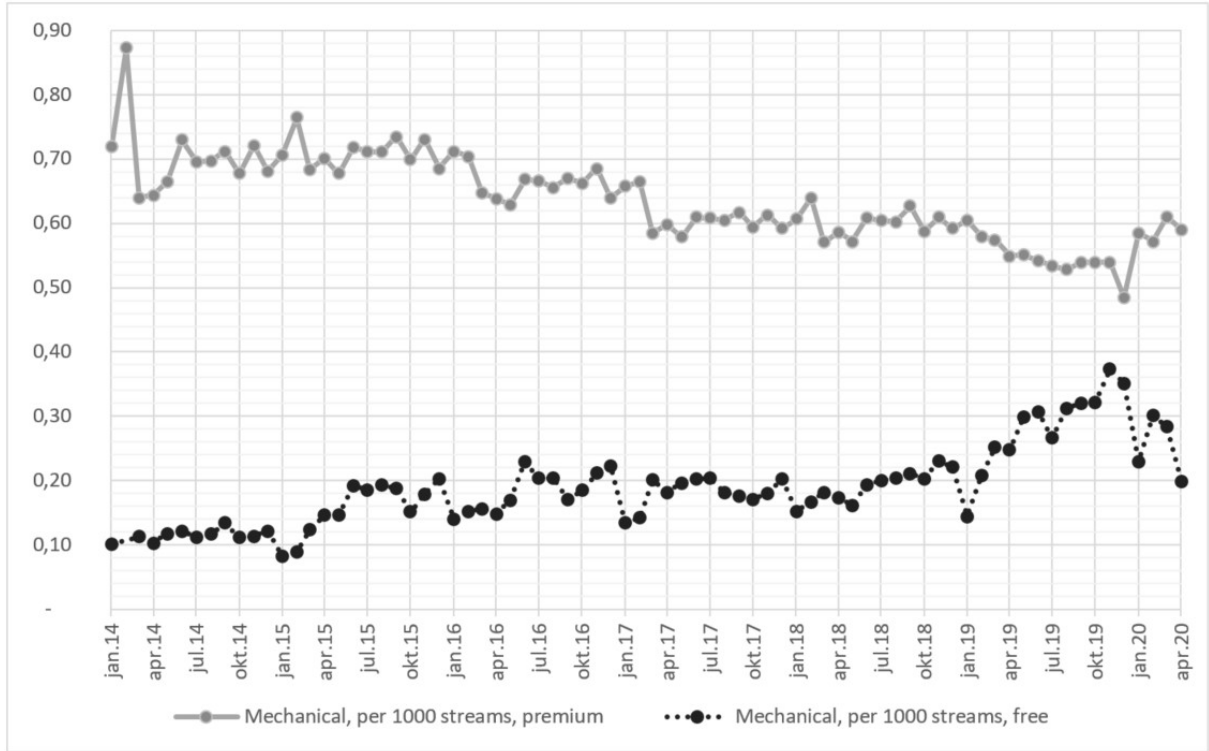
Figure 15: Mechanical royalties to songwriters per 1000 streams from Spotify premium and Spotify free, USA only. January 2014-April 2020.

The time series for performance royalties goes from January 2014 until March 2015. For Mechanical royalties data covers January 2014 until April 2020. Sources: (Audiam, 2020)

The two short time series do not reveal very clear trends, but a slight downward inclination is visible and measurable in the case of premium subscriptions. In the case of mechanical royalties, we have a longer time series, and there is clearly a downward trend in mechanical royalties per stream in the case of premium subscriptions, while there is an increase in the case of the free tier. Data analysed by *The Trichordist* indicate that royalties per stream in the USA have been shrinking since 2014, but stabilised in 2019 (Trichordist, 2017, 2020).

4.4.3 **Factorising royalties-per-stream**

Royalties per play from a given market for a given month is a weighted average of royalties per play for each tier. As an example, let us say a service has two tiers: one subscription and one ad-supported, then royalties per stream is given as:

$$\frac{Royalties}{S} = \frac{S_s}{S} \times \frac{Royalties_s}{S_s} + \frac{S_f}{S} \times \frac{Royalties_f}{S_f}$$

This can be expanded to include other measures presented above:

$$\frac{Royalties}{S} = \frac{S_s}{S} \times \left[\frac{Royalties_s}{R_s} \times \frac{R_s}{U_s} \times \frac{U_s}{S_s}\right] + \frac{S_f}{S} \times \left[\frac{Royalties_f}{R_f} \times \frac{R_f}{U_f} \times \frac{U_f}{S_f}\right]$$

where R is Spotify's revenues, $U = U_s + U_f$ is the number of users, $S = S_s + S_f$ is the number of streams. Subscriptions and the free tier are indicated by subscripts s and f respectively. Royalties per stream from subscriptions are given by *Average Revenue Per User* (ARPU) for subscribers, (the inverse of) streams per subscriber, and the royalty rate. Likewise for the free tier. Total royalties per stream is the sum of the two, weighted by each tier's share of total streams. Royalties per stream can be viewed as a product of Figure 10, Figure 11, (the inverse of) Figure 12. , and Figure 16, Figure 17 which can be found below.

The royalty rate was stable around 70 % in the period, and, to my knowledge, it still is.[24] The composition of subscribers/free users was quite stable around 22-23 % in the period, but has since risen, as evident from Figure 11. The number of streams per subscriber increased modestly through this period. Revenues per subscriber fell

Figure 16 shows subscription revenues per paying subscriber and Figure 17 shows non-subscription (advertising) revenues per active, free user. The time series for 2014-15 are from Audiam and covers the US only. More recently, Spotify has published ARPU for its subscribers globally.[25] Numbers for one market cannot be compared directly with those for the world, so they must be considered separate time series.[26]

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[24] Shareholders letters and annual reports from Spotify specify *cost of revenue,* which is mostly, but not exclusively, royalties (Spotify, 2019a, p. 45).

[25] Spotify's *financial statements* contain ARPU for 2016-Q4 until 2020-Q3. Their shareholders letters contain ARPU for the quarters 2018-Q1 to 2020-Q4. All of these can be found from (Spotify Investors, not dated) at https://investors.spotify.com/financials/default.aspx

[26] For the first period, data are reported per month. I have averaged over the three months in each quarter. Data from the early period is measured in USD, while more recent data published in annual reports and shareholder letters are in terms of Euro. I have recalculated all numbers to Euro using current (quarterly average) exchange rates from the European Central Bank (undated).
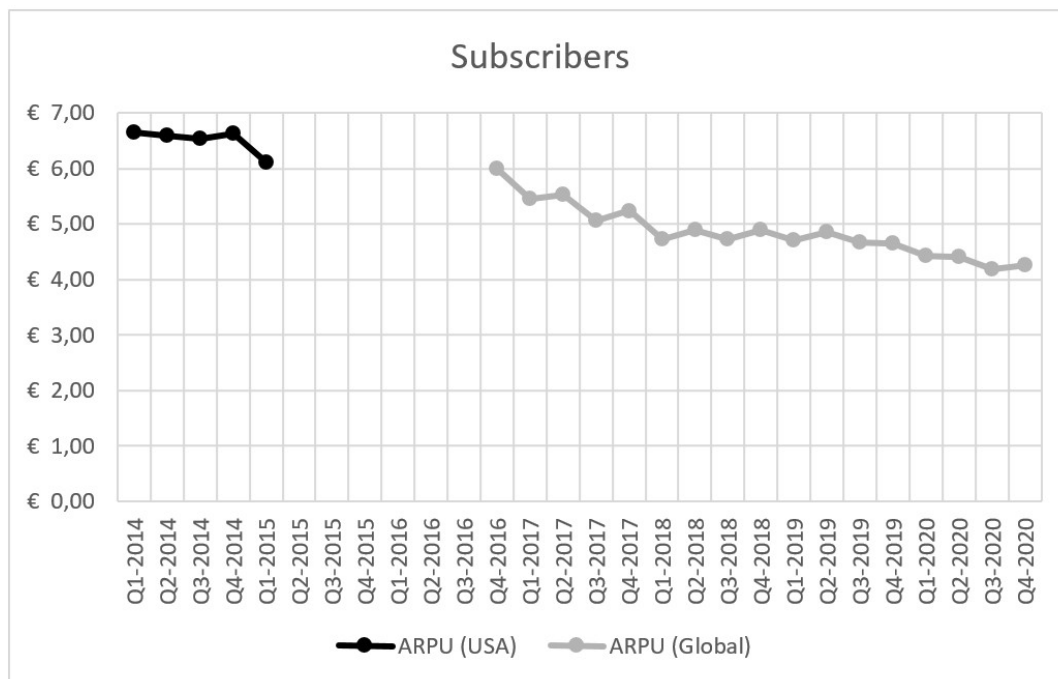
Figure 16: Spotify monthly revenue per premium subscriber.

Data for the USA from January 2014 to March 2015 (Audiam, as made available by Price, 2015). Data for the world from 1st quarter 2017 to 4th quarter 2020 from Spotify shareholder letters and financial statements (Spotify Investors, not dated).
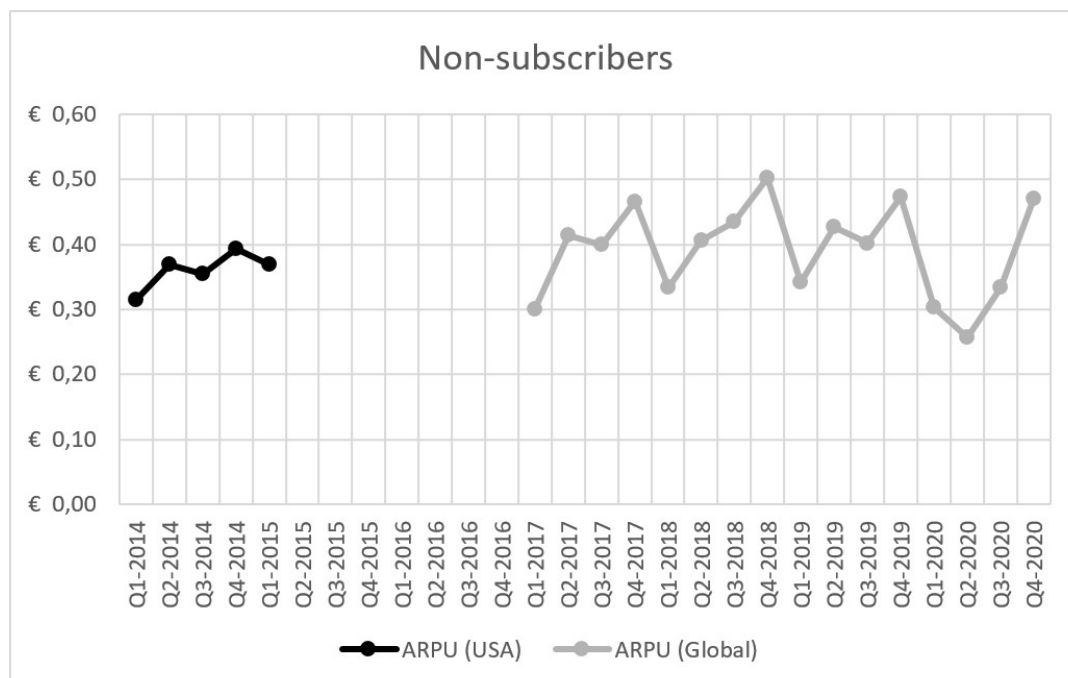
Figure 17: Spotify monthly non-subscription revenue per non-subscribing Monthly Active user.

Data for the USA from January 2014 to March 2015 (Audiam, as made available by Price, 2015). Data for the world from 1st quarter 2017 to 3rd quarter 2020 from Spotify shareholder letters (Spotify Investors, not dated).

Advertising revenues appear to fluctuate strongly in the short run, but have no obvious trend and appears to be on a similar level in the USA as in the rest of the world. On the other hand, there appears to be a decreasing trend in the subscription revenues per paying subscriber. The explanation for the reduction in ARPU is driven by changes in "product mix" and "geographic mix". Product mix implies increased use of family plans, student plans, discounted trial periods and so on. Changing geographic mix implies that emerging markets with lower prices grow faster than established markets with higher prices (Pastukhov, 2019; Spotify, 2021). Non-constant exchange rates may also contribute.

It seems reduced average price of subscriptions is the variable that is most important in terms of downward pressure on royalties per stream. The fact that each subscriber listens more and more, adds to this.

Future royalty per stream

One would expect the first adopters of streaming services to be the most avid music listeners. The first subscribers would likely listen to a lot of music in return for their monthly fee. The late adopters, however, will likely not listen to as much music but still pay the same monthly fee. Thus revenues will increase more than the number of streams, and services can increase payment per play to rights holders, while also increasing their own margins. As time goes by, each user's preferences may adapt to the new reality. It may be an example of *taste formation* that leads to increase usage per person. The before mentioned discounts available are the main explanation, and those discounts cannot increase much more. On the contrary, as the business model gets increasingly entrenched and unlicensed alternatives steadily less available, I expect prices to rise. Spotify has increased their prices in several markets in recent years (Spotify, 2021). Furthermore: As the latecomers have never spent that much money on music, the resulting cannibalisation of sales of CDs and downloads will likely not be as great as in the early days.

4.4.4 Models of royalty distribution

The model of royalty distribution employed by Spotify, and other similar services is what has been termed the *pro rata model* or the *Big Pool model.* In the markets for most other goods, the expenditure of a given consumer is distributed to the suppliers of the goods and services that specific consumer utilises. That is not so for music streaming services. All revenues of

the music streaming service goes into one big pool, and then rights holders get paid proportional to their share of the total number of streams and the total amount of consumer expenditure.[27] A contrasting model that to my was explored by the Norwegian music research project *Clouds and concerts*, and that has since gained quite some traction, is that the fee a consumer pays is distributed to the rights holders of the music this particular consumer listens to in a given month (Maasø, 2014c). If a consumer only listens to one song once and nothing else during that month, then the rights holders will get $\approx$ \$/£/€7 for that single play. They term this model the *user-centric model.*

Pro rata model	Spotify revenue	X	Rights holder's streams / Total streams	X	70% to rights holders	=	Rights holder's payout
User-centric model	User fee	X	Rights holder's streams by user / Total streams by user	X	70% to rights holders	=	Rights holder's payout from user's fee
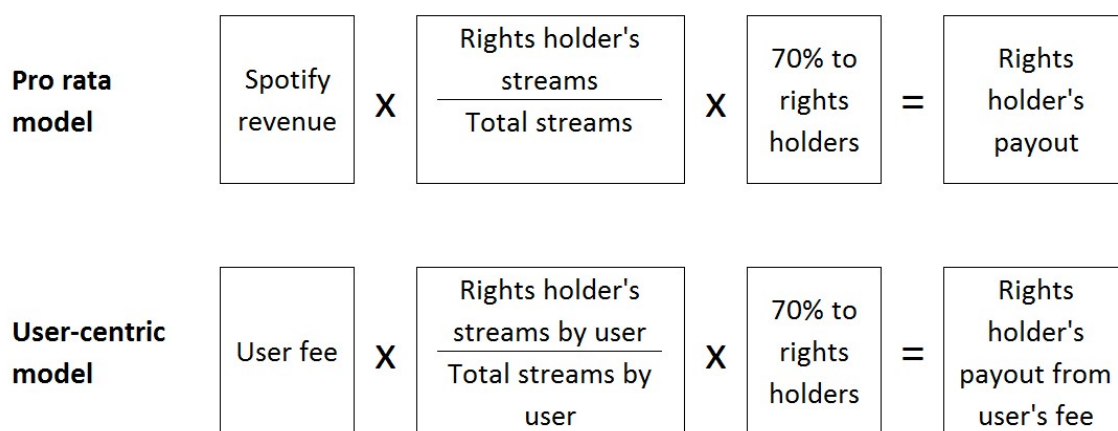
Figure 18: Pro rata model and User-centric model compared

Figure 18 shows the logics of the two distribution models with some simplifications. Under the current pro rata model, a rights-holders payout is calculated per territory and tier. Under the user-centric model, a rights-holder's payout is calculated based on from each subscriber's use.

According to British Recorded Music Industry, Artists with a younger fan base dominate the list of most streamed tracks stronger than they do the sales list (BPI, 2013). Youth generally have less money and more time for music listening than the population in general. Their effect on sales of CDs and downloads have been limited by their limited monetary budgets. In the case of subscriptions, it is their *time budget* that sets the limits of music consumption and

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[27] There is not a single sum of money that applies to all streams: This will depend on which market the song is replayed in and on which tier of the service it is replayed through and it varies from month to month. It also depends on the contract the rights holders have with the service. To my understanding, the royalty rewarded to a given work from a given tier in a given market at a given point in time is proportional to the share of all streams that work obtains within that tier/market/month. So only in a limited sense is it exactly true that royalty is proportional to the number of streams.

directly determines the distribution of revenues to rights holders. Youth as a group are also more likely to listen to present day hit-music repeatedly. Under the user-centric model, youth would have less of an impact on the composition of the charts.

An implication of the suggested *user-centric* model is that subscribers that listen little will have an equal impact on distribution of revenues as subscribers that listen a lot. This compares to the current model where the only fans that matter to revenues are those that click a lot. At Spotify, it takes 31 seconds to trigger a royalty payment. It is thus theoretically possible to trigger 86 400 such payments in a 31-day month. At Apple Music it supposedly only takes 20 seconds, allowing for almost 134 000 per month (Laguana, 2015). If royalties per stream is in the area of $0.008 per stream, then 1250 replays are enough to trigger royalties higher than user payment.

The existing model thus provides considerable scope for fraud (Bedell, 2015). Streaming bots are becoming a rising problem and, reportedly, major labels hire bots to push their releases up the charts (Boyer, 2020). This has the potential to break the business model completely. It may not provide the right incentives to create. It may lead to strong redistribution from popular artists to those with most bots to work for them. The system for remuneration will lose legitimacy, and music listeners may start thinking they may just as well resort to unlicensed alternatives if the money does not reach the artist anyway. If there is no way to separate bots from listeners, then the only way out is to tweak the business model. Converting to the user-centric model is one possible alternative.

Many appear to believe that the existing pro-rata model inherently favours superstars. Marshall (2015) discusses "*the way that royalty payments are calculated, which is inherently beneficial to those with large catalogues."* While I believe this premise is absolutely correct, it is correct for the wrong reasons. I fail to see how the pro-rata model is advantageous to those with large catalogues, but catalogue is rewarded by streaming in ways that I will return to in section 5.8. He goes on to state that "*Independent and less popular artists would benefit from an alternative system of payment that directly distributed an individual's subscription to only those artists to which the individual had actually listened.*" It might be true that a user-centric model would benefit less popular artists, but a qualification should be added: It depends on the concept of "less popular artists" being operationalised as *streamed fewer times* rather than *appreciated by fewer listeners.* The pro-rata model distributes revenues proportionally to how much music is listened to. It only favours superstars to the extent that

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their songs are listened to *more times per listener* than other songs are. That may not be the case. Some bits of evidence does exist. I am aware of two research projects that studied such evidence. Listing the main findings of the Clouds and Concerts project, Danielsen and Maasø (2016) writes *"When we calculated how the real-life usage of all users in Norway would influence revenue shares between the two models, the alternative distribution model—where money paid by the individual user would be distributed to the artists to whom the user listens—would benefit two out of three local artists. A larger share of the revenue would also fall to the most-streamed artists, and especially the most popular local acts."* This finding is based on Norwegian streaming data from the service Wimp. I.e. while the user-centric model may favour local artists, it also tends to favour popular artists. In a related paper Pedersen (2014) analyses Wimp data for the Danish market and present almost identical findings. The second research project is presented by Muikku (2017). He presents an analysis of a sample of streams from Spotify in Finland. The methods of sampling and analysis are rather opaque, but he states results that clearly indicate the pro-rata model favours superstars while the user-centric model favours the tail of the popularity distribution. Just like Danielsen and Maasø (2016), he finds that the user-centric model benefits local artists. In most markets, local artists generally do not belong to what we would call superstars. Thus, evidence so far appear to confirm that the user-centric model will distribute revenues more.

When judging on the fairness efficiency of revenue distributions, it is important to also keep in mind the distribution between new recordings on the one hand and catalogue content on the other. The tail of the distribution consists largely of catalogue content. I return to this in section 5.7.2. It addition to fairness, there is efficiency. Page and Safir (2018) trust the findings of Muikku (2017), but argue that increased costs of implementation and administration may outweigh the revenues potentially distributed from the head to the tail. A further complication that is discussed by Page and Safir (2018) as well as Hesmondhalgh (2020) is that if services adopt the user-centric model, while others do not, that may incentivise rights holders to license exclusively to services with the model that gain them the most.

The chosen model of payment is really quite arbitrary, or at least not the only possible model of revenue distribution that could be argued to be fair: Artists that record long works have complained that they get the same sum paid per play as punks playing one minute songs. This is of particular concern to rights holders of classical music and certain branches of jazz. This

is a valid complaint, and an alternative to payment-per-play may be payment-per-minute. Not least, the all-you-can-eat at a flat rate subscription price could be replaced with consumer payment per stream or with several tiers allowing for a differentiated amount of replay. Differentiated pricing according to usage would strongly reduce the difference between the pro-rata model and the user-centric model, and it would all but rule out the existing fraudulent practice.

4.5 From the supply side to the demand side

In the three previous chapters, we have looked at development in the music industry, summarised some things that differentiate this industry, and cultural industries more broadly, from other industries. Chapter 3 discussed digitisation in the context of music, while chapter 4 presented data on the economic development and the transition to new formats of consumption. In the chapters that follow, we will study the demand side. In chapter 5, economic theory of consumer demand will be analysed in relation to music consumption. Chapters 6 and 7 will contribute to the empirical knowledge on consumer behaviour.

PART II
Consumer demand for music subscriptions

5   Demand for cultural goods

Traditional theory of demand is indispensable in understanding demand for cultural products. The simplest textbook economics are supplemented with a long list of add-ons in various attempts to capture the peculiarities of demand for culture: *heterogeneous preferences*, *omnivorousness*, *the bandwagon effect, taste formation, experience good characteristics*, *superstars* and *the long-tail* are all keywords for enriched economic modelling and interpretation. This chapter provides a theoretical starting point and some literature review for the investigations in the empirical chapters. Streaming subscription services have seen widespread adoption globally. This chapter presents hypothetical explanations according to theory and suggests what implications it might have.

Technological change arises when new goods or methods arrive, and they provide a superior experience to at least some consumers. That number of consumers will often rise over time, both as information on the good or service proliferates, understanding of how to utilise the good to its full potential becomes commonplace and other goods and services increasingly provide complementarities. Some goods provide direct network effects, which implies that the utility a consumer can draw from a good increases as the number of other consumers increases. There are similar psychological effects that we will discuss below. While streaming services are the result of certain innovations on the supply side, the more important element to understand is arguably on the demand side: consumer adoption. That is where I will put my emphasis.

5.1 Determinants of demand

According to standard microeconomics, the level of individual demand for a good or a service is given by utility functions, which express the personal preferences, and a budget constraint. The utility function will be subject to change if the characteristics of some goods change. The budget constraint is given by income (as well as wealth and credit) along with the price of the good at hand and prices of important complements and substitutes. In all but very special cases, a price increase will reduce the demand for the good, all else being equal. Increasing price of a good that is consumed decreases the total amount of goods affordable to the consumer. This is the *income effect*, and it will lead the consumer to consume less of one or more goods. Furthermore, increasing a price makes that good more expensive relative to other

goods. Consumers will choose substitute goods instead of the good in question. This is the *substitution effect.* If a good is a close substitute to another good, and the price of that other good increases, then demand for the good at hand will rise as consumers choose it rather than the substitute. (Cross-price elasticity is positive.) If a good is a *complement* to the good at hand, meaning they tend to be consumed together, then if the price of the other good goes up then demand for the good at hand will *decrease.* (Cross-price elasticity is negative.) Just like the own-price elasticity, cross-price elasticity can be decomposed into an income effect and a substitution effect. Considerable amounts of research has gone in to the question of whether unlicensed copying is a substitute or a complement to licensed copies of music. The effect of emerging streaming services on sales of music on physical carriers has been studied less, probably because less is at stake, as long as rights holders get (at least some of) their money one way or the other.

The effect that prices have on demand for subscription services is not straightforward. For example, demand for Spotify subscriptions in Norway has not responded at all to an unprecedented and experimental price increase from NOK 99 to NOK 109 in 2018 (Ingham, 2019b). Similar results are subsequently seen in similar experiments in other markets around the world (Spotify, 2021). While such price increases can be justified by costs, and possibly exchange rates, the price increases represents boundaries that are being broken. Although these experiments have been successful, substantial price increases may possibly give too much of a competitive disadvantage in markets where Spotify has a smaller market share. While many are sufficiently addicted to subscription services, they may still consider different services as sufficiently close substitutes to go with the cheaper option. Thus, demand facing the individual service is less steep than demand facing the subscription industry combined. [28]

Another commonly important determinant of demand is income. Demand for subscriptions seems to be increasing in income for certain income brackets, but income elasticity of demand is not great, and does not seem to deviate much from that of paid downloads or physical sales. We will follow up on this in chapter 6.

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[28] It is well established in microeconomics that the price elasticity of demand is lower (in absolute value) for categories of goods than for specific variants of that good. E.g. demand for toothpaste is inelastic, while the demand for a specific *brand* of toothpaste may well be elastic.

Time is variable that may be important to take into consideration when trying to understand consumption of cultural goods, as many of them are quite time consuming. Prioritising time may potentially be modelled as a second budget constraint. Most commonly, time, or rather, the opportunity cost of time spent, is treated as a *cost* along with price and other costs. As income grows, the shadow price of leisure (such as reading a book) increases. Thus this "price" increase works contrary to the presumably positive income effects (Glorieux, Laurijssen, Minnen, & van Tienoven, 2010; Linder, 1970; Løyland & Ringstad, 2009; Ringstad & Løyland, 2011). In order to increase the yield of scarce leisure time, consumers may consume less of time intensive goods like books and instead buy a fancy car or refurbish the house. Expensive consumer goods require economic resources, while they might allow consumers to enjoy their scarce leisure time more "capital intensively". This implies buying more consumer goods (Linder, 1970, p. 4). In the words of Glorieux et al. (2010), consumers that work a lot and are well off '*will overwhelm themselves with "inconspicuous consumption," a form of consumption characterized by expensive leisure goods, bought with the intention of using them but since there is no time to use them, that can only be stored (e.g., being fully equipped to go mountaineering but not having the time to do so)'.* Or to pick an example closer to the creative industries: such consumers spend fortunes on a home cinema but have little time to watch films. The implication of increasing income, in light of this theory, is that time consuming cultural goods will face increasing competition. Linder (1970) goes so far as to postulate that 'the cultivation of the mind and spirit is quite simply an inferior activity' with negative income elasticity (Linder, 1970, pp. 94-95). Linder goes on to cite Aldous Huxley's pessimism:

> *Different prophets* […] *all agree that the lives of our leisured posterity will be high. They will eagerly make themselves acquainted with 'the best that has been thought or said' about everything; they will listen to concerts of the classiest music; they will practice the arts and handicrafts* […] *they will study the sciences, philosophy, mathematics and meditate on the lovely mystery of the world in which they live. In a word, these leisured masses of a future* […] *will do all the things which our leisured classes of the present time so conspicuously fail to do.* (Huxley, 1928, pp. 234-235)

Huxley's concern is that people prefer to spend their time watching sports, cinema films and reading bad fiction, rather than pursue admirable activities and enjoy the high arts. Linder's concern, on the other hand, is that people will have is little time for popular culture as for the

high arts. They are equally time consuming. A likely prediction one may draw from Linder is that people will not have time for low-budget, time consuming activities such as watching TV-series from Netflix or HBO. They prefer activities that are capital intensive.

Music may be among the cultural goods least vulnerable to the Linder-effect. An advantage of music is that you may listen to music while you do other things. While you drive your fancy car or refurbish your house. The explosive popularity of audio books is a strong indication of a turn towards multitasking consumption. Linder (1970) cites Walter Kerr: *We have music to read by, music to make love by, music to sleep by and, as one humorist has had it, music to listen to music by. [...] They admit at the outset that no one is expected to sit down, for heaven's sake, and attend to the music.* That is something that sets music apart from other cultural goods and experiences.

To my knowledge, little empirical research is done specifically on which aspects of subscription services appeal most to consumers. One contribution that can be mentioned is that of Dörr et al. (2013). They use tools from psychometrics to identify and measure the impact of constructs that affect pirates' intentions to use subscription services or free streaming services. They have a survey conducted during August 2010 among German students. They find that pirates show a clearly positive approach towards streaming services, and that good recommendations functions, a flat-rate payment scheme, reduced search costs and prevention of moral scruples are characteristics they value in legal streaming services. They find that sound quality is less of an issue and that pirates mostly seem to feel safe from prosecution. However, most pirates prefer the free, ad-supported streaming model. Dörr et al. do not have a control group of non-pirates, so this is only anecdotal evidence.

I will devote this chapter to interpreting characteristics of demand for cultural goods in terms of economics, and we will discuss how the introduction of subscription services might alter things.

5.2 Heterogeneous preferences

It is generally understood that each person has his/her own personal utility function, and that this function might change over time. One person likes one thing, another prefers something else. Next year, they might both have changed their minds. A different understanding evident in e.g. Stigler and Becker (1977) essentially factorises out everything that differs between

people and over time from the utility functions. This leaves us with utility functions identical for all consumers at every point in time. What changes is instead input variables. Not only prices and income, but information, human capital, time constraints, family relations, age, hobbies and so on. What some might consider a change in tastes over time, others might consider accumulation of "consumption capital".

Whether you wish to hide heterogeneity between people and changing preferences over time in a black box of "taste", or factor it out as explicit (but not necessarily measurable) variables, the result is basically the same except for the mathematical formulation: many factors affect demand. Demand, given prices and budget, differ between consumers and may change over time.

The more people differ in their preferences, the more important it is for rights holders and services to supply a broad catalogue of recordings. Even if people have very different preferences, that is not necessarily in opposition to the existence of superstar artists. As long as a large number of consumers have at least some recordings common in the music they consume, superstars will emerge. However, if people have very different preferences, the presence of superstars in the subscription services is not enough to draw consumers. There must be a large variety available.

5.3 Substitutability of formats

Digitisation and development of the internet has led to music being available in a range of formats. The physical carriers of music, such as CDs and vinyl records are facing contest from digital download services such as iTunes and streaming services such as Spotify, Deezer, Tidal, Amazon Music Unlimited and Google Play Music. Internet radio is an alternative, services that vary in nature from being equivalent to terrestrial radio to being more genre based or even very narrow: they can resemble playlists in Spotify or the traditional home-made mix-tape. Products and services are available in legal and illegal versions.

Whenever a new product is brought to market, it will experience success as long as it is a superior product, at least to some consumers in some situations. One would think it obvious that music consumed through one channel will be a substitute for music consumed through another. But it is not *that* obvious. People may listen to CDs in the car, vinyl at home and music files through a telephone while at work or when running. Individuals that listen to a lot

of music are likely to buy music in many formats, possibly even the same recordings in different formats. The record industry has always viewed radio airtime as beneficial to sales, i.e. as complementary to record sales. In recent years, as streaming is growing dominant in a more and more of countries, physical products are increasingly considered as *merchandise*, which is certainly complementary to the consumption of music. One may well purchase a vinyl record at a concert, possibly have it signed by the artist, and never listen to the record, preferring instead to stream the music. Unlicensed file sharing, which had its glory days in the first decade of this century, have been a substitute to licensed alternatives, although the degree has been the subject of heated debate.

Whenever a new method of distributing music is made available, it is likely to be a substitute to existing methods to some degree. CDs replaced vinyl records and music cassettes almost completely. That much can be stated without controversy. When it comes to substitutability among other alternatives, conclusions are more diverse.[29]

When discussing and estimating substitutability, one needs to be specific. E.g. a streaming *service* is certainly complementary to *recorded music* as it is a channel of access to this music, just as *compact discs* are complementary to the music it contains. On the other hand, a streaming service is likely a substitute to the compact disc. Timeframe is also essential. It is perfectly possible that the increased exposure some music received through file sharing stimulated sales of the same recordings in the early 00s. As consumer preferences changed, and as music files could more easily be replayed from gadgets other than a desktop computer, this might very well have changed. It is highly plausible that substitutability changes over time as technology and habits change. Furthermore, it is highly plausible that unlicensed copying of a given recording will have a different effect on physical sales of that specific recording, than it has on aggregate sales of CDs. This is the *fallacy of composition,* to which we will return shortly. The following sections will review literature on substitutability

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[29] Goods are normally considered substitutes if the cross-price elasticity of demand is positive. It is positive if demand for the good increases when the price of the substitute increases. Correspondingly, two goods are *complements* if demand of a good *decreases* as price of the other good *increases.* In practical terms, price is rarely part of these analyses of several reasons: there is not sufficient variation in price between observations and price may be difficult to observe as it may be non-monetary. Fear of persecution for illegal copying is such a price. The alternative, and more common approach, is to observe the effect of the introduction of a new technology on the demand for the alternatives. (Introduction of a new good can be represented by its price being reduced from infinite to finite.)

between methods for accessing recorded music. Substitutability/complementarity with live music attendance is not covered. The findings are summed up in Table 1.

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Table 1: Empirical results with regards to substitutability of formats

	Time period covered by data	Exogenous	Endogenous	Effect	Note
Aguiar and Martens (2013)	2011	Illegal downloads	Legal downloads	Weakly positive	
Rob and Waldfogel (2006) Waldfogel (2010)	2003 2009-2010	Illegal downloads	Physical/digital	Negative	1
Danaher et al (2014)	2008-2011	Illegal downloads	Legal downloads	Negative	
Bastard et al (2012)	2008	Illegal downloads	Legal downloads	Positive	
Hammond (2014) (data at level of recording)	2010-2011	Illegal downloads	Digital albums	No effect	2
Adermon and Liang (2014)	2007-2009	Illegal downloads	Digital sales	Negative	3
Koh, Murthi and Raghunathan (2014)	1999-2007	Illegal downloads	Physical sales	Negative	4
	2003-2007	Illegal downloads	Physical sales	No effect	
	2003-2007	Paid downloads	Physical sales	Negative	
Koh, Hann, Raghunathan (2015)	1982-2013	Digital album	CDs	Negative, weak	
		Digital single	CDs	Negative, strong	
		Paid downloads	illegal downloads	Negative	
Gran et al. (2012)	2011	Downloaded products	Physical products	Negative	
Liebowitz (2004)	1921-1974; 1973-2000	Radio	Physical sales	Weakly negative	
Nguyen, Dejean and Moreau (2014)	2011	Free streaming	Physical sales	No effect	5
Aguiar and Martens (2013)	2011	Streaming	Legal downloads	Weakly positive	
Borja et al. (Borja et al., 2015)	Not specified	Streaming	Illegal downloading	Positive	6
Hiller (2016)	2009	YouTube streaming	Albums, physical and digital	Negative	7

Notes
1: Effect of illegal on legal similar in 2003 and 2009-2010. Availability of legal, digital options do not affect outcome. Unspecified whether there is a difference in impact between physical and digital in 2010-study.3: With same methods they find that piracy has a negative effect on sales of physical
2: No effect at individual level, but may still harm in aggregate. Fallacy of composition.
3: They find that the effect of strict enforcement on digital sales is stronger and more lasting than the effect on physical.
4: Broadband penetration used as proxy for illegal. Result interpreted as licensed digital reducing the impact of piracy.
5: Only hinted towards a possible complementarity
6: It is ambiguous whether they interpret the relationship between streaming and piracy as causal. They do in one context state that "music streaming is a strong predictor of piracy." The hypothesis stated is whether the use of streaming affects the probability of piracy. Concluding on a causal relation seems not justified by their methods.
7: The data is limited to the Billboard 200. The effect is strongest for the top selling albums and the author emphasises that YouTube may bring substantial promotional benefits to less known artists.

5.3.1 The effect of unlicensed services on sales of physical records

Since illegal file sharing took off with full force with Napster from 1999, researchers, musicians, politicians and others eagerly discussed to what extent the illegal services replace sales, and thus harms revenues to artists and other rights holders. Hypotheses have emerged that illegal file sharing works like advertising, much as radio has commonly been perceived, due to sampling of experience goods improving the match between product characteristics and buyers' preferences (Peitz & Waelbroeck, 2006). There is an extensive literature on how unlicensed file sharing has affected sales of music since the turn of the century. This is a question of substitutability. As this is mostly a discussion of the past, I will not reference the individual contributions, but briefly refer what we may call conclusions. Most studies find that file sharing replaces sales to some degree. I.e. these methods of delivery of music are substitutes. An important review and analysis of this literature is by Stan Liebowitz (2016). In this article, he finds that most of the existing literature is surprisingly consistent when a common metric is used. He finds that the damage to sales done by illegal copying amounts to the same amount as the decline in sales seen from the turn of the century, at least until the advent of licensed digital alternatives. This does not rule out that other explanations can also bear truth. Other factors may explain why the growth in sales stopped. The effect of illegal copying has been a long ongoing debate. There are still some doubt concerning the magnitude of the impact, but the evidence is strong of a significant negative impact on sales, at least until licensed digital alternatives were properly established.

5.3.2 Results related to licensed digital alternatives

One question is how licensed digital alternatives substitutes for physical sales. Another is how they may interfere with the effect unlicensed copying have had. Licensed digital may be a better substitute for piracy than for physical. After the introduction of licensed online music distribution, the effect of piracy may thus have changed. Koh, Murthi and Raghunathan (2014) point out that while studies conducted on data collected from the period before 2003 mostly find a negative effect of online piracy on physical sales, such an effect is commonly not found from data collected post-2003. 2003 was the year iTunes Music Store was launched.[30] Other similar services became available around the same time. The explanation

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[30] iTunes was launched in 2001, but was initially mostly for cataloguing content owned and for ripping CDs (Wikipedia: iTunes).

for this change may be a preference for particular tracks that leads to many consumers having sufficient willingness to pay for a track but insufficient willingness to pay for an album. For such consumers free, illegal copies could be very attractive prior to iTunes, but less so since 2003. The authors conduct Granger tests to find that illegal downloading is associated with less sales of physical. When data prior to 2003 are excluded, this association disappears. Although a Granger test does not really allow for conclusions concerning causality, the paper concludes that the introduction of legal channels for digital music has weakened the negative effect of online music piracy on physical music sales. In the presence of legal digital music channels, it is instead *legal* digital music that displaces physical music. The relation between illegal online and legal online is not studied by Koh, Murthi and Raghunathan (2014) because their proxy for illegal copying – broadband penetration – also affects legal online sales.

Legal online can have this moderating effect either by reducing piracy, or by reducing the degree of substitutability. Piracy has certainly gone down during the last decade, and the substitutability may also have been affected. Waldfogel (2010) more or less repeats a study by Rob and Waldfogel (2006). He finds that "shared" copies of music reduces acquisition of "legal" copies by between one sixth and one third. This is a displacement rate very similar to what Rob and Waldfogel (2006) found using data from 2003, thus the introduction of licensed digital has not changed the impact piracy has on sales. However, it is perfectly possible that licensed digital substituted for piracy and piracy thus decreased along with its impact on physical sales. The findings of Waldfogel (2010) are therefore not necessarily in conflict with those of Koh et al. (2014). This is difficult to judge, not least because Koh et al. (2014) analyse on the level of countries and over time, while Waldfogel (2010) studies a cross-section of individuals.

Aguiar and Martens (2013) use data on individuals' usage of websites and digital applications. They identify websites related to music downloading, music streaming, music video streaming and radio, divided into legal and illegal sites. They assume that the number of "clicks" is representative of purchases and use. They attempt to assess the impact of *illegal downloading* and *legal streaming* on the *legal purchases of digital music*, and find that both have a weak, positive effect.

Nguyen et al. (2014) use survey data on French consumers to find that free streaming of music ("like Spotify or YouTube") has no significant effect on purchases of CDs. Streaming

is associated with a high propensity to buy music online, but they do not explore the causalities involved.

Koh, Hann and Raghunathan (2015) in their working paper use a diffusion model to find that peak sales of CDs could have been 15 percent higher than they were if legal and illegal digital alternatives had not existed. Demand for music from CDs diminished by about 11 percent every year with the introduction of licensed digital music. The option of legitimately purchasing digital music converts some non-paying consumers to paying consumers. Over the period 1998-2013, they estimate that 7.28 billion units of demand for CDs migrated to digital music. 61 percent of this migration was due to piracy, 32 percent due to unbundling (preference for single tracks) and 7 percent due to pure digitisation. They conclude that introducing a legal, digital alternative has reduced the impact of piracy on sales of CDs so that unbundling has recently had a stronger impact than piracy has had. They also find that digital sales leads to conversion of non-paying to paying consumers.

Hiller (2016) takes advantage of a natural experiment when Warner removed its content from YouTube for a nine month period in 2009. He finds that presence on YouTube affects sales of music albums (physical and digital) negatively. This is especially true for the top selling albums.

Danaher et al. (2014) use data on the product level. They find that the French HADOPI law, which targeted illegal copying, led to a significant increase in iTunes sales of specific recordings in France, compared to other European countries. Adermon and Liang (2014) use monthly data from Sweden, Norway and Finland to find the impact of a copyright protection reform in effect from April 2009. They find that prosecuting pirates has a positive effect on sales, and negative effect on piracy, proxied for by internet traffic. While the effect on physical sales deteriorates quickly due to weak enforcement, the effect on digital sales is more lasting. The results are consistent with an analysis that the intervention might have triggered or enhanced a transition to digital formats such as streaming. The fact that internet traffic picks up again to the previous trajectory is consistent with that the reform may have pushed consumers to bandwidth-intensive streaming such as Spotify or YouTube.

Aguiar and Waldfogel (2018) investigates the impact that streaming has on sales and piracy, at the level of songs and artists and on an aggregate level. They have panel data across countries, week by week. The level of aggregation matters. On the level of songs and artists,

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streaming appears to boost sales and piracy. This is blamed on unobserved heterogeneity. On an aggregate level, streaming displaces both sales and piracy.

Gran et al. (2012) asked a sample of Norwegian consumers how downloads substitute for physical. They state the following claims that respondents must express their degree of agreement with (my translation):[31]

- "Downloading of music/film replace purchases of physical products like CDs and DVDs completely"
- "It is much more satisfying to own physical products like CDs and DVDs."
- "Saving money is the most important reason that many download illegally."

The respondents in 2011 did not think digitally downloaded goods could replace physical products entirely. This is evident from both the low average score of 2.72 on the question of replacement, and from the high score of 3.82 on the question of satisfaction with physical as compared to non-physical products.[32] Saving money is the most important reason for illegal downloading: the response is on average 4.15.

Borja, Dieringer and Daw (2015) interviewed US students to find that having a music subscription increases probability of participating in illegal copying by 23.5 percent. No causation is implied between these. Tech savviness is thought to be a common cause.

As can be seen, evidence of substitutability between digital alternatives is mixed. Concluding on the effect the various licensed and unlicensed methods of music consumption has on the extent of consumption of the others, is very difficult. It is very difficult to be sure of causes, effects and spurious relationships. We observe that expenditure on recorded music diminished in the same period as unlicensed copying became widespread, but quantifying the causal effects is more challenging. Musical markets have not been stable in the past, and to assume them to have been in an equilibrium prior to Napster is bold. The shift to compact discs might have inflated sales as people bought old, reissued recordings they may already have owned on other formats. Furthermore, as time is a limited resource, music competes with other leisure goods, and there has been a rapidly growing supply of such, largely because of the digitisation. Digitisation may therefore have a negative effect on consumption of music

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[31] On a scale of 1 to 5 where 1 is "completely disagree" and 5 is "completely agree".

[32] The authors interpret the score of 2.72 as downloads not being a perfect substitute. An alternative interpretation is that a share of the respondents simply do not download.

independent of unlicensed downloading (Cameron, 2016). Analysis at the level of the individual consumer is difficult because time-series do not exist, and cross-sectional analyses struggle with the endogeneity problem caused by the fact that some people are more interested in music than others. They may thus acquire music through many different channels even though the channels may be substitutes to a large extent. Nevertheless, the cumulated evidence from research indicates that illegal copying has had severe effect on industry revenues. The substitutability between the licensed formats is less explored and evidence is more mixed. As unlicensed alternatives are gradually less of a problem, substitutability between licensed services – in particular between streaming and sales – becomes a more relevant topic than piracy. The transition to streaming services, as evident Figure 8 on page 50, can only be explained by substitutability. Unlicensed copying may have had a role in this as an agent in taste formation and, not least, to shake up the supply side enough to license content to streaming services. In turn, streaming services have proved to be a method for accessing music that many consumers view as superior to both unlicensed services and to unit sales.

Unbundling albums into single songs may be both a consequence of digitisation and also an explanation of consumer adoption. If consumers mostly find utility in single tracks, then digitisation leads to technologies that better serves existing preferences. It is also possible that digitisation shapes fundamental preferences: Some argue that people have a shortened attention span due to the constant information overload, and therefore no longer demand albums (Eliassen, 2020).

Suppliers of music may respond to changes in demand by releasing single songs. Changes on the supply side may, in addition to being a response to changes in demand, can also be a consequence of restrictions being lifted on the supply side: While releasing and distributing a physical album is more cost effective per song than distributing singles, that is no longer an argument with intangible digital formats. Artists may work with and release single songs or multiple songs as they see fit

5.3.3 The fallacy of composition

It is important to take note of the level of analysis in the studies surveyed in sections 5.3.1 and 5.3.2. An analysis based on individual recordings need *not* find the same results as an analysis based on aggregate numbers. This is called *the fallacy of composition.*

Liebowitz (2004) discusses the apparent paradox that record companies in the USA for decades have been willing to pay *payola* to radio stations for spinning their records, while at the same time evidence indicates that radio airplay of music may harm the total revenues of record companies. This form of advertising is important for an individual recording, but music radio stations may still be a substitute to buying records. Inferring from the level of recordings to the level of the music industry is in this case a fallacy. This may also apply for unauthorised distribution of music and substitution between modes of music consumption in general. The elasticities of substitution between modes of consumption of individual recordings are not the same as those between modes of consumption of all music.

Hammond (2014) uses data from torrent trackers together with sales data to see the impact of illegal file sharing on sales of individual albums. He does not distinguish between sales of physical format and digital format. He finds that the average effect of file sharing of an album on the sales of the same album is insignificant. This finding does not rule out that the aggregated effect of file sharing on the totality of recordings is negative.

Blackburn (2006) finds that the most-selling albums have sales affected negatively by piracy while less popular acts benefit from piracy of their titles. The average effect is zero. Blackburn is well aware of the fallacy of composition and takes as given that the aggregate effect of piracy on the music industry is negative.

The effect of piracy on sales of originals can be decomposed into three. There is a *substitution effect* as copies replace originals. The copy may substitute for originals of the same title, but also for other titles. There is *penetration/marketing/exposure effect*, which increases sales of the same title as it is made more known through illegal copying. Finally there is also potentially an *income effect*: if people acquire free copies of some recordings instead of purchasing them, then they may have room in their budget to buy recordings they otherwise could not afford. Expenditure on recorded music is a very small share of income for most people, thus the impact of price reduction on disposable income is very little. However, if people have a more or less fixed budget for music, then there might indeed be an income effect experienced by other recordings.
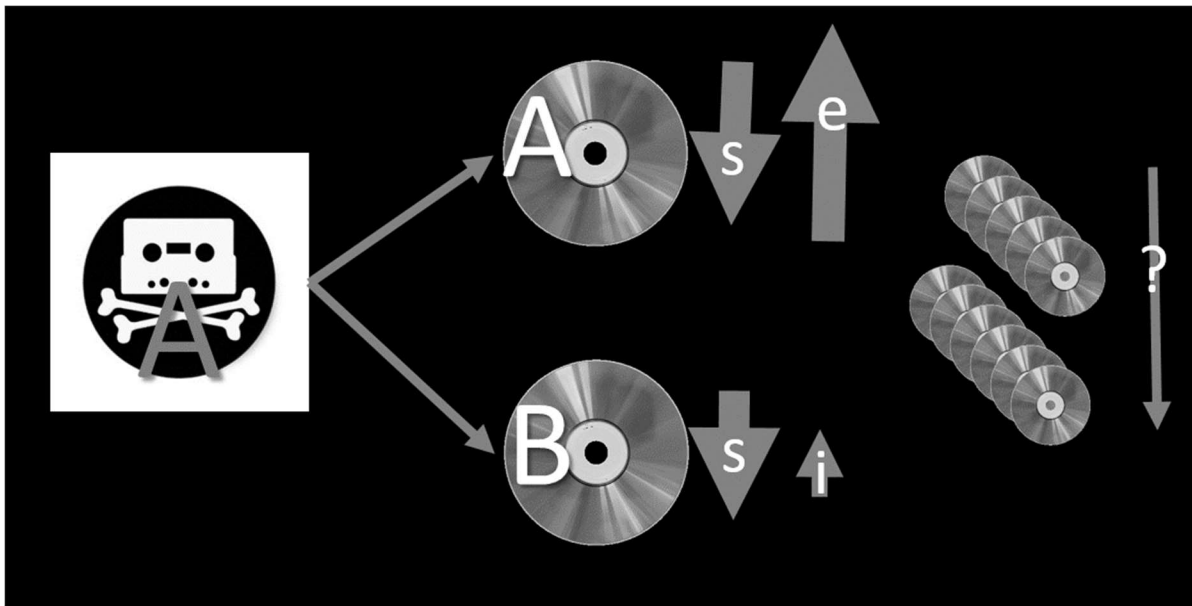
Figure 19: Consequences of piracy

An unlicensed copy of title A is a substitute for buying title A and there is also a substitution effect (*s*) on sales of title B, as far as A and B are substitutes. Copying contributes to an exposure effect (*e*) and the money saved makes up an income effect (*i*). Piracy of a title may have a positive impact on sales of the same title. It will have a negative impact on sales of other titles. Most evidence points towards aggregate impact on all titles combined being negative.

5.4 Cultural omnivorousness

Related to the question of substitutability is the concept of omnivorousness. An omnivore is one that "eats" everything, in our context a person that appreciates and consumes a broad selection of goods. Expressed in the formal economic terms used above, omnivores will perceive cultural goods less as substitutes and more as complements to each other. The cross-price elasticities will be less positive or even more negative.

Omnivorousness is most commonly analysed across genres of music, but can be defined at many levels. It may imply listening to many different works of music, to many different artists or to many different genres. Music lovers with a very broad interest in music will obviously benefit enormously from streaming subscriptions that give access to tens of millions of recordings. Thus, the first adopters are likely to have broader interests than average, and if broad interest is common, then the consumer welfare from subscriptions will far exceed price. Omnivores may also be interested in many different *cultural forms* (e.g. news, books, music, theatre, films) or, as is the topic in chapters 6 and 7 of this thesis, they

may be *technological omnivores*: they may listen to music, or access literature, through many different media technologies (e.g. physical, downloads, temporary access).

In the tradition from Bourdieu's analysis of taste as laid out in *La Distinction*, there came several papers that has noted that the "highbrow" snobbery was replaced by highbrow omnivorousness. While the highbrows used to only appreciate highbrow cultural expressions such as opera and classical music, they had to an increasing extent also turned towards lowbrow and middlebrow musical genres. Both a period effect and a cohort effect is identified as driving such a change from 1982 to 1992 (Peterson, 2005; Peterson & Kern, 1996). Omnivorousness was considered the new standard for good taste. Also among those that do *not* enjoy highbrow music, there was a movement towards omnivorousness in that more people enjoyed music within more genres, making omnivorousness/univorousness a more important distinction than highbrow/lowbrow (Peterson, 2005). There thus appear to be many types of omnivores and univores.

Rossman and Peterson (2015) use the same methods and dataset as Peterson and Kern (1996), but supplemented with new data from 2002 and 2008. They do not find evidence of increasing omnivorousness: 1992 is an exception in that respect. Savage and Gayo-Cal (2009) disputes not only the results of Peterson's analysis of the 1992 data, but also the usefulness of the term *cultural omnivorousness.* They find that "There is rather little evidence, in the UK, of genuine, wide ranging musical omnivorousness in which different genres and musical types are appreciated by the same people. If anything, the musical field appears more contested and differentiated than in the past." Instead, they explain Peterson's results with the introduction of the new genre *light classical*, classical music with a broader appeal to a larger audience that primarily enjoys other genres.

Bennett et al. (2009) perform a cluster analysis of self-reported liking and disliking of music genres. They find that 24 percent of the respondents are located in clusters that have a liking of at least half of the eight genres. They find weak or no support for the hypothesis that this omnivorousness correlates with class and education. They do find, however, an age-related cultural divide where popular music appeals to the young and classical music appeals to the old.

Others, such as Savage, Gayo-Cal, Warde and Tampubolon (2005), criticise the use of large block "genres". They argue that every music genre, or category of other kinds, may

potentially include both "high" and low". Will Atkinson (2011) adds to this "counter-attack" on the omnivore theory: "*I will argue, what appear to be 'omnivorous' musical tastes amongst dominant and dominated agents turn out, on closer inspection, to be rather spurious*". "*[Various observations] gives the distinct impression that omnivorousness is in action [...] and it would certainly register as such in the tick-boxes of closed questionnaires. Yet once we go beyond the simple listing of preferences and begin to sift through and break down the interviewees' answers in a little more detail, a rather different, less omnivorousness-friendly scenario transpires*:"

Omnivorousness has also been analysed for a wider variety of cultural goods. Savage et al. (2005) consider variety of cultural engagement and leisure activities more broadly. They perform a multiple correspondence analysis and find that "*the prime rupture across all parts of the cultural field is less between those who like one kind of culture, and those who like another, but between those who like any named cultural form, and those who do not.*" I.e. that those that are into culture are into a broad range of cultural interests and activities, while many are not into any. The activities enjoyed by those that in general have little interest in participation are watching *variety, chat shows, reality TV and soap operas[33]*, and those who like to eat out in *café's, teashops, or fish and chip shops*. I.e. typically lowbrow interests. Thus the *axis 1* of the analysis, the most important division, lends some support to a view that the division between omnivores and abstainers is most important.

Hallmann et al. (2016) investigates active participation in sports and high culture. They find that there is a small but significant correlation between the two controlling for other factors. This is a slight sidestep as it is not about consumption but participation. It still sheds light on the interest in culture and sports.

The literature on cultural omnivorousness is inconclusive and we are left with more questions than answers. In chapter 6, I will conduct a cluster analysis in an attempt to present some new evidence on the question of technological omnivorousness, specifically on whether consumers in general tend to access music through several channels. While the concept of omnivorousness us most commonly used in connection to a preference for multiple musical genres, is translates as a special case of *taste for variety* and *substitutability*. I find it useful to

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[33] Various different types of shows have been grouped together using factor analysis prior to the correspondence analysis. They belong together in the sense that they appeal to the same audience.

also employ the concept of omnivorousness to consumption across media (books, film, music) and across formats (physical, downloads, subscriptions). The question is very closely related to the question of substitutability of formats.

5.5 Demand interdependence - bandwagons, fads, superstars and underground

It is sometimes difficult to aggregate from individual demand to market demand. If choices made by some consumers affect the choices other people make, understanding the impact a given price change has on the market becomes more complicated. One cannot estimate the effect a given price change will have on individual's demand and then sum over the individual demands to get an aggregate effect. To evaluate the market effect of a change in price, one must also take into account the indirect effect that works through other people's demand. If a consumer's decisions are influenced by the decisions of other consumers, we have *demand interdependence*. This phenomenon can be termed external effects on utility, consumption externalities or external (dis)economies of consumption. Katz and Shapiro (1985) use consumption externalities as, to my understanding, synonymous with Leibenstein's (1950) external effects on utility. Liebowitz and Margolis (1995) argue that the existence of network *effects* do not necessarily imply a presence of socially relevant *externalities*. To avoid confusion I prefer to use the term demand interdependence as the overarching concept in this section.

Figure 20 shows a classification of the terms I will discuss and how they relate to each other. I will discuss socio-psychological effects in section 5.5.1, technological network effects in 5.5.2, and finally effects due to information in section 5.5.3.
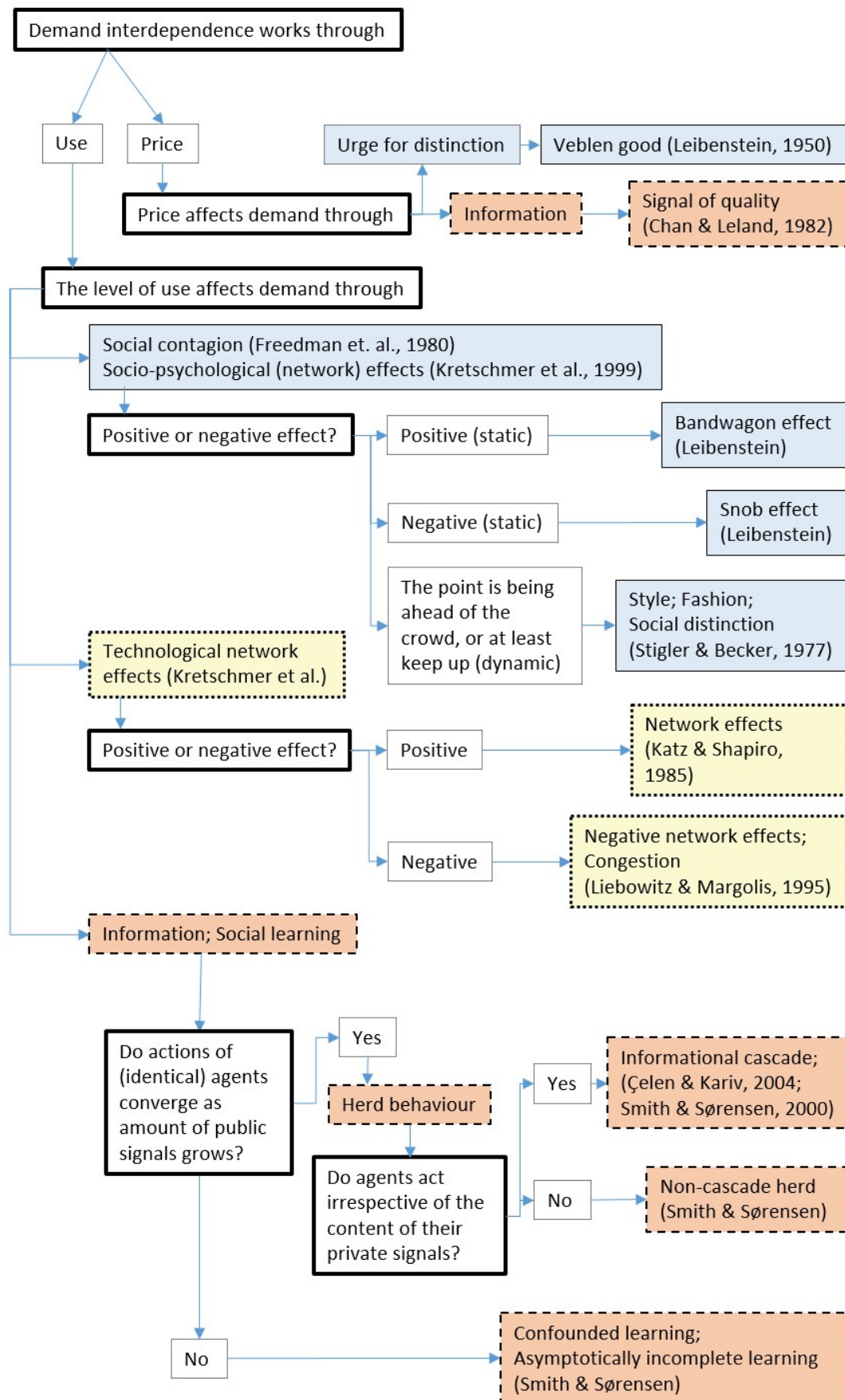
Figure 20: Classification of demand interdependence

5.5.1 Socio-psychological network effects – consumption by others affect preferences

A useful place to start off from is Leibenstein (1950). Leibenstein distinguishes between functional and non-functional demand. He specifies functional demand as that part of the demand for a commodity which is due to the qualities inherent in the commodity itself. Within the non-functional there are three categories: 1. External effects on utility; 2. Speculative demand; 3. Irrational demand. I will emphasise the first. Leibenstein's external effects on utility has three sub-categories: the bandwagon effect, the snob effect, and the Veblen effect. The bandwagon effect implies that if many other people buy the good, you are more willing to purchase it too. The effect is thought to be socio-psychological: Consumers want to do the same things as other people. The wish to conform. To keep up with the Joneses.

Leibenstein discusses social taboos as the flip side of the bandwagon effect: There is a functional demand for the good, but consumers refrain from consuming it because others refrain. As consumption increases, the taboo diminishes and increases one's own probability of consuming the same. In the context of music, an example of taboos can be what is commonly (and controversially) called guilty pleasure songs. However, guilty pleasures tend to be songs that are or have previously been very popular.[34]

The snob effect is the opposite of the bandwagon effect. Consumers that wish to stand out from the crowd will be less likely to consume a good that many others also consume. The Veblen effect implies that consumers derive a higher utility from a good if (they believe other people believe) they have paid a lot for it. In Harvey Leibenstein's model, consumers pay a real price and derive utility from what he calls the conspicuous price, the price (the consumer believes) other people think the consumer paid for the good (Leibenstein, 1950). If an expensive good is made available at a lower price through a general price reduction in the

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[34] We may have some fun constructing the consumer behaviour for guilty pleasure listening: First the bandwagon effect must be present. For a select group of high-brow consumers the *snob* effect kicks in instead. *Within* this group there is a social taboo, a stigma, attached to consuming certain popular recordings. But the underlying "functional demand" may fight the taboo and result in some (well hidden, in the basement at night) *guilty pleasure listening.*

market, this can make the good less attractive to the consumer. If, however, the good can be purchased at a rare individual discount, this makes the good very attractive to the consumer.[35]

If the Veblen effect is present for a good, it is commonly called a Veblen good. The upward-sloping demand curve of Veblen goods reminds us of the peculiar, almost mythic Giffen good. A good you buy more of when price increases. In spite of the apparent similarity, Giffen goods and Veblen goods are quite different. Veblen goods are normally luxury goods while Giffen goods are understood to be an inferior good that people buy if it is the only thing they can afford. If price of this basic subsistence good goes down, it may free up enough money to substitute some of the Giffen good with a higher quality (e.g. more nutritious) good. In addition, the increase/decrease in demand for a Giffen good is directly attributable to price, and it is due to inherent qualities of the good. The increase/decrease in demand for the Veblen good, however, is usually understood as the consumer's preferences for the good changing. If the buyer of the Veblen good where able to buy an expensive item at a rare, individual bargain price, the buyer would be happy. The good would still signal a high price to others.

Some consumers' demand for a good may be affected by the bandwagon effect and others' demand by the Veblen effect, both at the same time. The definitions of the effects are necessarily at the individual level: individual demand is a function of aggregate demand. Being a snob is a feature of the individual consumer, not of the good. However, certain characteristics of a good will affect its appeal to snobs or bandwagoners. Although the effect is in individual, but it is very hard to detect if it does not show up in aggregate demand. When the bandwagon effect is strong for a sufficient number of consumers, the price elasticity of aggregate demand will be higher than for each consumer and higher than it would have been in aggregate if the effect was absent. If the Veblen effect is strong for a sufficiently high number of consumers, it may dominate over the ordinary negative price effect. Aggregate demand may then potentially be increasing in price for some price intervals, and necessarily decreasing for other price intervals. The demand curve need not be monotonically decreasing or increasing in price. It may not even be continuous. The impact of bandwagon, Veblen, snob and network effects can be very complex. There might be a strong bandwagon effect up to some satiation level where the snob effect gains dominance. There might be a pressure towards conformity within subcultures that at the same time distance themselves from the

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[35] Sellers approaching potential buyers with "special price for you, my friend", have incorporated this insight into their strategy.

mainstream. Consumers are highly heterogeneous and might have different inclinations for conformity. There might be interactions between effects. For instance, the bandwagon may dominate for low income levels while the Veblen effect and/or snob effect may dominate when income is higher.

If a band releases a special luxury limited edition of a record at a high price, this can appeal to consumers through both the Veblen effect and the snob effect and also through what Leibenstein calls the speculative demand: increase in demand due to expectations of future price rises, as commonly occurs with collectibles. Even with non-material cultural goods, consumption can arguably be considered a combination of an indulgence into something that is fun, and an investment into knowledge, character and reputation.

Stigler and Becker (1977) offer an alternative view on fashions and fads. They essentially incorporate both the snob effect and the bandwagon effect into one effect: a drive towards social distinction. They view fashions as a race where participants always want to be first. If they fail to be first, at least they wish to keep up. The consumption of trendsetters can be associated with what appears as the snob effect, the consumption of trend followers appears as a bandwagon effect. This model of understanding seems well suited to understand fads where the leaders are happy to see the followers following them into the fad. (If there were no followers, they would not be trendsetters after all.) The trendsetters will then jump to the next fad. The model is less well suited to understand how consumers of luxury or niche products can be very unhappy with having their territory invaded by the masses. The perspective of fads can only be understood dynamically. The attractiveness of a given good changes over time.

Fads are not only interesting in relation with cultural goods in general. There is also a very interesting point to be made specifically concerning the transition from sales of music recordings to subscription services. Subscription services give people the flexibility to jump from one fad to the next. Previously, people were bound to listen to records from their collections, (supplemented with radio and mix tapes from friends). They can now listen to the entire top-selling chart whenever they want. Thus, listening patterns may possibly be more concentrated than ever. Indeed, C. Handke (2010a, p. 126) writes, in a time mostly before streaming, that the fact that music recordings are near perfect durables and thus only consumed (purchased) once, allows sales to be not very concentrated. Instead of repeated consumption of one variety, they will go on to buy other varieties the next time they spend

money. With subscriptions, this has completely changed. What is being counted is now replays of songs, and replays are *not* durable. Thus, repeated consumption is the order of the day. Changing the music one listens to has no monetary costs, once a subscription is paid for. Subscriptions may make people free to follow fashion, but as more music is more easily available, subscriptions also make people free *not* to follow fashion. Whether this leads to more concentrated demand than traditional sales does, is dependent on whether it is the most popular recordings that, over time, are best suited for repeated listening. That does seem likely. Thus, this may be a force for concentration, but it will meet counteracting forces such as increased availability or more information. We will return to that below. How strong the fads and how big the superstars are, can be thought of in terms of revealed listening patterns, revealed distribution of revenues or the undisclosed underlying preferences. These three will not necessarily change to the same degree, or even in the same direction. New technologies can alter preferences (Potts, 2014). Stigler and Becker (1977) would instead say that consumers have stable preferences for the "commodity" *enjoyment of good music*, and the specific goods needed to produce this commodity would change over time as learning takes place and the social environment changes.

Sociology has been grappling with social contagion, or behavioural contagion, for a long time, e.g. Freedman, Birsky, and Cavoukian (1980) and Burt (1987). Kretschmer, Klimis, and Choi (1999) relate the concept to consumer theory. They use the term social contagion interchangeably with socio-psychological network effects as opposed to technological network effects/externalities.

Streaming services can be used as a social tool with which to flash one's taste and to help other people discover good music. It varies how social people are around their consumption of music, but a substantial number of people pay a lot of attention to how their interest in music is reflected through subscription services (Hagen & Lüders, 2017). It is not unlikely that the urge to flash social distinction through music is stronger than ever before. While the social dimension may be is strong, it is unclear how it will affect listening. The bandwagon effect and the snob effect as well as fads and fashions can all result from the social aspects of music listening.

5.5.2 Technological network effects – consumption by others affect quality of good

A network effect is present if the number of people consuming the good affects the utility of each consumer. Kretschmer et al. (1999) distinguish between the socio-psychological network effects that I have discussed above, and technological network effects, which commonly are just called network effects. A traditional example is the telephone, which is more useful if many other people also have telephones. If network effects are negative, we call it congestion effects. Network effects will certainly be present when choosing between platforms for consuming music. If your friends collect vinyl you may want a vinyl player yourself to be able to borrow music from them. If they subscribe to Spotify, you may do the same to get access to their playlists.

Negative network effects will exert a negative external effect on utility, just like snob goods. Leibenstein's (1950) vision of snob goods was that it represented people's desire to be exclusive, to dissociate themselves from the common herd. I will therefore consider snob effects as distinct from negative network effects. Negative network effects, or congestion, implies that the good in question becomes objectively less useful. An example is traffic congestion, which makes roads less useful to the individual. Congestion might not be very relevant to the understanding of recorded music that is infinitely reproducible. In the case of live music performances, however, a large crowd both contribute to the atmosphere (positive network effects) and obstructs access to the artist on stage (negative network effects). Which is the stronger effect depends on the individual experience of the specific concert.

Katz and Shapiro (1985) as well as Farrell and Saloner (1985) differentiate between direct network effects and indirect network effects (or market-mediated effect). The direct network effect is that directly between consumers of the same good. The indirect network effect is also the result of many consumers consuming the same good, but it works through the supply side: If many consume, then a greater variety of complementary goods and post-purchase services will be supplied. This increased variety is a benefit to consumers through what, in the literature for two-sided markets, is termed *positive cross-group external effects.* These external effects are what gives rise to the indirect network effects (Franck & Peitz, 2019). An increasing number of consumers thus indirectly increases the value of the purchase. Such indirect effects are very important in the case of two-sided platforms, but are not limited to those.

Liebowitz and Margolis (1995) point out that the above earlier contributions underestimate the economic difference between direct and indirect effects. Indirect network effects can

certainly give rise to better support for the product, or a higher quality or a lower price. But the same can be said about any product that is supplied subject to increasing returns. Thus, they criticise the term *externality* in this context. In my words: indirect network effects may change the quality, price and complementarities of a product as an indirect, dynamic, effect of increasing scales. However, at a given point in time, market demand is still the lateral summation of individual demand. I have therefore not included indirect network effects in Figure 20.

5.5.3 **Information – consumption by others informs decision**

Knowledge of other people's consumption can give you pre-purchase knowledge on the existence and quality of goods. There are several terms and distinctions used in the literature discussing this. Other people's consumption provide information for the individual consumer, but the information provided is not always correct, and rational behaviour can lead to bad outcomes. One framework is *informational cascades*. Pre-purchase information can be created by marketing campaigns, "buzz" in media and among fans etcetera. In this framework, individuals follow the patterns established by other consumers. The outcome of informational cascades may resemble the outcome of models of social pressure (bandwagons, taboos), but the driving mechanism is access to information, not a question of functional or non-functional demand.

Millions of albums are available in the market for music recordings. Any given consumer can only ever have heard of a small fraction, and experienced even less. One rarely listens to music completely at random. Most people listen to music that has been recommended to them by friends, a blog, a radio station, a streaming service or a sales chart. Streaming services has taken the level of information to a new level, for instance in how they list the most replayed recordings of each artist. Other economic models can also shed light on this incomplete information, such as the search/experience framework (Nelson, 1970). Nevertheless, the fact that the recordings other people consume tend to become more accessible, makes the framework of herd behaviour and informational cascades very interesting in the context of music.

The terms herd behaviour (Banerjee, 1992) and informational cascades (Bikhchandani, Hirshleifer, & Welch, 1992) are often used interchangeably, but some authors make a distinction: Herd behaviour is a pattern of observed behaviour that may or may not be caused

by informational cascades. Informational cascades imply that information on the actions of others lead consumers to (rationally) ignore their private information entirely. Under herd behaviour, they do not necessarily ignore their private information, but actions converge nevertheless. This distinction appears to be due to Smith and Sørensen (2000). Both Çelen and Kariv (2004) and Duan, Gu, and Whinston (2005) use this distinction in their investigations.

As can be seen from Figure 20, price can also give signals on the quality of a good (Chan & Leland, 1982; Ellingsen, 1997). Music recordings might to some degree have varied in price due to rarity or novelty. However, price has likely never widely been perceived as a signal of quality. I therefore do not consider this a relevant branch of literature for our purposes.

5.5.4 **Is the above classification of demand interdependence uncontroversial?**

Can technological network effects and informational cascades be considered subsets of, or causes of, the bandwagon effect? To the extent that informational cascades bring to the consumer new information on the (likelihood of) inherent qualities of the good, it is difficult to view this as leading to a bandwagon effect. Leibenstein's definition of non-functional demand, within which the bandwagon effect is a subcategory, is that part of the demand for a commodity is due to qualities not inherent in the commodity itself. Thus, if informational cascades lead to a correct outcome, then it is not a bandwagon effect, it has reduced uncertainty about the inherent quality of the good. Also, if the outcome is an incorrect cascade, it is not a bandwagon effect in Leibenstein's sense, it is simply public misinformation. Admittedly, Bikhchandani et al. (1992) do claim that informational cascades can cause conformity, fads and fashions, things they more generally term *uniform social behaviour*. Their model is, however, clearly limited to information and explicitly an alternative to models of *preference for* conformity and sanctions on deviants. Banerjee (1992) relates the concept of herd behaviour to information only. He *does* claim that his model can shed light on changing fashions, but he clearly states that there are other explanations than herd behaviour for the presence of clustering behaviour.

The value that stems from network effects are not inherent in the good itself but are external effects on utility stemming from other people's usage. It is also the case that aggregate demand is not the lateral summation of individual demand. Thus, technological network

effects seem to be more closely related to socio-psychological network effects than herd behaviour is. However, it is very peculiar to consider the utility of having other people with which to speak through a telephone, as "non-functional". Thus, it is ambiguous if (technological) network effects fit in the categories bandwagon and snob. Leibenstein's classification may not be entirely satisfactory. Technological network effects are doubtlessly rational, and they tend to bring utility in an objective sense. The bandwagon effect will often be understood as a less rational, or at least more subjective, urge to do whatever other people do. I believe my demarcation at this point is in line with that of Kretschmer et al. (1999).

Leibenstein explains his concept of the bandwagon effect this way: "*It represents the desire of people to purchase a commodity in order to get into 'the swim of things'; in order to conform with the people they wish to be associated with; in order to be fashionable or stylish; or, in order to appear to be 'one of the boys.'*" Whether or not network effects or information on quality can be said to be part of, or lead to, bandwagon effects, depends on how much emphasis one gives to Leibenstein's description of the effect, or indeed how much emphasis one gives to Leibenstein. If Leibenstein's classification is to be complete, then the bandwagon effect must cover these. If one follows his description, one ends up with a narrow concept. Farrell and Saloner (1985) are among the authors that allows the bandwagon effect to be a result of technological network effects. I have used the narrow concept in Figure 20. I find support for the use of the bandwagon effect in a narrow sense not only from Leibenstein's description, but also from a foot-note in Katz and Shapiro (1985): "In addition to the sources of consumption externalities mentioned in this paper [technological network effects], there are a number of more subtle ones. These include: (i) the fact that product information is more easily available for more popular brands; (ii) the role of market share as a signal of product quality; and (iii) purely psychological, bandwagon effects."

Although definitions and demarcations are not entirely clear in the most seminal articles, concepts are somewhat narrowed down and defined in subsequent contributions such as Kretschmer et al. (1999) and Çelen and Kariv (2004). Nevertheless, my classification in Figure 20 is my own interpretation. I believe it is useful to keep some of the concepts separate from each other and in a well-defined relation to each other.

5.5.5 Shared goods – the structure of society

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Things such as telephones certainly have technological network effects, but the utility of telephones is largely social. That does not make telephones less functional. Even more so for experiences such as going to a club. The utility you derive from attending the club increases if others attend the same, especially if they are your friends. This example may border between wish for conformity and network effects.

Klamer (2017) uses the term *shared goods* for goods that most of all are a contribution to *a common practice*, and that have to be recognised by others as a contribution in order to have a value.[36] The value of the club is not inherent in the club, the value comes with your friends that are there. The value of art is not only artistic, but also social. There is social recognition to win from participating and, according to Klamer, you are less likely to free ride (even if possible) in the case of shared goods. Without a contribution, there is no good to consume. Klamer explains why art is a shared good: "*…artists contribute to a shared or a common practice.* […] *Art is social. Its values come about in a social setting. A singular work derives its values from being a contribution to a common practice, that is, a practice that a group of people, artists, connoisseurs, museum directors have in common. That is why art is a shared good.*" Thus, there is no such thing as "inherent value" in the case of arts, or shared goods in general. The archetypical shared good is friendship. Other examples are knowledge and trust. The term is applicable for goods that cannot be bought and which you maintain by contributing to it. The good takes effort to acquire.

Kotipalli (2018) applies the concept of shared goods to intangible heritage in general and craft in particular. His argument is based on the interpretation of anthropological) culture as *shared values* (Klamer, 2003). While craft may produce tangible objects that can be purchased and privately owned, craft also *has the ability to produce shared goods as it serves as a context within which co-creation of values becomes possible* (Kotipalli, 2018, p. 137).

In my interpretation, the most obvious example of commercial art that has its value derived from the "conversation" it is part of, is parody. What would the *Hot Shots!* films be worth without Top Gun, Rambo and the other films they take inspiration from? But music, film and literature of all genres are full of references to things that have been contributed before. They honour, they plagiarise and they add to previous works. Shared goods seem especially relevant to art in the context of "prosumers", user-generated content, commons such as

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[36] Other authors have other uses of the term *shared goods.*

Wikipedia and active participation in art. To be a participant, you must contribute. At the very least, participants must contribute with attention and reflection, i.e. work (Klamer, 2017, p. 93).

Shared goods can possibly be understood as networks or institutions that increase its members' utility from other goods. The concept puts emphasis on the personal and societal institutions through which information, social pressure and unity flows. Institutions like rule of law, safety, trust, markets, technology, standards, public information and friendships are all shared goods. Shared goods are the fabric of society. They are the framework that allows for production of goods, exchange of goods, enjoyment of goods and for the flow of externalities. Without shared goods, no private goods could ever be traded. Friendships are not only valuable for the value they add to clubs, concerts or mountain hikes, however. They are also goods in their own right, although not traded in markets but acquired in fundamentally different ways.

Thus, shared goods are fundamental to human activity and, according to Klamer, may have received too little attention in economics. Shared goods do not get a box in the above classification, as the structure of the tree itself is basically made up of shared goods. Art, and among it, music, is a conversation, an institution, a shared good. A specific (copy of a) *work* of art, on the other hand, has elements of a private good that can be sold, bought, and privately enjoyed. The most important elements, however, may be as part of a public conversation. A painting can be privately owned, but if it has been published, it is also a public good and a shared good. Shared goods are rarely considered as separate arguments into a utility function. That does not necessarily mean that they are left out. Shared goods will be a fundamental part of that which gives the shape of utility functions as well as production functions. Shared goods have inherent value, a value that to some extent may be absorbed, utilised and monetised through commercial goods such as social platforms, coffee, beer, sports equipment, board games or any other good that essentially draws its value from the joint appreciation of it. One may also interpret technologies and skillsets that makes it possible to combine input factors into output, as shared goods. It is evident that such a broad application of the notion of shared goods brings us very close to branches of economics such as institutional economics and behavioural economics (Kotipalli, 2018, p. 65).

While I will not in any way understate the importance of shared goods, it is not the topic of this thesis, and I will not apply or discuss it any further.

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5.6 Dynamic effects on demand

While Leibenstein (1950) is explicitly limited to a static exposition, fads and fashions can only be understood in a dynamic model. Many models on social learning are also dynamic, such as the sequential learning presented by Smith and Sørensen (2000). In this section we will discuss some further issues that may lead to individual demand changing over time. These changes may or may not be related to demand interdependence.

5.6.1 Search and experience

Incomplete information on the quality of goods is very important in the case of cultural goods. There is infinite variety, and one cannot really evaluate the quality of any of the varieties reliably without experiencing them oneself. Nelson (1970) is the originator of the distinction between *search goods* and *experience goods*. When goods are costly to acquire but where information on quality are accessible, *search* for information is the best way of getting information on quality. When goods are easily sampled and consumed (Nelson's example is canned tuna fish), the best way of getting information on quality is by *experiencing* it first-hand. When quality is objectively measurable, that makes information by others valuable. If quality is subject to individual taste, then that weighs in on the experience side.

Nelson assumes that different brands are perfect substitutes. That is far from the case when it comes to varieties of cultural goods: we might want to consume many different varieties, not choose *one* optimal. It is therefore not worthwhile to delve into the details of his model, but by and large his logic is relevant. Cultural goods have qualities that are at least partially subjective, and have therefore often been considered experience goods.[37] Kretschmer et al. (1999) argue that cultural goods are neither search goods nor experience goods, but fall in a third category: *credence goods*. Credence goods are goods for which quality is rarely learned, even after experience, a prime example being repair of durable goods. Quality is difficult to judge, much because *output is a stochastic function of service input.* (Darby & Karni, 1973) I disagree with the categorisation of cultural goods as credence goods. It seems to rests on an assumption of quality in some objective sense. What is relevant to the individual is the quality that the individual subjectively experiences. Indeed, Nelson (1970) states that the consumer's

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[37] Cultural goods are also "experience goods" in a different sense, where the "experience" is not (primarily) an experiment, a *means to an end*, but an end in itself. I.e. the good itself *is* an experience (Hutter, 2011).

information problem is to evaluate the *utility* of each option. This utility can mostly be evaluated through experience, even though, as Kretschmer et al. makes us aware of, we may change our opinion on the quality as we mature, as we digest the content or as we learn other people's opinions. As I understand it, this is not an information problem, but presence of bandwagon effects, network effects and taste formation, the last of which I will return to in section 5.6.3.[38]

The internet have made information on all sorts of topics more available, and may swing in the direction of *search* being more important than *experience* (C. Handke, 2010a, p. 116). Indeed, a web search will give you countless guides on what are the best and worst brands of canned tuna! Expert advice as well as forums for discussion give information on the existence of music artists as well as their qualities. However, the internet not only provide information *about* goods. Goods that are themselves information, such as music, can in many cases easily be sampled and experienced through the internet. The arrival of streaming services has made experience easily available without any investment other than the time spent to listen to the music. Thus, the pendulum might have swung back towards experience. You may search for new artists within a genre you like, but if you know the name of an artist you are curious of, then experience is quicker than search.[39] The decision of monetary expenditure for music subscriptions does not come with the choice of music to listen to, but with the choice of service to subscribe to. When it comes to the choice of service, search for information as well as personal experience with different services may be important. However, as the services are quite close to perfect substitutes, network effects may overshadow both search and experience: If Apple music is bundled with your iPhone, or if everyone you know subscribe to Spotify, then you may not bother with even considering the alternatives.

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[38] To employ Darby and Karni (1973), the good has credence qualities if (1) the consumer does not have enough information on alternative goods or services to judge on the quality received (did the taxi driver choose the shortest route?), or if (2) output is a stochastic function of input (a quality repair may not last long, a crappy repair may, with some luck, last a long time). I find it hard to judge cultural goods as credence goods because, although output (subjective utility) may be stochastic, the "input" (objective quality of service) does not really exist. Furthermore, Darby and Karni emphasise the opportunity that credence goods raise for fraud. It is very difficult to relate this to most cultural goods.

[39] Anecdotal evidence from Norway suggests that streaming services are less important for discovery than friends are, but that the services allow the user to follow up on recommendations (Kjus, 2016).

A main purpose of Nelson's contribution (1970) is to highlight the implications information has for market power. People will tend to experiment with brands they are familiar with, and different consumers will tend to experiment with the same brands. The lower the frequency of purchase of the good in question, the less experiments will be conducted, and the less information is gathered. A result is that if people tend to choose the same brands, then there is a positive relationship between the number of experiments and the number of brands the market can support. If information is easily available on many varieties, either through search or experiment, then market power is reduced. Music is already a good with a high frequency of transactions, and thus many brands (music artists) can be supported. Easier access to information through the internet should make markets more contestable, and thus demand *less* concentrated (C. Handke, 2010a, p. 118). However, as has been mentioned, other mechanisms may work in the opposite direction.

We can relate this to the literature above on demand interdependence. Information acquired through search is similar to (or possibly identical to) the private signals consumers are assumed to receive in the literature on informational cascades and herd behaviour. That literature yields the same conclusions as the search literature when it comes to market power. Stronger and cheaper (more easily available) private signals will weaken the possibility of cascades, and thus make demand less concentrated.

5.6.2 New technology changes cultural consumption

New technology can make certain goods or varieties more easily available, less costly to acquire, or the technology may potentially change preferences. Potts (2014) provides an overview of the mechanisms through which this may work. First, new technology changes relative prices. Some goods will have a lowered price relative to other goods, in some cases price falls to zero. Introduction of new products may be interpreted as price decreasing from infinite to finite. For most types of goods, demand will shift towards the good becoming cheaper, and consumer surplus will increase. Second, new technology increases variety. The varieties may come into existence because of new technology, or they may become more accessible. Consequences for consumer utility through this mechanism is more ambiguous, as consumers that do not adapt may struggle to keep up, and some that *do* adapt might have preferred previous goods and technologies that over time become less accessible. For many consumers, the new technology offers increased utility, as they get to choose preferred options that were previously out of reach. Lastly, new technology may induce new preferences. New

technology can affect preferences through all the causes of demand interdependence laid out in Figure 20. It affects dispersion of information regarding the existence of, and the quality of given works. It affects the structures of social networks and composition of peer groups that in turn affect the propensity for conformity. Not least, technology affects the conditions for direct and indirect technological network effects, something that in turn may affect preferences.

5.6.3 **Taste formation and addiction**

Demand for creative output can be viewed as different from other goods for a number or reasons mentioned in section 2.1.2. One typical trait is that the taste for cultural experiences grows through exposure. Therefore, the utility one derives from music depends on the time previously spent on music. The time spent on music enhances your knowledge of music and your ability to fully appreciate it. It is an element of human capital stock that accumulates through consumption (Caves, 2000, p. 176).

Rational addiction theory (Becker & Murphy, 1988; Stigler & Becker, 1977) controversially claims that addiction can be explained within a framework of fully informed, rational agents. In such a model, welfare cannot be improved by forcing policies upon individuals unless their abuse causes negative externalities. However, addiction can be better understood allowing for certain non-rational aspects. Not least by modelling abusers as time-inconsistent consumers. That is just as compatible with empirical evidence as the rational addiction theory, and it has very different implications for policy. Government interventions can thus be understood as increasing the welfare of the affected individual (Caulkins & Nicosia, 2010). Accepting that some outside authority is a better judge of individual utility than the actions of the individual are, is what is called *merit goods* (Musgrave, 1956/57).

The reason I mention addiction in the context of music consumption is that Stigler and Becker (1977) postulate a symmetry between "harmful" drug addiction and "beneficial" addictions, such as tastes that are acquired through repeated consumption of music. Consumers that possess a lot of "music capital" will appreciate "good music" more highly than those with less music capital will. In the case of *beneficial addictions,* consumption capital increases as one consumes. One's ability to comprehend and appreciate culture grows with exposure to it. Thus, if one consumes today, one will get more utility from consumption tomorrow. Consumption is also an investment. The rational consumer will therefore consume more than

he/she otherwise would in order to invest in this future. Stigler and Becker (1977) assume constant tastes and argue that what appears as changing tastes can be explained as accumulation of "consumption capital".

It is well established that adolescents listen to a lot of music, and that they ascribe a particular importance to music (Lonsdale & North, 2011; North, Hargreaves, & O'Neill, 2000). According to Stigler and Becker (1977), this is not because they get more appreciation from listening to music than older people do. On the contrary, they get *less* appreciation as they have accumulated less "consumption capital". The reason they may listen more is that the young have a stronger interest in long-term investment into consumption capital. Thus, the young do not *indulge* into music, they *invest* into music. What Stigler and Becker do is essentially to decompose "taste" or "preferences" in the broader sense, and redefine preferences as something more fundamental and stable. Into the stable preference function, they introduce new inputs in the form of *capitals* that shape individual demand.

An empirical test of this application of the rational addiction theory should be quite simple: One could survey music listeners about whether some kind of investment is an important motivation for adolescents listening to music. While the specific hypothesis may not have been tested explicitly, several contributions can enlighten the subject. Lonsdale and North (2011) conduct a factor analysis on a long list of reasons for listening to music. Their third factor accounts for 11 percent of the variance, and concerns aspects of *learning.* None of the variables tested are *learning to enjoy music,* however.[40] Tarrant, North, and Hargreaves (2000) conduct a similar factor analysis, but with only ten variables and none than resemble investment. The most frequently cited reason for listening to music is "other". This *other* may potentially include elements of strategic investment. The analysis also includes other variables that may be considered investment into social relations, but those are investment with immediate returns, and not long term returns. Neither Gantz, Gartenberg, Pearson, and Schiller (1978) nor (Roe, 1985) include variables that are concerned with learning or long-term investment. The former contribution includes an open-ended question where 2 out of 468 respondents mention that listening to pop music affects their appreciation of music.

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[40] The variables are *to learn how to do things*; *to learn how to behave in future*; *to obtain useful information for daily life*; *to discover who I really am*; *to learn how other people think.*

The idea that consumption largely is motivated by the future payoffs from the investment, might have some merit for the high arts, such as modern dance or classical music. It seems completely unreasonable to suggest that when young people listen to a lot of popular music, or visit the cinema to watch *Fast & furious*, it is motivated by their future ability to appreciate music and film. Thus, this might be a situation where the distinction between "high-brow" and "low-brow" is relevant. Popular culture tends to give direct thrills. High culture is more of an investment (Caves, 2000, p. 187). North et al. (2000) find that young people themselves believe classical music and pop music to some extent serve different functions, although none of the proposed functions is as an investment vehicle into future enjoyment of music.[41]

Apparently, the thought that adolescents listen to music purposefully in order to be able to enjoy music properly when they get older, is an idea that has not occurred to either the surveyed adolescents or the researchers conducting the various surveys. Unless it is empirically demonstrated that long-term investment is a major motivation for young music listeners, I do not find the framework of investment into consumption capitals useful for understanding music consumption. I.e. even if taste formation is understood as *addiction,* it a long stretch to consider it *rational addiction.*

Taste formation is arguably a form of demand interdependence, albeit one that does not (necessarily) relate to other people. If we consider consumers' individual consumption aggregated over the long-term, then taste formation will affect this individual aggregate. It will not, however affect the further aggregation from individual to market demand. Thus it is not considered in Figure 20.[42] *Rational addiction* is a form of investment, and under the classification in section 5.5, such investment will be considered speculative demand in line with Leibenstein (1950), and therefore not covered by Figure 20. While this form of taste formation is certainly learning, it is unrelated to the learning models reviewed in section 5.5.3.

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[41] Stigler and Becker (1977) seem to recognise this distinction, as they emphasise *"good" music (i.e., music that educated people like!).*

[42] Limiting the figure to statics is to some degree governed by the starting point: Leibenstein (1950) limits himself to statics in his classic exposition, while arguing that the most interesting parts of the problem may be found in the dynamics.

Where social learning only affects the information about goods, taste formation affects the usefulness of the good.[43]

5.6.4 **Path dependence**

Another phenomenon that is necessarily dynamic is that of *path dependence* (or *positive feedback*). Typical examples are how consumers are effectively locked into standards such as Betamax/VHS (Arthur, 1990) or Dvorak/QWERTY keyboard layout (David, 1985). The utility an individual experiences from a given product at a given point it time may be independent of how many others make the same choice at that same point in time. However, the historic sequence of choices made by suppliers and consumers make one choice relatively more attractive than it would have been if history was different. Utility *may* depend on what your friends have previously decided on, in which case we are dealing with network effects or bandwagon effects. Utility may also depend on which films are supplied on each format or on how the hardware producers print their keys. Last, but not least, if you have learned to love or learned to use one thing, then it takes some resolution to switch. Thus, even if there is no demand interdependence present in a static analysis, a dynamic analysis may reveal it. This interdependence can be due to most of the effects that are laid out above, be it psychological, technological or informational. Path dependence can also be the result of economies of scale.

Path dependence is relevant for understanding how formats and modes of consumption shift, or do not shift, in cultural industries. A relevant example is that as people have subscribed to music subscription services for a number of years, and have forgone to build collections, they become increasingly dependent on continuing access to subscription services. In parts, this is a result of new habits, but it is also because the outside option of listening to their collection of CDs is increasingly poor when the collection is not constantly maintained. Thus, we may assume that the price elasticity of demand for music subscriptions will decrease, and prices may be raised. The emphasis that theories of path dependence put on how insignificant differences may lead to market domination through initial happenstance reminds us of some of the models explaining the emergence of superstars. Superstars is the topic we will turn to next.

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[43] Learning to use a tool will affect the utility you are able to draw from the tool. *Social learning* does not affect your ability to use the tool, it only provides you with information on the existence and quality of different alternative tools.

5.7 Concentration of demand

Positive demand interdependence will cluster demand around certain varieties that become more popular than their relative quality alone would imply. Informational cascades and bandwagon effects contribute towards the phenomenon of superstars. A discussion on global superstars has been present since Rosen's 1981 article *The economics of superstars*, the central question is what part of the demand concentration is due to quality differences, and what is due to subsequent reinforcing mechanisms. Rosen (1981) explains superstars solely with consumers' preference for *quality,* which is quality in some objective sense that consumers agree on. Demand interdependence only enters the equation as counteracting forces: congestion and overexposure. Adler (1985) on the contrary, assumes no quality differences and explains superstars solely from social preferences for being able to talk to others about their cultural experiences. This is easily recognised as the bandwagon effect.

Digitisation re-ignited this literature, and the question became who gain and who lose due to digitisation. The theory of the "long-tail" of digital music sales started with Chris Anderson coining the term in a text on the *Wire.com* in 2004 (C. Anderson, 2004), further elaborated in his book (C. Anderson, 2006). Anderson argues that the future will hold big business in the tail of the sales distribution, where the items that have not commonly been available in the physical formats can be found. Andersen's statements concern the effect of digitisation specifically, and are thus not contradictory to Rosen's identification of the steadily increasing importance of superstars. Still, the superstar phenomenon and the long-tail phenomenon are two trends with implications for the same distribution. A hypothesis derivable from the long-tail theory is that it counteracts the superstar effect, although this is not a mathematical necessity: The losers may be in the middle ground. Literature on the redistributive trends and effects of digitisation blends into explorations of the explanatory factors behind superstars. Digitisation has unquestionably made a wide variety more available. Brynjolfsson, Hu, and Smith (2003) provides an analysis of how this may affect consumer welfare in the case of books. Counteracting the long tail effect of increased variety, digitisation might also have reinforced informational and psychological mechanisms that lead to superstars (herd behaviour and bandwagons). One case in point is whether recommendation services (manual or algorithmic) predominantly lead consumers up or down the popularity curve. Hinz, Eckert, and Skiera (2011) provides an interesting discussion of the drivers of the long tail, or lack thereof, along with an empirical analysis of video-on-demand in Germany.

If the theory of the long tail is correct, the reduced transaction costs of making available recordings of marginal popularity may draw a great share of the audience from recordings that were previously easily available, to the benefit of those that were not. Such content can be new material, but it may also be old recordings that resurface in the streaming services after long periods of inaccessibility. Whether it has been the largest or the smaller artists that has been most affected by digitisation has been a long debate without a conclusion and even without a common standard for evaluation. Hammond (2014) presents the theoretical reasoning behind the two conflicting hypotheses:

Superstars lose: Illegal copying allows people to get to know artists they have not heard of before. It is thus easier to discover new favourites outside the mainstream. This creates a "buzz" that will make it more likely that both the downloaders and others will spend money on these releases. Superstars, on the other hand, are already well-known and do not need this exposure. For them, unlicensed copies cannibalise sales and provides no benefits.

Superstars win: Consumers use unlicensed downloading to "sample" information goods they may otherwise have little knowledge of. Thus, purchased music will increasingly match the preferences of the consumers. If mistaken purchases are more likely with new/small artists, then a better matching of music and preferences will harm new/small artists relative to established/popular artists.

The wording above makes it clear that this was written at a time when the main concern was the threat of unlicensed file sharing. But the hypothesis of cannibalisation is equally relevant in connection to subscription services. The hypothesis has mostly been tested for periods when there was little or no streaming, or specifically with file sharing as explanatory variable.

5.7.1 Downloading and the long tail

Gopal, Bhattacharjee and Sanders (2006) use numbers from *Billboard Top 200 album charts*, (USA), and find that being known in advance is more important for record sales in the period 1995-96 than in the period 1998-2000. What separates these periods is the year 1997 when software for playing MP3-files was widespread for real. They also find support for the hypothesis that internet use decreases the superstar-effect. Mortimer, Nosko and Sorensen (2012) reach a similar conclusion based on data from 1993-2002: As for recordings, they claim that while all have experienced decreased sales after 1999, the biggest names have lost

the most. On the concert side, they find that the biggest artists experience little change, while smaller artists have gained much since 1999.

Krueger (2005) and Connolly and Krueger (2006) find somewhat different results in the case of concerts: The superstars take an ever larger share of revenues (data up until 2003) although this development has slowed down since 1996.

Blackburn (2006) finds that the negative substitution effect of piracy is stronger for ex ante well-known acts while the positive penetration effect dominates for previously unknown acts. I.e. piracy is good for the small, bad for the big. The negative effect on the major artists outweigh the positive effect on the small, so there is a large negative effect at the industry level. Hammond (2014) on the other hand, reports opposite results. He finds that artists that are already well-known benefit from being pirated while les known artists suffer. To support his case Hammond sites IFPI to show that debut albums make much less of an impact on charts in 2010 than in 2003. Sales of debut albums in the global top 50 has decreased by 77% compared to a decrease of 28% for non-debut albums. He also finds that piracy benefits sales of released albums from major labels but hurts releases from independents.

Waldfogel (2012a) finds pretty much the opposite results of Hammond, although with data from the USA only. He finds that the Billboard 200 featured about 600 distinct artists in the period 1985-2000, while this increased to more than 1000 for the years 2008-2010. He also finds that less than 15% of albums featured on Billboard 200 in 2001 were on independent labels, while this rose steadily to 35% in 2011. The increase is even more pronounced at the top of the chart.

The discussions around whether the *long tail theory* or the *winner-takes-all theory* has most merit suffers from the fact that no common metric for measurement is agreed upon. In 2009, Will Page of the British *PRS for Music* and Eric Garland of *BigChampagne Media Measurement* wrote a piece on *The long tail of P2P* (Page & Garland, 2009). They analyse music being licensed by PRS and music being downloaded through peer-to-peer services and find a high degree of concentration in the head of the distributions. They fail to refute the long-tail theory, however, as they compare shares of the *top 5 percent of the tracks*. What is relevant is arguably the *absolute number* of tracks, not the *relative number*. If digital services make many more works available in the tail of the popularity distribution, this will necessarily make the tail long and thin. It would still diminish the market share of, say, the top 1000

works. Brynjolfsson, Hu, and Smith (2010) explain the differences between *the absolute long tail* that Anderson bases his arguments on, and *the relative long tail, which* is applied by many later critics of the theory, such as Page and Garland. Brynjolfsson et al. (2010) and Brynjolfsson, Hu, and Simester (2011) explain how the relative long tail is unsuited for measuring changes in concentration when the number of products change. They also explain how contributions applying the absolute long tail tend to find the long tail is important, while those applying the relative long tail do not. The subsequent contribution from Anita Elberse, in the form of the book on Blockbusters, falls squarely in the latter category (Elberse, 2013). Elberse applies the relative long tail when she compares the sales distributions of digital downloads in 2007, 2009 and 2011 and finds increased concentration. The numbers she reports do not allow me to recalculate her findings in terms of the absolute long tail, but her argument is unconvincing.

Aside from the question of absolute or relative long tail, there is no single metric that is used for comparison. One can use the total number of songs that see any sales, the number that sells at least 100 per month, a Gini-coefficient, the top 200 hits' share of total sales, the number of songs that reaches more than a million sales or replays and so on. Furthermore, there is no agreement on where the "head" stops and the tail starts, or if there is a body in-between. Ordanini and Nunes (2016) sidestep many of these problems by analysing Billboard's Hot 100 singles chart for the period between 1974 and 2013, and find that we have witnessed a *transition from fewer blockbusters by more superstars to more blockbusters by fewer superstars.* That means that while there are more songs contesting positions in the chart, the songs are increasingly supplied by a small number of superstars that reach the charts repeatedly.

5.7.2 **Streaming and the long tail**

I am only aware of a few empirical contributions that look at the consequences of streaming on the long tail distribution. The first is by Music industry analyst Mark Mulligan (2014). He compares the distribution of relative numbers instead of absolute numbers, just as I discussed for Page and Garland (2009) above. Both of these contributions make valid and interesting points on costs, the difficulties of choosing between excessive amounts of alternatives and people's inclinations towards shared cultural experiences. They also include interesting and specific numbers. The conclusions however, are more miss than hit. Pedersen (2018) compares relative and absolute concentration of streams from the Danish market among the

artists of Sony Music. He finds that the streams of the top 1 percent is steadily increases as the amount of available music increases. However, the share of streams of the top 100 artists is relatively stable, with a possibly decreasing trend. I.e. as the tail of obscure works increases, the relative concentration increases almost by definition, even if the superstars capture no larger share than before. Pedersen (2018) does not compare the numbers with such from other formats, but argues that increased relative concentration is only to be expected as the availability of obscurities is enormous and increasing by the day. This is not an indication of increasing concentration among superstars.

Another contribution that must be mentioned is that of Hiller (2016). He finds that presence on YouTube has a stronger negative effect on the top selling albums than on others. The explanation is possibly that lesser known artist benefit more from the promotion such presence gives. The third contribution I third, and most important contribution I will mention is one by Datta, Knox, and Bronnenberg (2018). They investigate how adoption of Spotify affects the variety of music listened to on both an individual and an aggregate level. They find that consumption of music by superstars (top 100 artists) drops by 16 percent during the first two weeks after Spotify adoption. It picks up again somewhat, and stabilises at 7 percent below the superstar consumption they had on different services before adopting Spotify. On a different note, the authors also find that *individual* consumption is less concentrated around personal favourites. I.e. individuals listen to a greater variety than before, and they listen to different sets of varieties.

Mark Mulligan also contributes to the discussion in the form of a blog post that addresses the changing appeal of streaming services (Mulligan, 2017). He argues, plausibly, that early adopters of subscription services were music aficionados with a consumption pattern skewed towards indie artists. This may have changed with the increasing number of subscribers.

The concentration of replays is likely to be different from the concentration of sales, so an empirical comparison of streaming services with the pre-subscription era is very difficult. In chapter 9 of this thesis, I will present a theoretical model, which sheds some light on this topic. Even in the case of perfect information, perfect availability and unchanged consumer preferences, the transition from unit sales to access through subscription streaming services may have implications for the distribution of revenue between the top and the tail. Subject to the assumptions I make, subscriptions will give a fraction of revenues to the tail that is at least

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as high as what is the case for unit sales. There are no indications that the business model in itself rewards the superstars more than fringe artists.

Underlying these discussions is usually a premise that revenues should be distributed as evenly as possible across as many artists and creators as possible. That is definitely debatable, and I will make three points in that regard. First, is it necessarily better to distribute revenues to as many amateurs as possible, rather than to ensure a decent living for borderline professional artists? Would the resources be put to better use if they can help tipping the balance in the direction of full-time creation for more creators? Second, it seems often to be assumed that the long tail consists of endless numbers of poor artists. In reality, the tail might be dominated by *dead* artists. Analysing Danish streaming of Sony Music's artists, Pedersen (2018) finds that new releases (less than 18 months old) dominate only one section of the popularity distribution: the top 1%! This is remarkably important. For the category 1-10 percent on the popularity rank, catalogue (more than 18 months old) music makes up approximately two-thirds of the streams, and this domination of catalogue is steadily stronger towards the tail of the distribution.[44] It is therefore likely that distributing revenues from the head to the tail of the distribution would imply distributing revenues from active artists to the descendants of dead artists. The third point I would like to make is that there is a possible fallacy of composition when deducing from concentration in national market to the remuneration of global superstars. Pedersen (2018) subdivides new and catalogue into domestic and international repertoire. He finds among the top 1%, new domestic content receives 25 percent of streams. This share is less than half of what this content receives in every other rank category. Domestic "superstars" in small countries would mostly belong to the tail of the global distribution. All in all, the top 1% in national markets are mostly *not* superstars at all.

It appears that Chris Anderson might have been somewhat optimistic on behalf of niche products when he wrote his book. People have not managed, or wished, to distribute their demand on all the available products to the extent he seems to have expected. Nevertheless, his most fundamental proposition of a drift of parts of demand towards varieties that were previously unavailable, stands firm.

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[44] Pedersen (2018) refers to the age of *streams* and the rank of *artists.* It is not evident precisely how this should be interpreted.

5.8 Cultural depreciation

In some discussions concerning copyright legislation, the value of old recordings is a parameter of interest. This is particularly important in the debate on optimal copyright term. The value of old recordings can be found, or rather defined, by identifying a pattern of depreciation of value. Although this parameter is very important, there has been little research into it. In parts because the data available could have been better. There are some estimates of the pattern of depreciation, and these will be reported below. There is some dispute over how this estimation should be carried out. The dispute is not so much explicit as implicit in the assumptions made. The pattern of depreciation is likely to differ between art forms, between countries and over time. Technological change is likely to change the balance between new and old. Specifically, the transition from purchasing items to renting access.

A number of contributions attempt to calculate depreciation in value of music. Rappaport (1998) estimates that income to composers from non-classical music decays/depreciates at a constant rate of 3.6 %, calculated from the number of recordings of works still in the market. Landes and Posner (2003) make an estimation similar in method as that of Rappaport. They find (continuous time) depreciation rates of copyrighted works in general. They assume constant depreciation for a given work, but separate between different cohorts of works. (Depreciation is specific to each cohort/vintage.) Works from 1962 have depreciated with a rate of 5.4 % per year up until 1990. Works from 1886 depreciated with a rate of 12.2 % per year up until 1914. For all other measurement years between 1910 and 2000, the rate falls in between these with an average of 8.3 %. An overall finding is that depreciation rates are falling over time (lower for later cohorts).

PriceWaterhouseCoopers (2006) utilises data from Phonographic Performance Limited (UK) along with undocumented methods to calculate cultural depreciation.[45] They find the annual depreciation in value of sales *"to be around -3 % on average for the majors, and around -20 % for some of the independents whose catalogue mainly consists of relatively new titles."* CIPIL (2006) assumes a constant rate of depreciation of 6 % from a "plausible range" of 3-9 %. This range is based on PriceWaterhouseCoopers (2006). Pollock (2009) assumes a constant rate of 5 % from a "plausible range" of 2-9 %. This is in turn based on CIPIL (2006).

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[45] According to CIPIL (2006) PWC uses a constant rate of depreciation.

This makes up a series of contributions that make assumptions based on methods that are undocumented, or at least which I have not been able to find.

Liebowitz (2007) makes an attempt to estimate the depreciation of the value of music recordings. Based on a set of assumptions and simple methods, he makes estimates of the value of old recordings relative to the value they had when they were new, e.g.: *"... a sound recording first created in the 1950s generates sales in 2004 that are 13 % of the sales that existed in an average year from the decade of the 1950s. Similarly, the 2004 sales of* [a] *recording from the 1960s represent 30 % of the sales that occurred in a typical year in the 1960s."* His calculated rates cannot be used directly for purposes of predicting future revenues of a recording, as they are an aggregate of cultural depreciation and historic growth in the total market. No generalisation can be drawn from these numbers without further assumptions on how growth affects different cohorts of recordings.

Soloveichik (2010) builds on an unpublished "preliminary and incomplete" work (Soloveichik, 2009). She seems to have the most robust methods of calculation I have come across, and finds that *"More than half of all album sales occur in the first quarter after an album is released, and only 13% of album sales occur more than one year after release. Because a popular song can be re-released on compilation albums, the lifespan for songs is slightly longer than the lifespan for a particular album. However, compilations account for only 12% of CD sales on average. In addition, many compilation albums are released within five years of the original song release. Therefore, the vast majority of sales revenue occurs within the first two years after a song is released on CD."* In a different paragraph she writes *"According to both datasets, more than 75% of CD sales occur in the first year after a song is released."* The difference between the 75 % and the (100 %-13 %=) 87 % mentioned above is presumably the difference between *within the same calendar year* and *within one year from date of release*.[46] Soloveichik only reports combined depreciation profiles on the aggregate value of concerts, licensing and recorded music. She calculates discrete time depreciation rates, and finds that first-year depreciation is at 50 %. Depreciation then slows, and stabilises

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[46] I believe she has no more exact release date than the quarter of the year.

at around 4 %.[47] She notes that she uses two geometric curves added together to match the observed patterns.

Waldfogel (2012b) and Aguiar, Duch-Brown, and Waldfogel (2015) also contribute to this literature. They wish to study the quality (market value) of each vintage. For this end, they must take depreciation into account. Their dependent variable is the share of recordings sold/played in a given year that are of a given vintage. When they use shares instead of levels as the dependent variable, they implicitly assume that changes in sales value (e.g. due to market growth or unlicensed file sharing) will affect all vintages of music in the same proportion. They must make this assumption because they want full flexibility (using dummy variables for each year) for the age effect and the cohort/vintage effect. That means no variation remains to study period effects.[48] Their assumption might be reasonable for their purpose, but it is worth noting that it is the opposite of what can be presumed to be the implicit assumption made by Liebowitz (2007): variation in sales levels only affect new recordings. What Waldfogel (2012b) and Aguiar et al. (2015) interpret as differences in inherent quality of vintages, Landes and Posner (2003) would interpret as differences in depreciation schedule, something which can be understood as a period-specific effect.

Technological change may well have altered the rates of cultural depreciation as a consequence of new technology, new models of payment and possible changes in the patterns of listening among consumers. Traditionally, most recordings have become unavailable (other than second hand) after not too long, as record stores had to clear the shelves to make room for new releases. With digitisation, old recordings have become more easily available. Hammond (2014) claims that the majority of an album's sales occurs by the end of the second week following its release. Soloveichik (2009) finds that more than half of all album sales occur in the first quarter after release.

Schneider and Gros (2019) finds that the longevity of albums in sales charts in USA, UK, Germany and the Netherlands is decreasing over time. Albums increasingly debut at the number 1 spot, and they rapidly fall out of the chart. The trend is strong from the mid-nineties onwards. One may speculate that digitisation increased information and availability, so that

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[47] These numbers are calculated based on net present value, net of some costs, not based on current sales as others have done. As her topic is capital assets, she is interested in the depreciating stock rather than the depreciating revenue stream.

[48] Full flexibility in all of the three: age, cohort and period leads to perfect multicollinearity.

novelties increasingly reached everyone at once, and fatigue with the same works also reached everyone at once. Thus, presence in charts can be more widely distributed even if distribution of total sales throughout the period has not change at all. This implies an increasing cultural depreciation, at least for music that is fresh enough to be on the charts. The results give no indication on how the development might affect distribution between *new* music and *catalogue* music divided by the conventional 18 month limit.

Interestingly, Schneider and Gros (2019) also find the rapid descend from the charts are strongly counteracted by including streaming numbers into calculation of the charts. I.e. Streaming appears to *reduce* cultural depreciation.

With subscriptions, rights holders receive income each time the record is played. Revenues continue to drip in for decades, in many cases long after the composers and performers are dead. Thus, the per-use model of royalty payment leads to a permanent lag in revenues to rights holders. This is true even if patterns of listening are unchanged by the technological shift. Adding to this is the probability that many consumers will listen more to old music when "all" old music is suddenly available to them. These are three separate consequences of digitisation and streaming: (1) availability, (2) payment over time and (3) easier sampling and discovery with streaming. The first two surely contribute to lower rates of cultural depreciation, making catalogues of old content more valuable. The third effect may very well add to the other two. One of the few that have emphasised the effect of increased longevity of catalogue music due to the payment-per-play remuneration is Pedersen (2018).

5.9 Characteristics of demand for subscription services

This chapter has reviewed theories, and some empirics, that are relevant in understanding the drivers behind demand for streaming services, and also the consequences of a transition to such. The remaining section of this chapter will sum up some of what has been written above, and prepare for some of the upcoming chapters.

We do not know many details on listening habits in the days of unit sales. We only know what people purchased. Listening might well have been more concentrated than sales, and possibly the other way around. In the day of streaming services, listening habits are registered in every detail, but precious little is publicly known and nothing is aggregated across competing

services. We know nothing about willingness to pay, except whether or not people subscribe. It is therefore very difficult to compare consumer behaviour across the business models. We can only compare revenue distribution, and that is subject to goodwill from the services.

People that listen to a lot of music will have stronger incentives to subscribe to services than those that only listen every now and then. As mentioned in section 4.4.3, the early adopters were surely avid listeners and the late-comers presumably less so. This effect may however be offset by individual preferences adapting to the new format, so that each consumer stream more in 2020 than they themselves did five years prior. The effects would be straightforward to disentangle if I had access to the data, but I do not.

Information plays a critical, but somewhat ambiguous role, to the consequences of streaming. The internet provides accessible information one can *search* for, and streaming services provide easy access for *experience.* Both imply less market power to well-known artists. Subscription services such as Spotify will tell you which songs by an artist have been replayed the most, and these songs are most easily accessible. This is a strong public signal of quality. Although streaming services make the most popular songs most accessible, the difference might have been even bigger twenty years ago, when brick and mortar record shops would mostly stock the popular albums, and the most popular songs were released as singles. Thus, the information about and the accessibility of both the mainstream and the fringes are enhanced by digitisation in general and subscriptions in particular. My guess is that information will make revenues to rights holders *less* concentrated, all other things being equal. Information is one of several factors that may affect concentration of demand. I have no means to evaluate the impact, and through the rest of the thesis, I will not discuss information much. In chapter 9, information serves as one of several possible explanations of the assumptions I make on concentration of demand.

Subscriptions are well suited for consumers that have a broad interest in music. Subscriptions facilitate that consumers may adopt broader patterns of listening than they used to have. The extent to which consumers individually listen to variety of different music is conceptually different from the extent to which consumers listen to the same music. The superstar phenomenon is most closely related to the latter of these. Consumers may increasingly listen to the same music even if each and every one listen to a greater variety than before. This clustering around the same superstars might be stronger in a global perspective than for each national market. As Mark Mulligan (2017) argues, late adopters of subscription services may

be more mainstream in their listening habits than the early adopters, something that may lead to increasingly concentrated listening patterns. This is a third factor that may contribute to listening being increasingly concentrated through subscription services, but it is really an artefact of *the fallacy of composition.* In chapter 9, I will disentangle the various factors and evaluate the effect each may have on the distribution of surplus.

The transition from sales to subscriptions implies that the units the rights holders get paid for are not durable, they are a single replays. That means that repeated listening leads to repeated payment. Music that lends itself well to repeated listening will thus gain from the transition to subscriptions. The mathematical model in chapter 9 incorporates this, and differences is replayability is assumed in section 9.7.

As this chapter has shown, there are a lot of unanswered questions concerning the demand for music subscription services. I will return to an analysis of the implications of different assumptions on demand in chapter 9. Before we get there, I will study who the early adopters were, and how demand for subscriptions relate to demand for other formats of music carriers. That will be the topic of the next two chapters.

6 Who are the music consumers?

This chapter explores the characteristics of consumers of music subscriptions and other formats of music. I will look at various descriptive statistics to see basic structures of consumption habits. A cluster analysis serves to see if and how respondents can be grouped. This hopefully contributes to the discussion around omnivores that was referred in section 5.4. The survey date employed have some questions on attitudes, and I will see how attitudes vary between pirates, music subscribers and the total sample.

As the survey where the data comes from was conducted in November 2013, this was the late beginning of streaming services in the Netherlands, and the subscribers identified will be relatively early adopters. Presumably, the characteristics of music subscribers have since moved towards the population means as adoption has become more widespread. The chapter may hopefully, along with chapter 7, provide useful information on consumers to industry stakeholders as well as academic researchers.

6.1 The data

The data that has been made available to me, come from a choice experiment on the Dutch Longitudinal Internet Studies for the Social Sciences (LISS) panel. The panel consists of a representative sample of the Dutch population (including those without Internet connection). The questions used here were incorporated into the monthly questionnaire of November 2013. The sample was comprised of all 6216 active panel members at the time aged 16 years or older. The participation rate was 79.9 % (4986 respondents), and 4858 respondents (78.2 %) completed the survey questions (completion rate: 78.2 %; incomplete: 1.7 %). I have used most of the incomplete observations, so the sample utilised here consist of 4967 respondents. The data have previously been utilised by C. Handke, Balazs, and Vallbé (2015) and Vallbé, Bodó, Quintais, and Handke (2019). For further documentation of the data, refer any of those two papers. For more information on the LISS panel, refer CentERdata (2014).

The panel was asked to report their media consumption habits. They were asked questions on the amount and frequency of purchases on various offline and online, legal free (ad-supported), subscription based and pay-per-use as well as illegal content distribution channels

for music, audiovisual content and books. I also employ the background data that include socio-economic background variables.[49]

We have five products/formats of music consumption. *Physical* includes music on physical formats such as CDs and vinyl. *Downloads* represents iTunes-type paid downloads. *Free* represents free but legal online download or streaming services such as YouTube. *Pirate* is illegal downloads. Finally *Subscription* is paid subscription services such as Spotify, Deezer and Apple Music. For each product there are two questions: one on the amount consumed and one on the time of last consumption/acquisition.

Respondents have chosen an option from those given in Table 2. The respondents are asked: *When did you last…*

- *…purchase a CD or LP in a store or webstore?*
- *…purchase music as paid downloads via services like iTunes?*
- *…listen to music or download via a paid, legal online service such as Spotify premium or Deezer?*
- *…listen to music or download via a free, legal online service such as Spotify, YouTube or webradio?*
- *…download music via illegal services*

Table 2: Categories for time since purchase/consumption

1	2	3	4	5	6	7	8
Less than a week ago	A week to a mo.	1 mo. to 3 mos.	3 mos. to 6 mos	6 mos. to 1 year	More than a year ago	I have never acquired music this way	I do not remember

These variables are included in the cluster analysis below and the factor analysis in the next chapter. The main emphasis, however, lies on the *amount* variables below, and the time variables serve as useful support.

For the first four goods, physical, downloads, free and pirated, the data include a measure of the amount consumed: The respondents are asked: *How many music tracks have you, in the preceding year, acquired through…*

- *… buying a CD or LP in a store or online store?*
- *… buying music as paid downloads via services such as iTunes?*

- *... downloading or listening to music via legal, free online services?*
- *... downloading music through illegal services?*

Answers are grouped into the following table:

Table 3: bins of consumption

Option	0	1	2	3	4	5
Value implied	I have never acquired music this way	x<10	10<x<50	50<x<100	100<x<200	200<x

Consumption of subscription services are not measured in this question. Instead, respondents are asked: "*How much has your household spent per month for paid, online (subscription) services (such as Spotify Premium or Deezer)?*" The replies to the question indicate that quite a few people have not understood the question correctly or they have accidentally missed or added a zero. Some respondents report to pay as much as € 350 per month.[50]

There are questions concerning the consumption of books and film that correspond to those for music. These variables are used in some of the analyses below.

The above-mentioned variables are treated as interval-level variables. I tried to treat them as ordinal and applied ordered logistic regressions. That did not do much in terms of explanatory power, it mostly just make the analyses below more difficult to carry out and the results more difficult to interpret and communicate. Converting them into a range of binary variables would likewise make tables too long and results more complicated to interpret and communicate. Furthermore, the score test for the proportional odds assumption is significant. That implies that the model is too restrictive. Using a more general multinomial logit model, specifically a two-way latent variable model with a range of ordinal regressors, will produce too many coefficients for easy interpretation.[51] Thus, it is most tractable, and appears to be

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[50] One would expect most respondents to type either 0 or 10 euros, but that is not the case. I am not able to make perfect sense of the responses. One would also expect people that pay € 20 or more per month for music subscriptions to use their subscriptions daily, or at least weekly. But out of the 51 respondents who claim to pay € 20 or more, 21 claim not to have used such services within the last month and 7 claim not to have used it within the last year. Some of these may have a partner or children that subscribe.

[51] One could alternatively apply some representative value of each bin as an approximate value on a ratio scale. I have no prior opinion on the functional form of the variable dependencies: they may as well be linear in the options as in the (latent) variable or its logarithm. Any linear analysis will be based on an unjustified, but hopefully unimportant, assumption of linearity.

appropriate, to treat the variables as being at interval-level and use standard procedures for linear regressions and, in the next chapter, cluster analysis and factor analysis.

I use the *amount* variable for the four formats where this is available. I make a binary variable for music subscribers from the corresponding time-variable. Those that tick 1 or 2 (those that have listened to music through a service in the last month) are considered «subscribers», the others are not. This variable is used in most contexts below, unless otherwise noted. There might be a source of error in this: the question does not specify that the respondents have streamed music to their own devices through their own actions. In theory, it is enough that they have been present at a party or in a café where such services have been in use.[52]

The dataset includes some measures on attitudes towards various statements concerning supply of and remuneration for music.

Attitudes

Respondents are asked six questions on their attitudes towards issues related to copyright and production and distribution of music. The response is the level of agreement from 1 (I completely disagree) to 7 (I completely agree). The middle value is 4 (I neither agree nor disagree). It was also possible to tick 8 (I do not know).

Statement 1:

- I do not consider it a problem that works protected by copyright are copied without direct compensation for the creators and/or rights holders.

Statement 2:

- Unlicensed copying undermines the supply of new creative works.

Statement 3:

- All internet users must contribute to the financing of creative works that are available on the internet.

Statement 4:

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[52] There is no reason to believe this is a big problem. 41 respondents state that it is less than a year since they did *listen to music or download via a paid, legal online service such as Spotify premium or Deezer*, while at the same time stating they have not paid anything.(Another 75state they paid € 0.01 per month.)

- I am worried that copyright is a question that leads to social divisions.

Statement 5:

- I am worried that I, or people that I know, will be punished for unlawful use of material protected by copyright.

Statement 6:

- I am worried that the enforcement of copyright in the Netherlands will become stricter.

The attitude towards statement 1 is a general attitude on the issue of piracy, and it encompasses notions of fairness as well as economic efficiency, and long term supply. Statement 2 is not as much an opinion as a *belief* on how the world works. Respondents weigh in on the discussion on the supply effect of piracy. If they believe in the effect, and care about new works, they may support the statement out of pure rational self-interest. Statement 3 concerns the willingness to pay through an alternative copyright compensation system. For very heavy users it might possibly be the opposite: a wish for others to pay for *my* consumption. Statement 4 is on a wish for social harmony. They might want *a* solution more a *specific* outcome. Statement 5 concerns the fear of personal consequences. Statement 6 must be understood of the very lax enforcement of copyright in the Netherlands in 2013. So *stricter* might not imply very draconian, but more sustainable.

Background variables

As part of the LISS panel background data, respondents have been asked about their personal gross and net monthly income. I use monthly personal net income as our variable (measured in €1000 to get fewer digits).[53] One respondent report a gross, monthly income of €212 766,-. Although this may possibly be correct, it is an obvious outlier that may distort results, and I insert a «missing» value instead. I also use the income categories in some places.

Level of education is asked for and given in six categories: primary; preparatory middle-level vocational education (VMBO); higher general continued education/ preparatory scholarly education (HAVO/VWO); middle-level applied education (MBO); higher professional

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[53] If they do not report income in the open question, income is asked again in terms of categories. For each income category a mean income is calculated among those that have reported precise income. This mean value is imputed for all respondents in the same category that lack an exact measure. Thus a partially imputed continuous variable is obtained.

education (HBO) and scientific education (WO).[54] This is the level of education completed, but it should be noted that the primary category does not necessarily imply the completion of any specific level of education.

The background variables also include sex and marital status of the respondents.

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[54] Translations from English language Wikipedia: https://en.wikipedia.org/wiki/Education_in_the_Netherlands

Table 4: Descriptive statistics of the *amount of consumption* variables

	N	Mean	Median	Std. dev.	Never 0)	X < 10 1)	10 < X < 50 2)	50 < X < 100 3)	100 < X < 200 4)	200 < X 5)
Amount variables										
Music, physical	4967	0.75	1	0.89	2258	2023	472	139	38	37
Music, download	4967	0.24	0	0.65	4150	574	153	54	22	14
Music, free	4967	0.99	0	1.44	2629	1244	387	261	129	317
Music, pirate	4967	0.53	0	1.19	3789	555	201	160	98	164
Film, physical	4967	0.74	0	1.01	2674	1360	617	209	66	41
Film, download	4967	0.16	0	0.60	4510	268	99	49	21	20
Film, paid rental	4967	0.21	0	0.75	4462	244	117	63	36	45
Film, Video On Demand	4967	0.48	0	1.09	3853	490	286	146	74	118
Film, pirate	4967	0.54	0	1.32	4066	243	168	137	92	261
Book, physical	4967	1.47	1	1.31	1514	1068	1400	600	267	118
Book, download	4967	0.20	0	0.66	4423	21	151	86	23	13
Book, paid rental	4967	0.06	0	0.37	4820	80	26	26	11	4
Book, pirate	4967	0.30	0	1.03	4441	162	102	70	36	156

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Table 5: Descriptive statistics of the *time since consumption* variables

	N	Mean	Median	Std. dev.	1) Less than a week	2) A week to a month	3) 1 month to 3 months	4) 3 months to 6 months	5) 6 months to 1 year	6) More than a year	7) I have never acquired music this way	8) I do not remember
												Frequency of responses
Time variables												
Music, physical	4967	5.51	6	1.58	157	140	182	169	351	1715	832	458
Music, download	4967	6.51	7	1.30	104	72	91	96	107	352	3687	410
Music, free	4967	4.57	6	2.65	1208	402	255	152	149	180	2276	345
Music, pirate	4966	6.32	7	1.79	279	140	139	116	121	388	3253	530
Music, subscription	4967	6.30	7	1.76	349	70	72	62	66	156	3782	410
Film, physical	4938	5.64	6	1.72	163	169	288	275	371	1029	1796	847
Film, download	4937	6.67	7	1.16	96	52	56	62	55	138	4095	383
Film, paid rental	4938	6.60	7	1.32	145	60	69	57	53	122	4054	378
Film, Video On Demand	4937	6.05	7	1.90	327	174	160	137	133	184	3469	353
Film, pirate	4937	6.20	7	1.83	311	154	120	85	67	165	3662	373
Book, physical	4934	4.28	4	2.04	469	604	661	474	516	730	830	650
Book, download	4934	6.65	7	1.12	51	58	112	84	86	154	4034	355
Book, paid rental	4934	6.90	7	0.65	24	17	25	18	26	38	4440	346
Book, pirate	4934	6.64	7	1.17	70	64	103	77	83	130	4077	330

Responses of *I do not remember* are recoded as *more than a year ago* for the purpose of analysis. The measure of subscribers I use throughout, also in connection with the "amount" variables, is a dummy constructed by the sum or response=1 and response=2 in Table 5. That adds up to 419 subscribers,

Table 6: Descriptive statistics of the demographic variables

	N	Mean	Median	Std. dev.	Min	Max
Age	4967	51.3	53	17.7	16	93
Net income (€1000 monthly)	4709	1.42	1.35	1.05	0	14
Sex (f=0; m=1)	4967	0.47	0	0.50	0	1
Marital status						
Partner	4967	0.75	1	0.43	0	1
Married	4967	0.58	1	0.49	0	1
Separated	4967	0.005	0	0.07	0	1
Divorced	4967	0.09	0	0.28	0	1
Widowed	4967	0.06	0	0.23	0	1
Educational categories						
Primary	4967	0.09	0	0.29	0	1
VMBO	4967	0.25	0	0.43	0	1
MBO	4967	0.23	0	0.42	0	1
HAVO/VWO	4967	0.11	0	0.31	0	1
HBO	4967	0.23	0	0.42	0	1
WO	4967	0.09	0	0.28	0	1

The means of the binary variables are the share of respondents in the category.

Table 7: Descriptive statistics of the attitudinal variables

	N	Mean	Median	Std. dev.	1) I completely disagree	2) I disagree	3) I disagree somewhat	4) I neither agree nor disagree	5) A agree somewhat	6) I agree	7) I completely agree	8) I do not know
Attitude variables												
Copying not a problem	4915	3.49	3	1.78	524	875	534	794	432	366	260	1130
Supply undermined	4915	4.18	4	1.89	440	448	301	702	583	748	366	1327
All should contribute	4915	3.24	3	1.94	1024	675	266	686	453	399	208	1204
Copyright might be divisive	4915	3.21	3	1.73	671	639	251	856	306	220	123	1849
Fear of punishment	4915	2.79	2	1.75	1091	849	243	675	289	185	127	1456
Worry about enforcement	4915	3.74	4	1.83	516	548	238	895	479	422	233	1584

Responses of 8) – *I do not know*, are treated as missing in all analyses, and they are *not* included in calculations of mean, median and standard deviations.

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6.2 First exploration of music consumption

We start by getting an overview of the patterns of consumption by looking at some bivariate distributions. There are differences between age groups. The pattern is the same for all formats, although weaker for physical recordings: consumption is decreasing by each age group, as can be seen from Table 8 and Figure 21.[55]

Table 8: Mean values of response on consumption variables, per age group

	N	Physical	Downloads	Free	Piracy	Subscription (binary)[56]
Pooled	4967	0.75	0.24	0.99	0.53	0.08
15-24	528	0.83	0.41	2.45	1.82	0.17
25-34	485	0.91	0.44	1.72	0.94	0.14
35-44	697	0.82	0.37	1.22	0.62	0.11
45-54	879	0.89	0.29	0.96	0.43	0.09
55-64	1050	0.75	0.14	0.65	0.26	0.05
65+	1328	0.52	0.09	0.30	0.12	0.04
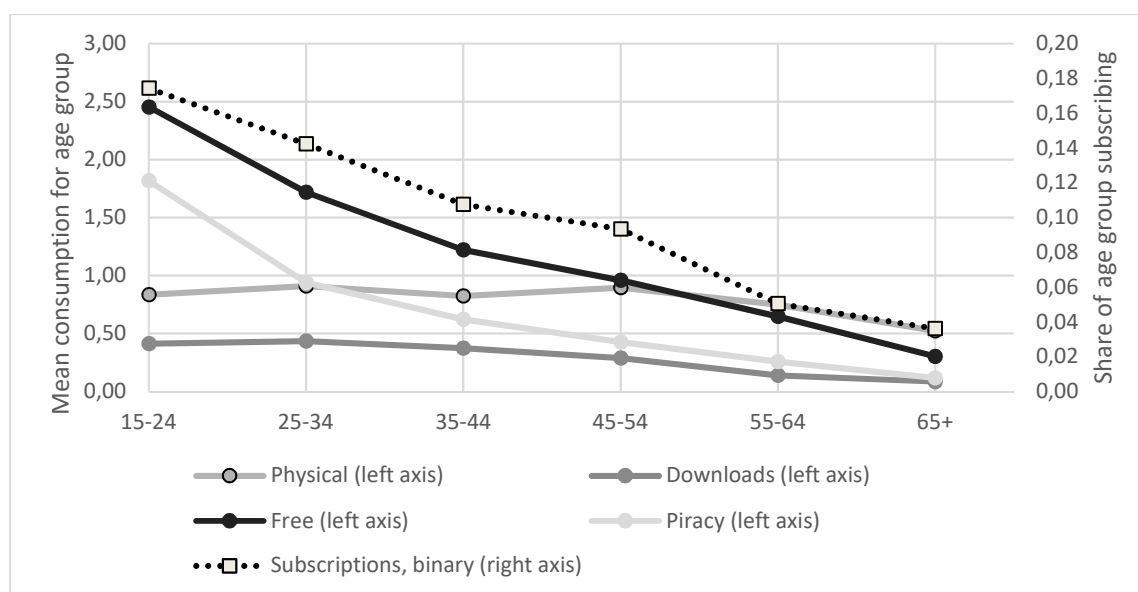
Figure 21: Consumption by age and format. Mean values of consumption variables, per age group

It is also interesting to study how consumption relates to levels of net monthly income. As can be read from Table 9, and seen more clearly from Figure 22, consumption of all formats

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[55] It should be noted that the average age in the sample is higher than in the Dutch population. 73 percent of the sample is aged 40 or older, 57 percent 50 or older. Average age is 51 years. According to data from the OECD, the percentage of the population above 15 that was also above 40, was 63 percent in 2013. Younger people are over-represented among the non-respondents.

[56] As subscription is measured by a binary variable, the mean is the share of group members that subscribe.

increases more or less smoothly from the 501-1000-category up to 3001-3500-category. Surprisingly, this also goes for free and pirated music, although the increase is somewhat less steep than for paid alternatives.

Table 9: Mean values of response on consumption variables, per level of income

	N	Physical	Downloads	Free	Piracy	Subscriptions - binary
No income	554	0.70	0.27	1.62	1.05	0.13
<€500	266	0.74	0.25	1.57	0.96	0.11
€501-€1000	871	0.61	0.17	0.70	0.37	0.06
€1001-1500	931	0.68	0.18	0.78	0.37	0.06
€1501-2000	979	0.78	0.25	0.93	0.48	0.07
€2001-2500	593	0.88	0.26	0.98	0.58	0.10
€2501-3000	255	1.02	0.39	1.01	0.50	0.10
€3001-3500	115	1.11	0.41	1.11	0.56	0.17
€3501-4000	60	0.72	0.57	0.85	0.27	0.12
€4001-4500	17	1.06	0.35	0.71	0.47	0.18
€4501-5000	14	1.43	1.21	0.71	0.43	0.07
€5000-7500	17	0.88	0.29	1.35	0.06	0.12
€7500<	11	1.45	0.55	0.82	0.55	0.27
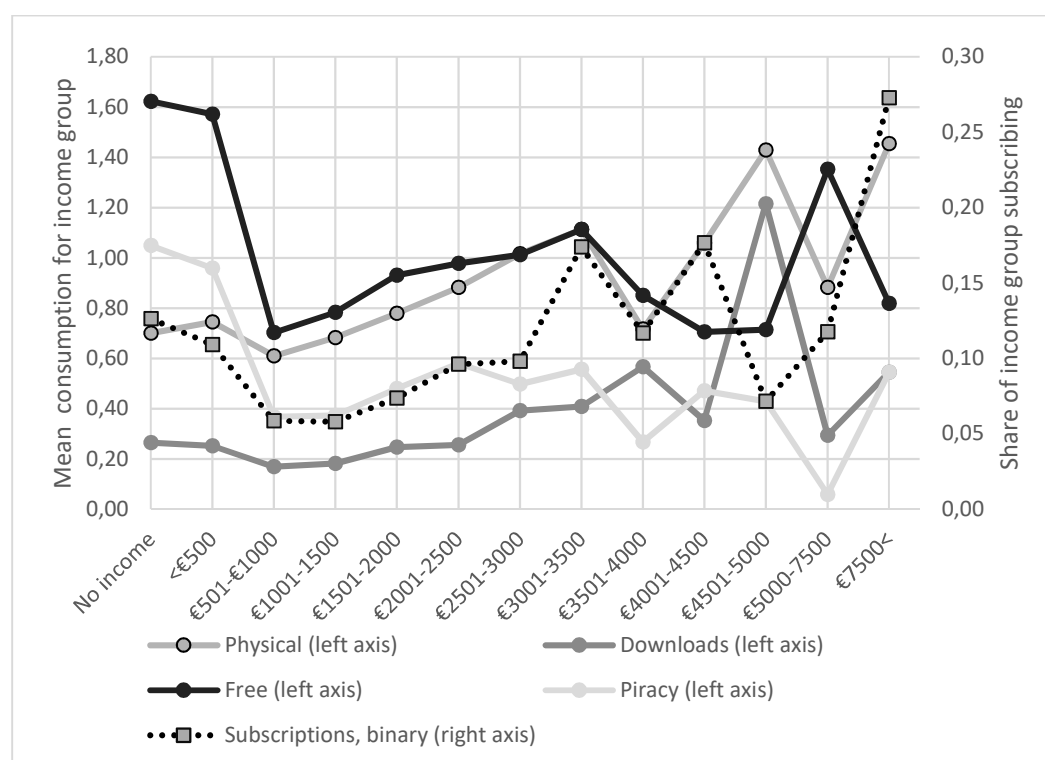
Figure 22: Consumption by format and level of income.

Those with very high income are few, and thus random variation dominates the sample. It is difficult to conclude on anything concerning the consumption patterns of the rich. More interestingly, consumption among those with no or very low income is surprisingly high, in particular the free alternatives are very popular. It turns out that this has to do with age: young

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people without proper income consume music, and largely the free alternatives. In Figure 23 the same figure is drawn only including respondents aged 35-44. The upper income categories are excluded as they all have only a single digit number of respondents. As we can see, the poor now behave more according to expectations. Even the free alternatives are less used among the poor than among those with higher income levels. Free still constitute a larger share of consumption, although those without income (N=47) appear not to pirate. Put simply: The poor consume less of all, least of the costly alternatives.
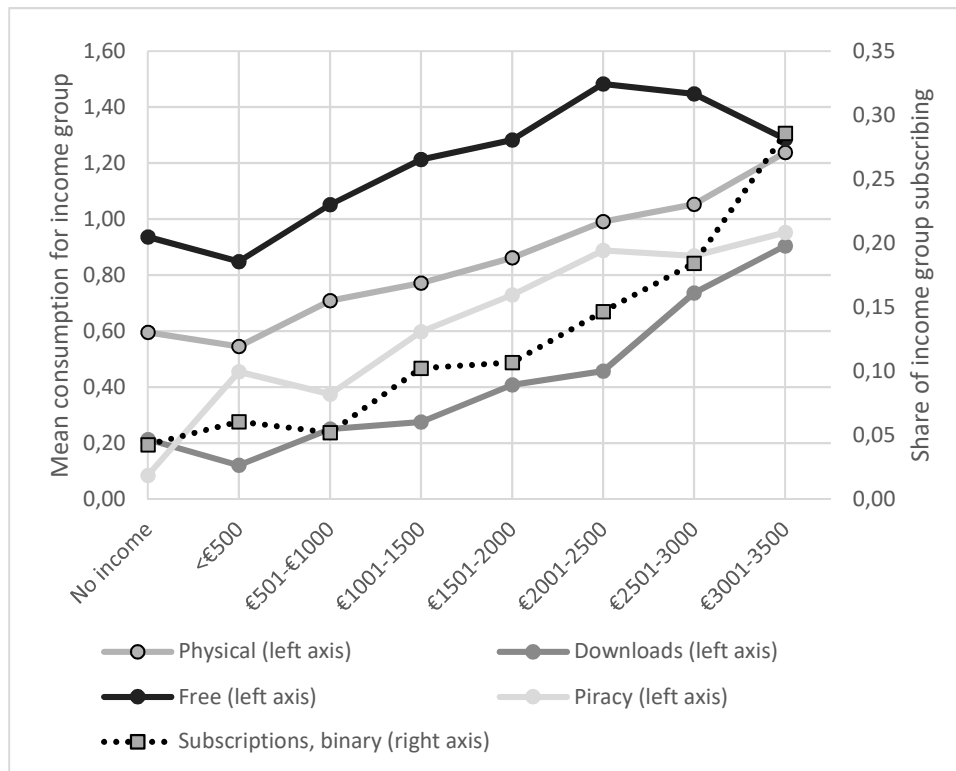
Figure 23: Consumption by format and level of income among those aged 35-44.

6.3 What characterises subscribers?

I wish to study what characteristics the subscribers have. Table 10 gives us the mean value of the product variables and the long list of control variables separately for the subscribers and the non-subscribers. We also conduct a Wilcoxon-Mann-Whitney test to see if the distributions are unequal. This test is suitable when variables are not normally distributed. The test is suitable for both continuous and ordinal variables (including binary variables).

Subscribers have a higher mean value for all variables that measure the amount of consumption. They have a lower mean value on all the *time since last acquisition* variables. They consume more music, more books and more films through any mode available. Non-subscribers are on average more than ten years older than subscribers are. The age distributions are shown in Figure 24. At first sight, educational categories do not reveal a clear pattern, but this is due to how they are ordered. Dutch children that aim for a university degree will typically follow a path after primary: *VWO->WO*. Music subscribers belong to this path with significantly higher probability than the non-subscribers do. None of the attitude variables are significantly different between subscribers and non-subscribers, which is surprising.
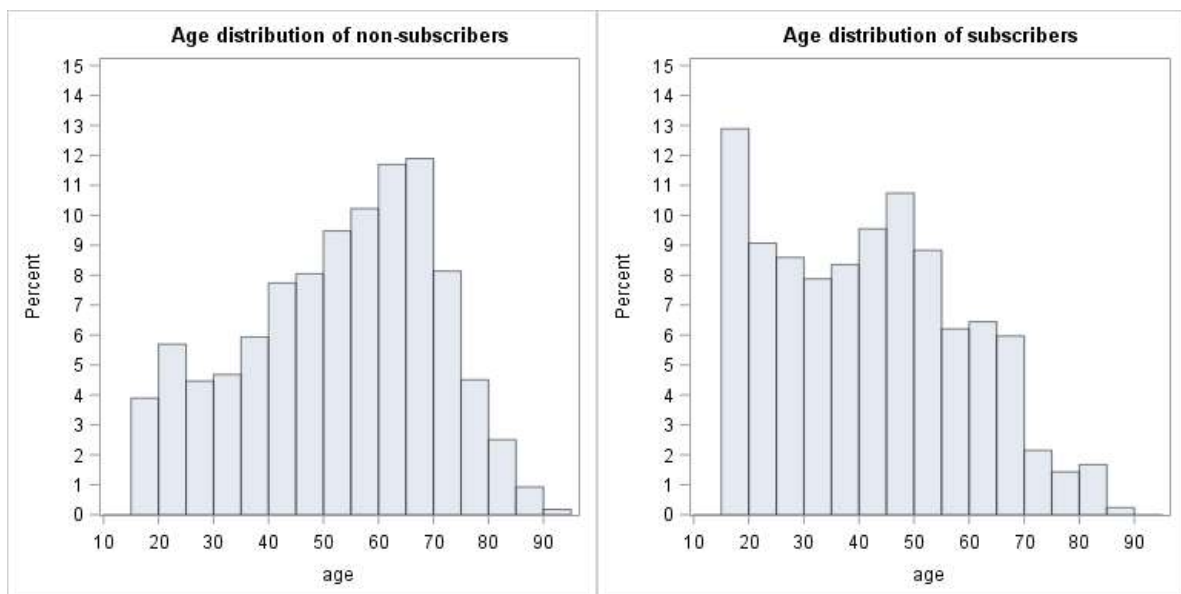
Figure 24: Age distribution of non-subscribers (left) and subscribers (right).

Table 10: Mean of variables, difference between subscribers and non-subscribers

		No subscription (N=4548)			Subscription (N=419)			
		N	Mean	Std dev	N	Mean	Std dev	Pr>|Z|
Amount var.								
Music	Physical	4548	0.73	0.88	419	0.97*	0.93	<.0001
	Download	4548	0.19	0.58	419	0.77*	1.04	<.0001
	Free	4548	0.84	1.31	419	2.54*	1.82	<.0001
	Pirate	4548	0.49	1.16	419	1.05*	1.43	<.0001
Film	Physical	4548	0.72	1.00	419	1.00*	1.08	<.0001
	Download	4548	0.13	0.54	419	0.50*	0.99	<.0001
	Paid rental	4548	0.17	0.66	419	0.66*	1.29	<.0001
	VOD	4548	0.43	1.05	419	0.98*	1.40	<.0001
	Pirate	4548	0.48	1.26	419	1.18*	1.78	<.0001
Books	Physical	4548	1.45	1.30	419	1.78*	1.32	<.0001
	Download	4548	0.18	0.62	419	0.42*	0.93	<.0001
	Paid rental	4548	0.04	0.34	419	0.17*	0.56	<.0001
	Pirate	4548	0.28	0.99	419	0.58*	1.32	<.0001
Time var.								
Music	Physical	4548	5.69*	1.30	419	5.15	1.73	<.0001
	Download	4548	6.59*	1.02	419	5.14	2.26	<.0001
	Subscription	4548	6.74*	0.70	419	1.17	0.37	<.0001
	Free	4548	4.91*	2.51	419	2.12	2.00	<.0001
	Pirate	4547	6.22*	1.58	419	4.89	2.33	<.0001
Film	Physical	4524	5.76*	1.53	414	5.04	1.85	<.0001
	Download	4523	6.70*	0.95	414	5.74	2.07	<.0001
	Paid rental	4524	6.64*	1.11	414	5.56	2.24	<.0001
	VOD	4523	6.15*	1.74	414	4.94	2.39	<.0001
	Pirate	4523	6.29*	1.64	414	5.02	2.44	<.0001
Books	Physical	4521	4.56*	1.98	413	3.91	2.01	<.0001
	Download	4521	6.64*	1.01	413	6.10	1.69	<.0001
	Paid rental	4521	6.87*	0.55	413	6.49	1.36	<.0001
	Pirate	4521	6.64*	1.05	413	6.06	1.78	<.0001
Demographics	Sex (f=0; m=1)	4548	0.46	0.50	419	0.54*	0.50	0.001
	Age	4548	52.2*	17.48	419	41.4	17.38	<.0001
	Net income (€1000 monthly)	4313	1419	1016	396	1480	1326	0.790
	Partner	4548	0.75	0.43	419	0.77	0.42	0.297
	Married	4548	0.59*	0.49	419	0.45	0.50	<.0001
	Separated	4548	0.00	0.07	419	0.01	0.08	0.473
	Divorced	4548	0.09	0.28	419	0.07	0.25	0.144
	Widowed	4548	0.06*	0.24	419	0.02	0.15	0.001
	Primary	4548	0.09	0.28	419	0.12*	0.32	0.039
	VMBO	4548	0.26*	0.44	419	0.15	0.35	<.0001
	MBO	4548	0.23	0.42	419	0.24	0.43	0.532
	HAVO/VWO	4548	0.11	0.31	419	0.16*	0.36	0.002
	HBO	4548	0.23	0.42	419	0.22	0.41	0.678
	WO	4548	0.08	0.27	419	0.12*	0.32	0.009
Attitudes	Copying not a problem	3421	3.51	1.79	364	3.39	1.75	0.217
	Supply undermined	3232	4.19	1.89	356	4.09	1.91	0.314
	All should contribute	3361	3.23	1.94	350	3.38	1.95	0.141
	Copyright might be divisive	2757	3.21	1.73	309	3.21	1.80	0.954
	Fear of punishment	3112	2.80	1.76	347	2.77	1.66	0.815
	Worry about enforcement	2996	3.76	1.83	335	3.59	1.83	0.103

Significantly higher values (5 percent level) have an asterisk

6.4 Types of consumers – cluster analysis

It is interesting to see if consumers can be grouped into "types" through a cluster analysis of consumption behaviour. Vallbé et al. (2019) do a cluster analysis on these same data. I follow a procedure that I believe is very similar to theirs, and results are very similar. The criteria for cleaning data are not identical to theirs, and results are not identical. It must be emphasised that the clusters are not robust to changes in methods or variable definitions, and do not survive imputation of missing values.[57] Furthermore, the evaluation criteria presented in Figure 25 are not very conclusive. In this analysis, I employ the interval level expenditure variable for subscriptions, not the binary variable.

We employ the standard Euclidean distance metric, hierarchical agglomerative clustering and minimise within-cluster variance through the Ward minimum variance method. According to SAS documentation, trimming off outliers is highly recommended when employing the Ward method. I have not trimmed outliers, however. The amount of trimming is rather arbitrary and it is difficult to know if it is saddle regions between clusters or true outliers that are removed. Furthermore, trimming made results less easy to interpret, something that is an important purpose with pragmatic, exploratory methods such as cluster analysis.

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[57] Examples of changes that change cluster structure: Standardisation of variables; trimming outliers; introducing a binary variable for subscribers; recoding "I do not remember" on the time-variables as "More than a year ago" instead of treating them as missing, to add circa 2000 observations to the analysis.
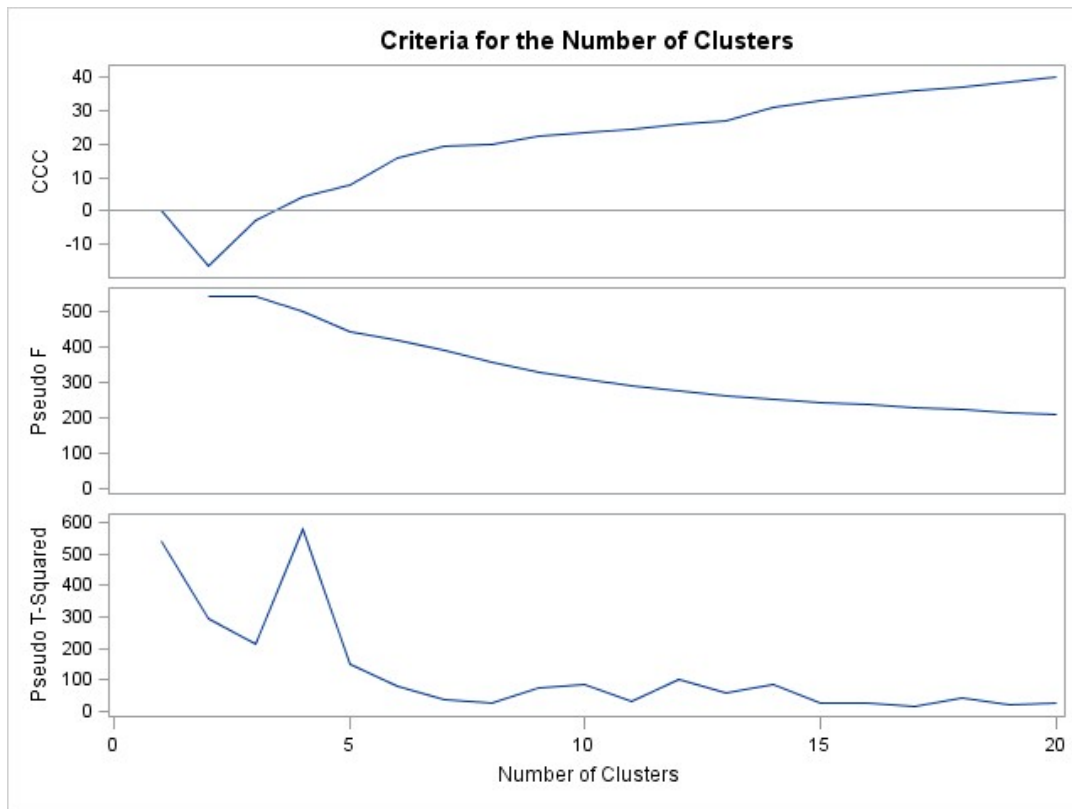
Figure 25: Cubic Clustering Criterion, pseudo F statistic and pseudo T-squared criterion.

The Cubic Clustering criterion seems to give weak indications towards 6,7,9 or 14 clusters. The pseudo F statistic indicates three clusters while the pseudo T-squared criterion indicates strongly that five is an optimal number of clusters and gives weaker indication towards 11 and 15 clusters (McCarthy, 2007). As T-squared criterion gives the most clear-cut indication, I will initially go with five clusters. Cluster numbers tell us how far along the tree one must go before the cluster splits. If we wanted to include six clusters, we know that the next split of a cluster would be within *The rest (Occasional)* as this is numbered as CL5. We would have to include 24 clusters for the *Non-consumers* to split into two clusters, so this is a clear cluster. Those consuming a lot will tend to ha *high* values on the amount variables, and *low* value on the time variables, as the latter is a measure of *time since last consumption.*

Table 11: Cluster means of variables when respondents are sorted into five clusters.

High numbers have a dark background. Colour codes implemented on a row-by-row basis

	Non-consumers	Bookworms/traditional	The rest (Occasional)	Pirates	Heavy users
Cluster	CL23	CL12	CL5	CL11	CL8
Frequency	691	627	987	368	142
Amount variables					
Music					
Physical	0.46	1.22	1.21	1.21	1.42
Download	0.04	0.15	0.33	0.42	1.09
Subscription (expenditure)	0.02	0.04	0.19	0.29	10.77
Free	0.07	0.07	1.67	2.08	2.89
Pirate	0.04	0.12	0.30	2.69	1.28
Film					
Physical	0.27	0.91	1.20	1.33	1.54
Download	0.02	0.03	0.25	0.24	0.70
Paid rental	0.01	0.02	0.32	0.37	1.06
Video On Demand (VOD)	0.07	0.14	0.79	0.68	1.36
Pirate	0.02	0.06	0.19	3.06	1.43
Book					
Physical	0.59	2.38	1.95	2.00	2.09
Download	0.01	0.29	0.26	0.35	0.61
Paid rental	0.01	0.00	0.06	0.16	0.26
Pirate	0.01	0.07	0.35	1.11	0.68
Time variables					
Music					
Physical	6.51	5.06	5.25	5.53	5.01
Download	6.95	6.74	6.36	6.41	5.11
Subscription (expenditure)	6.98	6.83	6.39	6.30	1.86
Free	6.90	6.93	2.75	2.71	2.13
Pirate	6.96	6.87	6.53	3.28	5.12
Film					
Physical	6.68	5.52	5.16	5.25	4.60
Download	6.96	6.95	6.50	6.68	5.50
Paid rental	6.98	6.95	6.39	6.46	5.15
Video On Demand (VOD)	6.92	6.78	5.46	5.94	4.56
Pirate	6.98	6.93	6.70	2.89	4.94
Book					
Physical	6.33	2.94	3.78	3.98	3.40
Download	6.99	6.54	6.58	6.48	5.96
Paid rental	6.99	6.99	6.85	6.81	6.42
Pirate	6.99	6.93	6.61	5.71	6.05

As can be seen from Table 11, we interpret the five clusters as non-consumers; bookworms/traditional; occasional consumers; pirates and heavy users. The clusters are similar to those found in Vallbé et al. (2019). The non-consumers consume least of everything. They have high scores in the time-related variables, indicating their last consumption took place a long time ago. They have the lowest scores in all the amount-related variables.

The *bookworm/traditional* consume little, and what they consume is mostly physical goods. In particular, they have a high consumption of physical books. The channel/medium of consumption is arguably more defining for this group than the love of books.

The third group, *occasional consumers*, is the largest of the five. They have consumption levels close to the average and have no clear defining characteristics.

The fourth numerical column reports the scores for the *pirates*. They have a high score of pirated copies of music, film and books. Other than that, they are quite average.

The last cluster consists of *heavy users*. Consumers in this group, on average, consume more through all channels except piracy and of all products except physical books. This is true whether measured by amounts consumed or by *time since last consumption/acquisition.* Vallbé et al. (2019) instead identify the cluster *digital.* This is in part due to somewhat different results, but in part due to different interpretation of very similar results. While heavy users consume more in general, it is for the digital formats they really stand out from the crowd.

The hierarchy reveals that non-consumers and traditionalists are the two most closely related clusters. If we reduce it to only three clusters, pirates and the occasional users will also be merged into one. The topmost division is into traditionalists and non-consumers on the one hand and pirates, occasional consumers and heavy users on the other.

There was a certain indication both from the Cubic Clustering Criterion and the T-squared criterion that 11 clusters might be a meaningful number. As we have used hierarchical clustering, we can readily expand the table to accommodate eleven, as is done in Table 12. The non-consumers, the pirates and the traditional/bookworms are the same as with five clusters. The heavy users will now be divided into two groups and the occasional consumers into six.

when respondents are sorted into eleven clusters.

CL4		CL2								
		CL3							Heavy users - CL8	
		The rest (Occasional) - CL5						Pirates		
		CL9			CL6					
			CL10			CL7				
Non-consumers	Bookworms/ traditional	Moderate free-riders	Occasional, physical	Literary pirates	Cable-TV-viewers	Frequent users	Rent and download		Collectors	Listeners
CL23	CL12	CL34	CL14	CL47	CL13	CL37	CL30	CL11	CL27	CL17
691	627	60	535	60	228	23	81	368	88	54
0.46	1.22	1.17	1.27	1.07	1.16	1.35	1.09	1.21	1.45	1.37
0.04	0.15	0.75	0.24	0.23	0.19	1.48	0.68	0.42	0.95	1.31
0.02	0.04	1.86	0.03	0.05	0.14	0.92	0.11	0.29	10.40	11.37
0.07	0.07	2.62	1.86	1.02	1.23	1.57	1.46	2.08	2.57	3.43
0.04	0.12	0.65	0.19	0.42	0.26	1.57	0.40	2.69	0.47	2.61
0.27	0.91	0.90	1.15	0.73	1.34	1.70	1.62	1.33	1.48	1.65
0.02	0.03	0.25	0.07	0.12	0.22	1.70	1.14	0.24	0.33	1.30
0.01	0.02	0.18	0.06	0.08	0.07	2.13	2.44	0.37	0.66	1.72
0.07	0.14	0.23	0.08	0.62	2.39	1.61	1.30	0.68	1.01	1.93
0.02	0.06	0.20	0.09	0.12	0.17	1.96	0.48	3.06	0.38	3.15
0.59	2.38	1.63	2.02	1.72	2.00	1.70	1.81	2.00	2.19	1.93
0.01	0.29	0.17	0.19	0.25	0.18	1.00	0.74	0.35	0.39	0.98
0.01	0.00	0.03	0.02	0.05	0.04	0.91	0.21	0.16	0.07	0.57
0.01	0.07	0.28	0.06	3.95	0.03	1.30	0.31	1.11	0.19	1.48
6.51	5.06	5.30	5.26	5.93	5.38	2.22	5.16	5.53	5.09	4.89
6.95	6.74	5.32	6.57	6.62	6.73	1.70	5.88	6.41	5.27	4.83
6.98	6.83	1.77	6.93	6.73	6.64	2.39	6.42	6.30	1.76	2.02
6.90	6.93	1.53	2.13	4.52	3.82	1.52	3.80	2.71	2.39	1.72
6.96	6.87	5.38	6.83	6.50	6.66	1.78	6.38	3.28	6.40	3.04
6.68	5.52	5.50	5.34	5.98	5.00	2.70	4.22	5.25	4.86	4.17
6.96	6.95	6.55	6.92	6.70	6.62	1.57	4.57	6.68	6.20	4.35
6.98	6.95	6.68	6.94	6.90	6.88	1.57	2.11	6.46	5.93	3.87
6.92	6.78	6.73	6.90	6.03	2.15	2.39	4.78	5.94	5.19	3.52
6.98	6.93	6.77	6.92	6.92	6.73	1.48	6.40	2.89	6.52	2.37
6.33	2.94	4.45	3.69	4.32	3.70	2.39	4.07	3.98	3.41	3.39
6.99	6.54	6.82	6.71	6.62	6.75	3.43	5.93	6.48	6.40	5.24

In Table 12 we have tried to put names on eleven clusters. As can be seen, the clusters are not everywhere easily interpretable. In particular, it is not easy to see why the *frequent users* are a subsample of *occasional consumers* and not of *heavy users.* The distinction between *collectors of tangibles* and *users* is far from clear-cut. It is also worth noting that *listeners* are as eager pirates as the *pirates* are, and that *frequent users* are more *frequent* pirates than the *pirates* are, but they score less on the amount pirated. *Pirates* are characterised by not consuming much of the non-pirate formats. They also mostly pirate music and film, while the *literary pirates* take care of pirating books. The evaluation criteria do not point towards these clusters as strong or obvious, but this is *one* way of clustering the consumers, and it is a way that makes some sense. It is interesting to note that the distinctions between the possible categories "music listeners", "film viewers" and "book readers" are few and weak. Mostly, those who consume one of the categories tend to consume all. The distinctions are stronger along choice of format than along media.

6.4.1 Conclusions from cluster analysis

The most important take-away from the cluster analyses is that consumers *do not* fit neatly into distinct clusters. This might in part be due to the discrete nature of most of the variables. It is also possible that consumers do not deviate a lot from a multivariate unimodal distribution, and that there thus are few real clusters. The one group that stands out from the rest throughout the variants of analyses attempted, is that of the non-consumers. The heavy users also tend to get a separate cluster, while "pirates" and "bookworms" are ephemeral. Even the one relatively strong cluster of non-consumers varies quite a lot in how many observations belong to it.

The hierarchy appears to confirm the findings of Savage et al. (2005): at this level, *univores* is not an important group, neither for media (music, film, books) nor for formats. The main distinction is between those that consume music, film and books on the one hand, and those that do not consume much of anything on the other. There is somewhat stronger evidence for *technological univores:* there are clusters that lean strongly towards physical formats only and towards piracy only, but this varies a lot between the different cluster analyses attempted.

7 Substitutability of formats

In this chapter, the aim is to shed light on the relation between the consumption levels of different formats. In section 5.3 we reviewed literature that has previously explored to what extent such products and services replace other products and services. This is my contribution, and I pay particular attention to music subscription services.

We only have one observation on each respondent and no information on how they would respond to a change in relative price. Thus, it is not possible to estimate substitutability in terms of cross-price elasticity. However, if substitutability is strong, we expect people to consume *either* one format, or another. The question of substitutability is closely related to that of omnivorousness which was discussed in the previous chapter. An important difference is that omnivorousness only cares about correlation while substitutability cares about causality. Individual consumers are likely to vary a lot in their individual taste for music: some listen a lot to music and spend a lot of money on it. Others spend very little. There will therefore be a positive correlation that is not due to complementarity, but due to a common cause. If one could perfectly control for individual heterogeneity, which is mostly unobserved, a negative relation would imply *substitutability* and a positive relation *complementarity.* Without such control, a negative relation still implies substitutability while a positive result is ambiguous, as substitutability can only be underestimated and complementarity only exaggerated by the omitted variable bias.

There is no logical hierarchy between the product variables. All the products are endogenous in the sense that they all depend on the (not directly measured) interest in music and culture and on prices of all the different goods (through the income effect and the substitution effect), and directly on the amount of other goods if they are complements or substitutes.

Still, I dare assume that subscription services are different. A subscription is more likely to affect an individual's acquisition of the other products than the other way around. The subscription gives immediate access to a wide variety of recordings, old and new. The extra utility of buying a recording that you already have access to is presumably considerably smaller than if you have no access. On the other hand, the number of records/albums/tracks bought in the previous six months is not likely to strongly affect the decision of subscribing or not. What *may* affect the decision is how large your collection of music already is. If your collection is large, and your interest in acquiring new music is moderate, a subscription is not

very useful. In other words, the *stock* of music in your possession may affect the subscription decision while the *flow* of new acquisitions will not.[58] For this reason, I will not have subscriptions as a dependent variable in the analyses that follow.

I wish to test if acquisition/consumption of music through one format will affect acquisition of the other formats negatively, i.e. if they are substitutes. There are two issues associated with regressing one product variable on the others: First, the unobserved heterogeneity of the individuals' interest in music gives rise to an *omitted variable bias*. Second, we have an endogeneity problem stemming from the possibly reversed causation. I will attempt to take account of the unobserved heterogeneity/omitted variable bias through constructing a measure of *taste for music*. The reversed causality is of less concern: As long as we assume the mutual effects to be of the same direction, we can still draw conclusions on the qualitative question: are the formats complements or substitutes.

7.1 The data

The data used are the same as in the previous chapter. Those that responded that they *do not remember* when they last time acquired/used a good through the different formats have to this point been treated as missing. From now on, they are recoded to *more than a year ago*, in order not to lose too many observations. Furthermore, there are two batteries of questions that have not been mentioned above, namely five questions at the end of the form that concern the evaluation of the survey. The five questions are:

- Evaluation 1: Did you find it difficult to answer the questions?
- Evaluation 2: Did you find the questions clear?
- Evaluation 3: Did the questionnaire make you think?
- Evaluation 4: Did you find the topic interesting?
- Evaluation 5: Did you enjoy filling out the questions?

Each question has response alternatives from 1 to 5 where 1 is *definitely not* and 5 is *definitely.* All of these correlate significantly with all modes of music consumption. Furthermore, they correlate in the same directions: Every mode of consumption correlate

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[58] The *stock* is the result of previous *flows*, and there may be a positive correlation between them. However, that is far from certain. Older people will tend to have a larger collection while the young are the most active buyers. Even when controlling for age, there might be decreasing returns to variety resulting in stock possibly having a negative effect on flow.

negatively with responses to the first question. Every mode correlate positively with responses to the four others.

Table 13: Correlation between consumption amounts and survey evaluation

	Subscription	Physical	Download	Free	Pirate
Evaluation 1	-0.04**	-0.05***	-0.06***	-0.07***	-0.11***
Evaluation 2	0.05***	0.07***	0.05***	0.09***	0.08***
Evaluation 3	0.04***	0.12***	0.07***	0.13***	0.12***
Evaluation 4	0.09***	0.15***	0.11***	0.20***	0.21***
Evaluation 5	0.06***	0.07***	0.05***	0.10***	0.12***

: Significant at the 5% level; *: Significant at the 1 percent level.

7.2 Correlated consumption

Table 14 shows the correlations between the consumption of all formats. Due to the high number of observations (N=4967), all correlations are strongly significant. They are all reported as $P(X > r|\rho = 0) < .0001$. If the goods are substitutes, this property is overshadowed by unobserved heterogeneity: Some people are more interested in music than others, and such interest affects consumption of all modes of consumption positively. Unfortunately, we have no measure for *interest in music.* Subscriptions correlate considerably less with physical than with digital formats.

Table 14: Spearman correlations between consumption/acquisition of the various goods.

	Physical	Downloads	Free	Pirated	Subscription
Physical	1	0.24	0.22	0.12	0.07
Download	0.24	1	0.27	0.20	0.25
Free	0.22	0.27	1	0.34	0.33
Pirated	0.12	0.20	0.34	1	0.13
Subscription	0.07	0.25	0.33	0.13	1

When dividing the data into the age categories 15-24, 25-34, 35-44, 45-54, 55-64, 65+, the strong correlation mostly remains. All correlations are positive within all age groups, most of them significantly so. When dividing the data along educational categories: HAVO/VW, HBO, MBO, primary, VMBO and WO, almost all correlations are positive. The only exceptions are within the group with highest education and involving subscriptions on the one hand and physical and piracy on the other, but these negative correlations are very weak and very far from significant. Table 23 and Table 24 documenting these trivariate analyses can be found in the appendix.

In the next sections of this chapter, I will control for other variables and attempt to solve the endogeneity issues. Two strategies will be presented: Two-stage least squares with instrumental variables and generating a measure of "*taste for variety*" through factor analysis.

7.3 Handling missing and *don't know*

There are a number of observations in the dataset that have missing values on one or more variables. The attitude variables have a lot of responses of *I do not know.* We have 4967 observations with complete data on the amount variables of music consumption. All the attitudinal variables have more than 1000 responses of *I do not know* (refer Table 7). Apparently, people in general do not have strong opinions on these questions, and they find it difficult to form an opinion when asked. In addition to the *don't knows,* many respondents respond with "4" – they neither agree nor disagree. Furthermore, many respondents simply tick the same box on all questions. While ticking "4" on all attitudes is a legit response, it appears erratic to agree with all statements or to disagree with all statements. Respondents that respond with all "4", all "1" and so on, are hereby termed "Yahtzee-people", inspired by the game you want to win by getting the same value on all of the dice.

Respondents are divided into three groups for comparison

> 1: Those with one or more *don't know* responses (including all *don't know*) (N=2399)
> 2: Those with all *identical* responses (Yahtzee) (N=198)
> 3: Those with a *complete* set of *opinions* on the matters. (N=2318)[59]

In addition, 52 observations have a missing value on *all* attitudes. It is useful to briefly look at the differences between the three groups. Those with *don't know* responses acquire less music through all methods, they are on average almost five years older than those with complete responses, they are less educated and 60 percent of them are women, compared to 45 percent among the complete observations. The Yahtzee-people consume somewhat less than those with coherent opinions, but much more than those with missing. They are 1.5 years older than those with complete, they are less educated even than those in the 'missing'-group and 58 percent are women. This provides a lesson on both the conduct of questionnaires and the interpretation of results when questions asked are difficult for respondents to relate to. The

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[59] I.e. some *responses* are deemed erratic (Yahtzee), and not *opinions.*

respondents with a complete set of opinions constitute less than half of all responses (47 percent of net sample, 37 percent of gross sample.)

Arguably, the *don't knows* could have been treated as responses of 4 – *I neither agree nor disagree*, but that is not exactly the same thing. For the purpose of analyses below, I will treat *do not know* as a missing value, and not as an *opinion.* In the following, all observations with complete *opinions* are included (if not been removed for other reasons not related to attitudes), as is the group of all "4"-respondents, but not other Yahtzee-people. Valid responses to each individual attitude are also included, even if the battery of responses is incomplete. 82 observations are left out due to erratic Yahtzee, 832 are left out because all attitude responses were *don't know,* and 52 are left out because they have all missing values. We are left with 2318 observations that have complete information of all five music consumption variables and valid opinions 6 attitudinal variables.

There are four possible strategies in this situation.

a) Listwise deletion: One may include only the 2318 complete observations when computing the correlation matrix, which is default in the FACTOR procedure in SAS.
b) Pairwise deletion: One can produce a correlation matrix from the data we have, implying some correlations are based on 4965 observations, others on as little as 2839. This is the default in the CORR procedure in SAS.
c) Imputation of values: One may impute missing values.
d) Estimation of covariance matrix: One may estimate the covariance matrix through maximum likelihood estimation.

Pairwise deletion is preferable to listwise deletion as long as we are not interested in the standard errors of the covariances (Statistics Solutions, not dated). Both listwise and pairwise deletion have the drawback of producing biased covariance estimates whenever values are not missing at random. If the amount of missing values is large, deletion is also at the expense of the power

Multiple imputation and maximum likelihood build on similar assumptions, and both perform better than deletion or conventional, single imputation. Maximum likelihood is more efficient than multiple imputation, and has no random draws and thus no indeterminacy. It is also simpler to use and requires less computational power (Allison, 2012). Maximum likelihood does not impute values for the individual missing values in the original dataset, however. While ordinary least squares regressions can be run based only on a correlation matrix, that

does not seem to be the case for the logistic regressions needed below.[60] A dataset is needed, and therefore imputation.

7.3.1 Imputing values

Multiple imputation (MI) is applied to fill in missing values of the dataset. MI does not estimate each single value. Instead, it draws a random sample of the missing values from its distribution, and one ends up with many datasets where the missing values are completed with different numbers. I generate ten imputations for each observation. Ten imputations is enough for quite efficient estimation of coefficients. Efficient estimation of standard errors would require a much larger number of imputations (Allison, 2012).

Ghosh-Dastidar and Schafer (2003) argues that the imputer should have a model that is less restrictive than the analyst's model. The SAS documentation makes the same argument, and advices to include as many variables as possible when imputing (SAS Support, not dated). I therefore throw in everything I have, including technical variables such as observation ID and the codes for which order the respondent have questions presented. Some of these variables correlate significantly with some of the variables of interest.

The default imputation method in SAS is Markov Chain Monte Carlo. This method assumes that the data are from a multivariate normal distribution. Our data violate that assumption, as variables are skewed and/or multi-topped. But von Hippel (2013) suggests that while imputing skewed variables under a normal model can lead to a bias, this bias is usually mild for popular estimands such as means, standard deviations, covariances and linear regression coefficients. I therefore presume the procedure is acceptable.

All the attitudinal variables have more than 1000 missing values (or *don't know,* which is treated as missing). There are also other variables with considerable amounts of missing values. Most of the variables I complete are strictly speaking on an ordinal scale. But, as discussed in the previous chapter, I treat them as on an interval scale. I therefore also impute them on an interval scale. Proper discrete/ordinal imputation is complicated, and rounding imputed values to whole numbers may distort the balance of the data. Similarly, the imputed data has a range outside of the range of the variables. Bounding the imputed values can produce biased estimates. Wu, Jia, and Enders (2015) find that "*naïve rounding*", forcing

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[60] At least I am not able to figure out how to perform it.

predicted values into the format of the scale of the variables, may make things worse, especially for skewed variables like we have.

The procedure above assumes that the missing observations are *missing at random* (MAR), that is, not missing *completely* at random (MCAR), but for *given values of the other variables*, there should not be a systematic difference between the missing values and the observed values. This is a strong assumption. Missingness is in this case mostly due to responses of *I do not know.* Items are therefore *missing not at random* (MNAR). I do not believe the conditions are met to employ methods for consistent estimation given MNAR, and therefore do not attempt this. Instead, I assume MAR, contrary to my own belief, and handle the assumed non-randomness by making an ad hoc adjustment: I replace the imputed values with the following:

$$x_{i,a} = 4 + 0.5 \times (x_i - 4) = 2 + 0.5x_i$$

where x_i is the imputed value and $x_{i,a}$ is adjusted towards the response of 4 – *I neither agree nor disagree.* Thus, deviation from indifference is reduced. While SAS includes certain options for integral adjustment of estimates, this particular adjustment towards 4 is easier to apply after imputation (Allison, 2014). This ad hoc method implies that *I do not know* is treated as a compromise between missing and indifference (neither agree nor disagree).

As an example of how the imputed values compare to the reported values, one may look at Figure 26. The variable shown is *attitude_copyright_divisive,* the variable with the most missing values. While the reported values are distributed as a discrete variable, the imputed values are distributed as a continuous variable with a minimum value of 0.03 and a maximum of 7.6. This is acceptable, refer to Wu et al. (2015). Furthermore, the imputed values lack the skewness of the reported values. That is also not of great concern, refer to von Hippel (2013). The imputed values have a mean of 3.72 while the reported have a mean of 3.22. This adjustment of mean towards 4 is intended.
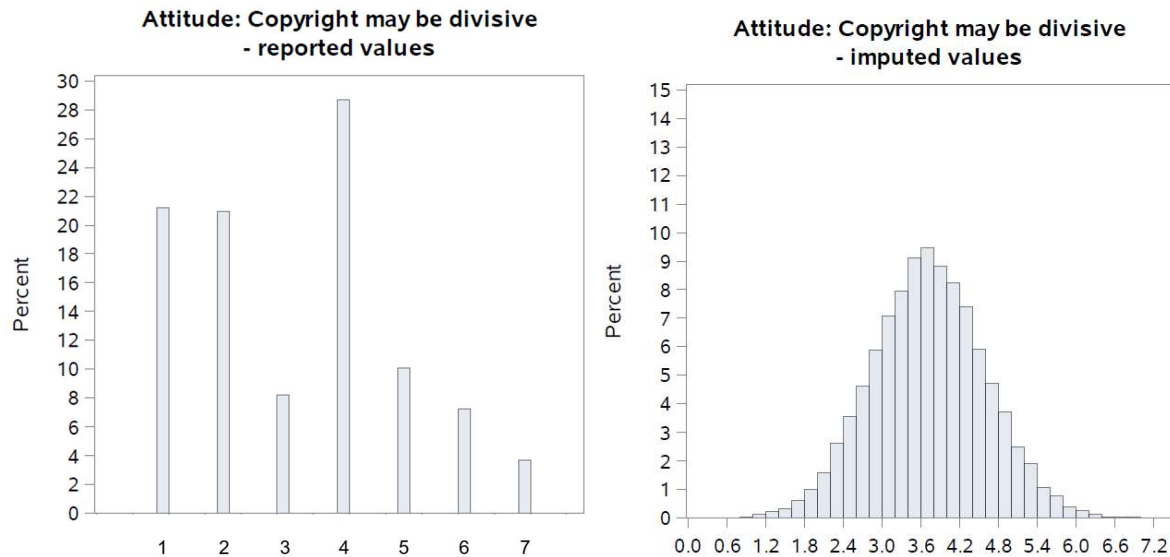
Figure 26: Values of the attitude of copyright divisiveness, *reported and imputed values respectively.*

7.4 Instrumental variables approach

The dataset contains a set of variables that can be used to assemble instruments in the regressions. I construct instruments from the exogenous control variables and the consumption levels and time since consumption of TV/film and books. These should not have a direct effect on the measure of music consumption in question. To give an example: By subtracting paid rental of books from paid downloading of books we can hope to obtain a measure that captures interest in the technology of downloading but leaves out the interest for books or, more generally, the interest in culture. This could be a valid instrument for music downloading in a regression where the consumption of physical recordings is the dependent variable. Such measures are constructed from all combinations of consumption of books and all combinations for consumption of film. When *physical recordings* is the dependent variable in the second stage, all physical formats are excluded from the instruments. When *downloading* is the dependent variable in the second stage, *downloading of books, and downloading of films*. The remaining combinations are too many in the sense that they are linear combinations of each other, so some must be excluded to avoid perfect multicollinearity.

There are more instruments than endogenous variables, so the model is overidentified. The instruments are found to be jointly relevant for all endogenous variables whether physical, downloads or piracy are the dependent variable in the second stage. The exogeneity of the instruments is not easy to test. It may be tested using the Sargan test if some of the

instruments are known to be exogenous, but among the variables at our disposal, the most surely exogenous variables (age, sex, income, education) are already included as control variables in the structural equation. The residuals of the structural equation will therefore by construction not correlate with the exogenous variables, and the Sargan test has no relevance (Wooldridge, 2010, p. 134).

7.4.1 **Two-stage regressions**

Each amount variable is regressed on a suitable subset of the constructed instruments, along with exogenous control variables. In the case of the binary subscription variable, logistic regression is applied. Because of this, we cannot use an automated 2SLS-procedure, but must manually do the regressions in two steps. The predicted values of the first stage are used as regressors in the second stage. Because of this manual procedure, the reported standard errors underestimate the real standard errors. No attempts are made to mend this. The increased uncertainty due to imputation of variables are taken into account, however.

This two-step procedure is conducted separately for each of the ten imputed datasets. The results are then aggregated, and corrected standard errors computed, using the MIANALYSE procedure in SAS. The results are presented alongside results from another method in Table 17, Table 18, and Table 19 below.

7.5 Constructing a proxy for the taste for music

Another approach to addressing the omitted variable bias is to find a proxy for interest in music. In the following, I use the five product variables together a range of other variables in a factor analysis. Factor analysis is based on the covariance matrix (or correlation matrix) of the involved variables and yield factor values for all observations. A factor of *taste for music* is identified and used as a control variable in a regression analysis.

7.5.1 **Choosing tools**

Principal Components Analysis (PCA) and Factor Analysis (FA) are methods that have very much in common, but they work differently and for different purposes. PCA utilises the total variance of the variables, including covariance, unique variance and error variance. FA assumes that the covariation in the observed variables is due to the presence of one or more latent variables (factors) that exert causal influence on these observed variables. Put

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differently, principal components are modelled as dependent variables determined by the observed variables and error terms, while factors are modelled as independent variables that, along with error terms, determine the observed variables. PCA requires no assumptions about the covariance matrix or the existence of a causal structure and is simply a variable reduction technique.[61] FA, on the other hand, usually builds on some hypothesised causal factors. Exactly for which purposes each method is most appropriate is still subject to some controversy. Still, from the above, I decide to use factor analysis.

The first thing to decide when employing factor analysis is the number of factors to extract. This may be decided from theory or from a range of statistics. The number of factors extracted does not affect the basic output of the factor analysis (unrotated factors). It only affects the rotation in the next step. If one plan on not rotating factors, one does not have to decide on the number of factors in advance.

PCA uses the correlation matrix directly to find components. The correlations in the diagonal of the matrix are, as usual, 1. In FA, however, 1 is replaced by the communality of the variable. To estimate this communality, one must input a prior estimate. The SAS procedure PROC FACTOR runs a PCA if no priors are inserted. We choose, somewhat arbitrarily, to use the maximum covariance that a given variable has with any of the other variables as the communality of this variable.

7.5.2 Factor Analysis

There are many variants of factor analysis. The traditional method is to find a number of factors that are either defined from theory (confirmatory factor analysis) or that just reveal themselves from the data to an unprejudiced researcher (exploratory factor analysis). The factors are then rotated in order to get a *simple structure* where each variable should as much as possible be explained by one factor and be minimally related to other factors. Such rotation can be *orthogonal,* implying uncorrelated factors, or *oblique,* implying correlated factors.

The aim of exploratory factor analysis (EFA) is to identify factors based on data and to maximise the amount of variance explained. No prior hypotheses are required. One may have hypotheses on the number and nature of factors, but these do not affect the choice of methods. By contrast, confirmatory factor analysis (CFA) evaluates one's hypotheses and is largely

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[61] SAS Statistics: Principal Component Analysis: *support.sas.com/publishing/pubcat/chaps/55129.pdf*

driven by theory. CFA requires the researcher to hypothesise the number of factors, whether or not these factors are correlated, and how the variables are associated with the different factors. CFA allows for constraining certain loadings to be zero.

Factor analysis is in nature a pragmatic method: the main criterion for judging whether the correct method is chosen is if the factor loadings are interpretable. According to Johnson and Wichern (2007, p. 526), the most important criterion for judging the quality of a factor analysis might be the WOW criterion. It is given as *"If, while scrutinizing the factor analysis, the investigator can shout "Wow, I understand these factors", the application is deemed successful."*

I have tried various methods and different combinations of variables in the analysis, although only one combination is reported here. In the choice of method, I wanted to include a substantial number of variables other than the product variables. My hope is that this will increase the possibility of producing a factor that resembles an "*interest in music*" without absorbing the covariance that might result from substitutability or complementarity, i.e. the direct causal effect. In many cases, it is very difficult to interpret the factors. Whenever they are interpretable, the interpretations vary, especially as I vary which variables are included. It is interesting to note that I am never able to find a factor that resembles interest in music without also representing interest in books and film. I.e., some consume everything, others consume very little. This result is the same as was reported from the cluster analysis in the previous chapter. I am therefore forced to use "*interest in culture*" instead of *interest in music*.

I have ended up excluding the variables of primary interest from the factor analysis, namely the amount of music acquired. This is because including them constructs some new endogeneity issues. The variables included are the five variables of music consumption that are of the form *time since last acquired,* along with the amount variables and time variables for books and film. Included are also the six attitude variables, and the five survey evaluation variables. Subscriptions has a considerably lower variance than the other variables due to its binary form and the, at the time, low adoption rate. This implies that the variable's variation will not have much effect on the total variation if the covariance matrix is used. I therefore use the correlation matrix instead, which is equivalent to using the covariance matrix of standardised variables (Johnson & Wichern, 2007, p. 489).

There is a number of rules of thumb one can use in order to limit the number of factors. Including factors that no variables load significantly upon, is no point. The rule that is called *Kaiser's stopping rule* (also called the *mineigen* criterion) tells us to only include factors with eigenvalues of at least 1. Following that rule gives us four factors.

In line with tradition, I subsequently search for a "simple structure" where each variable, to the greatest possible extent, loads on only one factor. Both orthogonal rotation (varimax) and oblique rotation (promax or biquartimin) tend to yield *less* interpretable results. Suitbert Ertel (Bellmann, 2016; Ertel, 2011, 2013) has developed a method which does not aim for *simple structure* but for *complex structure*: in many situations there is no reason to prefer variables to be explained only by *one* factor. If simple structure is imposed when unsuited, the factor loadings may not be interpretable. That appears to be true for our data.

Ertel's *varimin* rotation is not implemented in SAS. I used the specially developed *Varimin* computer programme[62] to calculate the varimin rotated factor loadings. Unfortunately, these loadings are no more interpretable than the simple structure loadings. But, leaning on the theoretical and empirical investigations of Ertel (2011, 2013) and Bellmann (2016), I find the courage to *not* impose simple structure by simply not rotating at all. Unrotated factor loadings are perfectly interpretable while also retaining the maximum variance explained. As the purpose of rotation is "*ease-of-interpretation*" (Johnson & Wichern, 2007, p. 487), I find no reason to rotate unless the result is easier to interpret. The unrotated factors are orthogonal by construction, and do thus not correlate. Furthermore, as long as factors are unrotated, the number of factors included does not affect the loadings of the first factors, and thus the number of factors included is not important to consider.

The factor analysis is run on the pooled data. Factor scores are calculated for each imputation sequence of the dataset in order to use these in subsequent analysis.

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[62] http://varimin.com/

Table 15: Factor loadings. Highest values are darkest. Most negative values lightest

		Factor1	Factor2	Factor3	Factor4
Amount var.					
Film	Physical	0.35	-0.01	-0.14	-0.17
	Download	0.48	-0.18	0.08	-0.09
	Paid rental	0.47	-0.16	0.07	-0.08
	Video on demand (VOD)	0.35	-0.08	0.02	-0.07
	Pirate	0.44	0.02	0.00	0.28
Books	Physical	0.19	-0.02	-0.20	-0.19
	Download	0.36	-0.12	0.05	-0.12
	Paid rental	0.39	-0.16	0.14	-0.07
	Pirate	0.34	-0.04	0.04	0.16
Time var.					
Music	Physical	-0.30	0.05	0.17	0.36
	Download	-0.52	0.20	-0.03	0.12
	Free	-0.49	0.01	0.18	-0.11
	Pirate	-0.59	0.01	-0.01	-0.45
	Subscription	-0.48	0.14	-0.04	0.02
Film	Physical	-0.38	0.04	0.12	0.20
	Download	-0.51	0.21	-0.09	0.09
	Paid rental	-0.50	0.19	-0.08	0.06
	Video on demand (VOD)	-0.37	0.10	-0.04	0.06
	Pirate	-0.50	0.01	-0.02	-0.26
Books	Physical	-0.22	0.05	0.19	0.21
	Download	-0.40	0.15	-0.07	0.11
	Paid rental	-0.43	0.19	-0.15	0.05
	Pirate	-0.44	0.09	-0.08	-0.15
Other variables					
Attitudes	Copying not a problem	0.11	0.05	0.11	0.32
	Supply undermined	-0.17	-0.02	0.14	-0.33
	All should contribute	-0.06	0.00	0.25	-0.34
	Copyright might be divisive	-0.10	0.05	0.63	-0.13
	Fear of punishment	-0.08	0.04	0.63	-0.05
	Worry about enforcement	0.03	0.10	0.60	0.15
Evaluation	Evaluation 1	-0.21	-0.23	0.04	-0.06
	Evaluation 2	0.26	0.59	-0.06	-0.02
	Evaluation 3	0.30	0.61	0.03	-0.15
	Evaluation 4	0.44	0.72	-0.01	-0.08
	Evaluation 5	0.33	0.77	0.04	-0.06

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When interpreting factors, it is common to only consider factor loadings above some cut-off value. Cut-off values (absolute value) of 0.3 or 0.4 are most common (Osborne, Costello, & Kellow, 2014). For my purposes, pure factors and simple structure is not important. We are mostly concerned about identifying a proxy for taste of music, but also want to be able to present reasonable interpretations of the other factors. I interpret the four factors this way:

Factor 1: Interest in culture
Factor 2: Fondness of the survey
Factor 3: Worry
Factor 4: Inclination towards piracy

Factor 1 captures a general interest in culture, revealed through consumption of music, books and film. As this consumption correlates positively with all but the first of the survey evaluation variables, some of that correlation is captured as well.

Factor 2 serves to differentiate between the evaluation variables and the other variables. As the variables are standardised, the difference is not due to difference in variance. It is because of the correlation pattern. Those that are happy with the survey in some respect, are also happy with it in all respects.

Factor 3 I have given the somewhat peculiar interpretation of *worry*. It loads most strongly on the attitudinal variables, especially those three that begin with *I am worried that…* (refer section 6.1).

Factor 4 captures some aspects of *piracy,* although it should be noted that the *interest in culture* captures more of it. Its strongest loading is on the variable *time passed since they last downloaded music via illegal services.* Among the factors, this is also the one that captures most of the variation in the first attitude variable: *I do not consider it a problem that works protected by copyright are copied without direct compensation for the creators and/or rights holders.* The loading is not very strong, however.

The suitability of the dataset to be subject to factor analysis can be tested in many ways. The correlation matrix should contain several correlations above 0.5, which the present data have. Kaiser's MSA is a summary, for each variable and for all variables together, of how much smaller the partial correlations are, controlling for other variables, than the original correlations. Values of 0.8 or 0.9 are considered good, while MSAs below 0.5 are

unacceptable.[63] None of our scores are unacceptable, and five are above 0.8. The overall measure is 0.71. Refer Table 16.

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[63] Source: SAS documentation on Principal Factor Analysis:
https://support.sas.com/documentation/cdl/en/statug/63347/HTML/default/viewer.htm#statug_factor_sect029.htm

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Overall MSA = 0.71283787

Amount var.		
Film	Physical	0.71
	Download	0.71
	Paid rental	0.68
	Video on demand (VOD)	0.63
	Pirate	0.72
Books	Physical	0.62
	Download	0.58
	Paid rental	0.60
	Pirate	0.63
Time var.		
Music	Physical	0.89
	Download	0.91
	Free	0.92
	Pirate	0.93
	Subscription	0.90
Film	Physical	0.72
	Download	0.73
	Paid rental	0.70
	Video on demand (VOD)	0.65
	Pirate	0.74
Books	Physical	0.64
	Download	0.62
	Paid rental	0.62
	Pirate	0.70
Other variables		
Attitudes	Copying not a problem	0.78
	Supply undermined	0.77
	All should contribute	0.72
	Copyright might be divisive	0.73
	Fear of punishment	0.74
	Worry about enforcement	0.69
Evaluation	Evaluation 1	0.72
	Evaluation 2	0.82
	Evaluation 3	0.79
	Evaluation 4	0.76
	Evaluation 5	0.78

Next, we will use the factor *interest in culture* as a control variable in regressions, in an attempt to avoid the endogeneity problems stemming from unobserved heterogeneity.

7.5.3 Regressions including *interest in culture*

For each imputation of each observation, a value of the factor is calculated. Thus, we have a new variable we can use in the analyses. The results of the regression are reported in Table 17. I have included the same regression with and without the proxy for *interest in music* for easy comparison, and I have done this in succession with *physical*, *download* and *pirate* as dependent variables. Alongside these regressions are presented results from the instrumental variables approach laid out above.

7.6 Results and interpretations

The following tables show results from the instrumental variables approach and the factor analysis approach alongside a regression where no attempt has been made to address the issues of endogeneity. Note that even with all these variables included, R^2 is very low. Also note that the size of the regression coefficient estimate is not a measure of the degree of substitutability or complementarity. The coefficient measures the ratio of exchange between the goods, and it is very imprecise when unexplained variance is large. The method of minimising squared *vertical* distance from the regression line implies that the estimated effect of piracy on physical is very far from the inverse of the estimated effect of physical on piracy. The t-value, on the other hand, which is the regression coefficient divided by the standard error of the coefficient, is symmetric whether piracy is regressed on physical or the other way around.[64] Furthermore, due to how consumption is measured, the regression coefficients cannot be interpreted in terms of units displaced anyway. It is the t-values that tell us how strong the relationships between variables are, and the t-values are thus better measures of substitutability than the regression coefficients are, as long as the number of observations is constant.

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[64] This does not hold when instrumental variables are used in place of the original variables.

Table 17: Regression of acquisition of physical recordings (amount variable) on other variables

Physical	Straight (biased)		Factor approach		Instrumental approach	
	Parameter estimate	t-value	Parameter estimate	t-value	Parameter estimate	t-value
Intercept	0.399	5.86	0.427	6.36	0.342	1.66
Downloads	0.245 ***	12.48	0.143 ***	6.74	0.167	1.27
Free	0.088 ***	8.71	0.066 ***	6.56	0.287 ***	2.77
Piracy	0.016	1.38	-0.044 ***	-3.57	-0.116 ***	-3.19
Subscriber	-0.101 **	-2.21	-0.294 ***	-6.11	-0.921 **	-2.01
Interest in culture	▓	▓	-0.236 ***	-11.87	▓	▓
Sex	0.025	0.92	0.004	0.16	0.048	1.44
Age	-0.001	-1.04	0.001	0.64	0.000	-0.14
Net income (€1000/month)	0.061 ***	4.23	0.064 ***	4.48	0.073 ***	4.17
VMBO	0.101 **	2.2	0.095 **	2.09	0.080	1.54
MBO	0.204 ***	4.32	0.189 ***	4.04	0.182 ***	3.58
HAVO/VWO	0.275 ***	5.13	0.271 ***	5.14	0.214 ***	3.42
HBO	0.367 ***	7.59	0.348 ***	7.28	0.299 ***	5.3
WO	0.325 ***	5.4	0.304 ***	5.12	0.253 ***	3.53
Partner	-0.028	-0.78	-0.025	-0.71	-0.043	-1.07
Married	-0.037	-0.93	-0.041	-1.05	-0.027	-0.56
Separated	-0.309 *	-1.78	-0.353 **	-2.06	-0.215	-1.15
Divorced	-0.030	-0.58	-0.052	-1.01	-0.049	-0.92
Widowed	-0.145 **	-2.21	-0.158 **	-2.45	-0.131 *	-1.92
R²	0.12		0.14		0.07	

Table 17 shows the effect different variables have on the consumption of music in a *physical* form, such as CDs. It should be noted that causation may have opposite direction from that postulated. Although I hope to have solved the issue of unobserved heterogeneity, I have no way of disclosing the direction of causality. The exception is, as noted above, that I assume subscriptions are not much affected by consumption of the other formats. As argued above, I put emphasis on the t-values rather than the coefficients. The factor approach weakens the positive effect of downloads, but it is still strong. The instrumental approach leads to the effect being insignificant. That is not due to a lower estimate, but due to the lower explanatory power of the somewhat weak instruments. *Free music* has a significant effect that does not change much from the straight to the factor approach. The instrumental approach shows a much higher coefficient, although the t-value is lower. Both the factor approach and the instrumental approach manage to produce a negative effect of piracy, and both strengthen the already negative effect of subscriptions. The instrumental approach indicates a stronger negative effect in both cases. None of the control variables changes much between the three

approaches. Again, R^2 is very low. Not much of the variation is explained by the variables (aside from *interest in culture*).

Table 18: Regression of acquisition of paid downloads (amount variable) on other variables

Downloads	Straight (biased)		Factor approach		Instrumental approach	
	Parameter estimate	t-value	Parameter estimate	t-value	Parameter estimate	t-value
intercept	0.077	1.58	0.126	2.8	0.191	1.24
Physical	0.125 ***	12.48	0.064 ***	6.74	0.003	0.07
Free	0.053 ***	7.33	0.016 **	2.31	0.060	0.71
Piracy	0.054 ***	6.63	-0.045 ***	-5.49	-0.082 ***	-3.06
Subscriber	0.393 ***	12.15	0.035	1.08	1.460 ***	5.36
Interest in culture	■■■	■■■	-0.363 ***	-29.02	■■■	■■■
Sex	-0.046 **	-2.38	-0.070 ***	-3.91	0.005	0.22
Age	-0.003 ***	-4.33	0.000	-0.15	-0.004 **	-2.06
Net income (€1000/month)	0.060 ***	5.74	0.058 ***	6.10	0.044 ***	3.55
VMBO	0.039	1.19	0.028	0.91	0.075 **	2.01
MBO	0.029	0.86	0.010	0.31	0.062	1.63
HAVO/VWO	-0.006	-0.17	0.001	0.03	0.047	1.07
HBO	0.006	0.17	-0.009	-0.29	0.075 *	1.94
WO	0.104 **	2.4	0.070 *	1.75	0.155 ***	3.17
Partner	0.021	0.80	0.021	0.87	-0.023	-0.79
Married	0.014	0.5	0.004	0.15	0.007	0.20
Separated	0.163	1.31	0.058	0.5	0.028	0.21
Divorced	-0.010	-0.26	-0.043	-1.26	-0.029	-0.73
Widowed	0.039	0.84	0.007	0.15	0.020	0.41
R^2	0.16		0.28		0.07	

Table 18 shows the effect the different variables have on the consumption of *paid downloads*. The positive effect of the physical format is weakened by the factor approach and eliminated by the instrumental approach. Consumption of free music has a very weak positive effect according to the factor approach. The instrumental approach shows no significant effect, although the parameter estimate is similar to the one from the straight regression. As was the case when physical was the dependent variable, both the factor approach and the instrumental approach reveal a negative effect of piracy. The effect of subscriptions is unclear, as the approaches yield different results. The straight regression indicates a strong positive effect. The factor approach eliminates this, while the instrumental preserves it. No approach indicates that the effect is negative, something one would expect to be the case. As for the control variables, a few things can be noted. The instrumental approach eliminates the already very weak effect of sex, while the factor approach eliminates the very weak effect of age.

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Table 19: Regression of acquisition of pirated recordings (amount variable) on other variables

Pirate	Straight (biased)		Factor approach		Instrumental approach	
	Parameter estimate	t-value	Parameter estimate	t-value	Parameter estimate	t-value
Intercept	1.532	18.58	1.386	18.39	1.454	5.29
Physical	0.025	1.38	-0.059 ***	-3.57	0.254 ***	3.18
Download	0.164 ***	6.63	-0.135 ***	-5.49	-0.098	-0.60
Free	0.126 ***	10.03	0.050 ***	4.30	-0.142	-1.03
Subscriber	-0.016	-0.29	-0.570 ***	-10.32	3.502 ***	7.00
Interest in culture	███████	███████	-0.673 ***	-31.55	███████	███████
Sex	0.448 ***	13.52	0.316 ***	10.35	0.450 ***	9.57
Age	-0.018 ***	-14.76	-0.010 ***	-9.03	-0.019 ***	-5.23
Net income (€1000/month)	-0.072 ***	-4.00	-0.047 ***	-2.87	-0.129 ***	-4.97
VMBO	-0.161 ***	-2.81	-0.145 ***	-2.76	-0.071	-1.09
MBO	-0.193 ***	-3.27	-0.189 ***	-3.51	-0.158 **	-2.35
HAVO/VWO	-0.027	-0.40	-0.010	-0.16	0.036	0.49
HBO	-0.177 ***	-2.92	-0.174 ***	-3.14	-0.089	-1.34
WO	-0.194 **	-2.58	-0.197 ***	-2.86	-0.100	-1.19
Partner	-0.121 ***	-2.68	-0.095 **	-2.30	-0.168 ***	-3.51
Married	-0.178 ***	-3.59	-0.163 ***	-3.60	-0.157 **	-2.57
Separated	-0.330	-1.52	-0.425 **	-2.15	-0.515 **	-2.25
Divorced	-0.161 **	-2.49	-0.199 ***	-3.36	-0.144 **	-2.18
Widowed	-0.056	-0.68	-0.096	-1.29	-0.027	-0.32
R²	**0.24**		**0.37**		**0.22**	

Table 19 shows the effect the variables have on piracy or, as the question was posed, *music downloaded through illegal services*. In this case the two approaches give several cases of estimates that are significant but in opposing directions. The factor approach indicates that both physical recordings and subscriptions come at the expense of piracy, while the instrumental approach indicate that both contribute to piracy, i.e. are complements to piracy.[65] The factor approach indicates that paid downloads also substitute for piracy, while no effect is found from the instrumental variables approach. The factor approach indicate that free music contributes to piracy, while no significant effect is found with the instrumental approach. The

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[65] The parameter estimate of subscriptions is extremely high with the instrumental approach. To some extent, this is also true when physical and downloads are the dependent variables. This must be seen in connection with the first stage logistic regression, which estimates the probability that a person is a subscriber. Subscriptions is in this case no longer a binary variable, but a continuous variable with an estimated mean probability of 8.4%. The group specific mean probability increases from 7% for piracy=0 (the majority of respondents) to 16% for piracy=5. The estimate above tells us that an increase in probability from zero to 100% is associated with an increase in response to piracy of 3.5 steps on the ordinal scale. In contrast, the subscription variable is a binary variable in the *straight* approach and the factor approach.

indication is on the negative side. As for the control variables, not much changes between approaches. As can be seen from the R^2, piracy can be explained to a somewhat larger extent than acquisition of physical and downloads can.

7.7 Methodological reflections

Ngyen et al. (2014) have a measure of taste for music and also use the consumption of online news as an instrument. I have tried something similar, although I had to construct the "taste". Trying to disentangle endogeneity in a cross-sectional analysis like this is very uncertain science. Factors that are likely to affect the consumption of one good is also likely to directly affect most, if not all, of the other goods. Also, even if methods and data are perfect, substitutability between goods may change over time due to evolving preferences, and the results from a cross-section may reveal results that are surprising to observers of what has been going on in the music markets for the past few decades. It is therefore likely limited what substitutability at a given point in time can tell us about the future of markets.

I am somewhat more confident that the instrumental variables approach gives unbiased results than that the factor analysis approach does the same. The instrumental variable approach is well-tested and well understood. I believe my instruments are valid, although somewhat weak. I therefore trust that method most. The utilisation of factor analysis to construct a "taste for music" or "interest in culture" is, to my knowledge, novel. The results that emerge from the method are not very robust to changes in which variables are included in the construct. The conduct of any factor analysis depends on the investigator's judgement of interpretable results, and my judgment may have been poor. It is also possible that the method is not well suited, indeed, that might be why it has not been used before.

7.8 Conclusions

The present analysis shows that those who consume music in some format, tend to consume it in other formats as well. It also shows that those who consume music also tend to consume books and films. This tendency of some people to consume a lot of many different goods translates as an unobserved heterogeneity where some people are more interested in culture than others. This unobserved heterogeneity is an obstacle to the analysis of substitutability. I have utilised two different approaches in an attempt to overcome this obstacle. Previous studies that have looked at the relations between the consumption of different formats of

music have come out with somewhat contradicting results. The impact of consumption of one format on another may come out positive or negative. 5.3 above provides a review of literature. With the present analysis, I have added to that literature.

The results from Table 17 indicate that paid downloads and free music both are complements to physical recordings, while piracy and subscriptions are substitutes.

The results from Table 18 indicate that a subscription is a complement to paid downloads. Physical recordings and free music are possibly likewise, while piracy is a substitute.

The results reported in Table 19 are very inconclusive. Downloads might be a substitute to piracy, while free music may be a complement. The results concerning the relation between physical recordings and subscriptions on the one side, and piracy on the other, are contradictory: Each combination has one significantly positive and one significantly negative relationship.

Figure 27 below sums up the findings. Unidirectional arrows imply that causality could go either way, but is assumed symmetric. Only subscriptions are assumed to be exogenous, as argued in the beginning of the chapter. In determining complementarity or substitutability, I have looked at the results from the factor approach and the instrumental approach. As physical, downloads and piracy are both used as dependent and independent variables, there are four relations between these. Results are sometimes ambiguous. If one result is significant complementarity, and another insignificant complementarity (as between downloads and free and between subscriptions and downloads), then I have accepted complementarity. If three results indicate substitutability and one complementarity (as between physical and piracy), I have accepted substitutability. Even more ambiguous results are denoted as *unclear*.
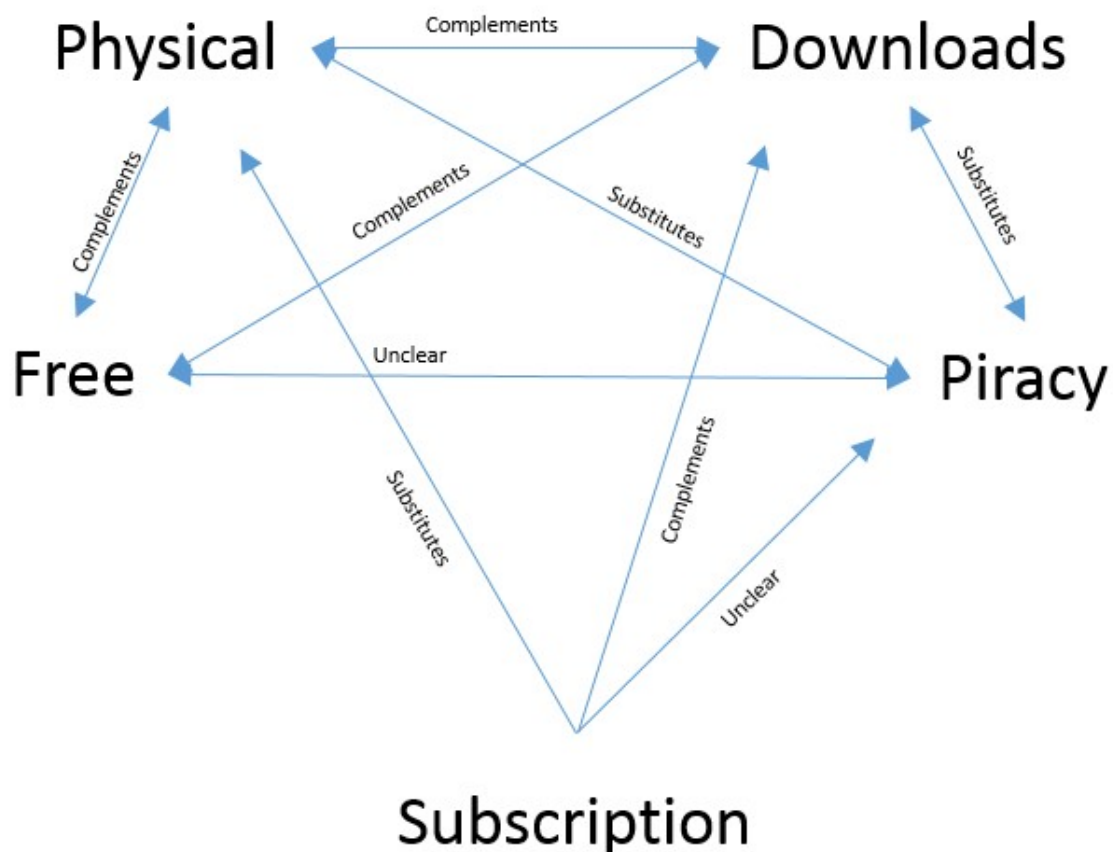
Figure 27: Substitutability between formats

The result that piracy is a substitute to physical recordings and paid downloads is in line with the majority of previous contributions. The result that paid downloads appear to be a complement to the physical format is more surprising. The impact of subscriptions may possibly not be well captured by the present analysis. Subscriptions appear to harm physical recordings, but the effect on piracy is inconsistent and the effect on paid downloads appear to be positive. Casual observation of development over time would seem to invalidate this result. It is possible, however, that there might be complementarities at any given point in time, but that preferences change over time. It is also possible that the estimated complementarity was only present in the Netherlands at a given point in time, and cannot be generalised.

Several papers reach the surprising result that unauthorised sharing of music (piracy) has a more negative (or less positive) effect on physical sales than on online sales (Aguiar and Martens, 2013; Nguyen et al., 2014; Hammond, 2013). I do not find support for that result. Looking at Table 17 and Table 18, this study finds the effect of piracy on physical and downloads to be very similar. Table 19, however, indicates that downloads is more of a substitute to piracy than the physical format is. Given the symmetry I have assumed, that also implies that piracy may substitute more strongly for downloads than for the physical format.

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Research on substitutability of formats has yielded contradictory and sometimes surprising results. This chapter is no exception. One explanation may be that substitutability is not the most relevant concept to grasp development over time. New technology produces new products and services, and preferences may change. Over time, a good may replace a good that individuals perceive as complementary to it. Even if e.g. CDs and subscriptions are moderately complementary to each other, the decreasing availability of CDs may gradually lead consumers towards subscriptions. I discussed such effects in section 5.6.

PART III
Welfare economics – Redistribution and efficiency

8   Welfare economics of music subscriptions

In the next chapters, we will move into the territory of welfare economics. Welfare economics is a branch of *normative economics,* as opposed to positive economics. While positive economics is concerned with predicting how agents will adapt to new circumstances, normative economics is concerned with evaluating the pros and cons of those circumstances. The new circumstances are in our case the new technological conditions for production, distribution and consumption of recorded music. These circumstances affect demand, as well as the industrial organisation of the supply chain. As the positive economics of subscriptions are not well understood, the positive will be discussed throughout, and the normative economics will attach to those discussions.

Welfare is tricky to measure or even conceptualise properly. At the individual level, we may assume that *individual ordinal utility* can be observed from the choices consumers make. It is very much more challenging to measure utility on some *common cardinal scale.* Without a common cardinal scale, the impact that an undertaking has on social welfare cannot be evaluated properly unless it either benefits everyone or harms everyone. So, how can one compare the subjective utility of one individual with that of another? The question has employed economists for centuries, and will not be solved in this thesis. Instead of trying to sum up total social welfare in one number, I will make some simpler discussions of economic efficiency combined with analysis of how costs and benefits are distributed among groups of stakeholders.

In the evaluation in this chapter and the next, no social welfare functions are involved, just an aggregate demand function. To my understanding, this implies that the evaluation will be similar to the principles in *Paretian welfare economics* established by Nicholas Kaldor, John Hicks and Tibor Scitovsky – the various compensation tests. While such tests spring from the desire to avoid making interpersonal comparisons of well-being, they do not accomplish that (Blaug, 2011; Graaff, 1967, pp. 84-90). This framework of evaluation that I use will implicitly, but not explicitly, assume that one unit of currency is worth the same for every agent involved. If I had instead utilised *Pigovian welfare economics,* or something of the same spirit, I might have posited that the time spent on music is a better measure of the utility it gives, than the willingness to pay is. While Pigovian welfare economics may be more

reasonable, at least in some contexts, it is also more complicated. I stick with Paretian welfare economics because it is a conventional choice and a convenient choice.

This chapter will continue by discussing the basics of economic surplus and efficiency, and subsequently move to how efficiency and welfare is affected by the industrial organisation of the markets. Literature on vertically related markets and two-sided markets are reviewed, and the highlights of the literature are tentatively related to the study of music subscriptions. Chapter 9 reviews a few articles on bundling and ownership vs renting. Based on these contributions, a novel model is built, combining the properties of bundles of music with non-durable access to music. The model is used to compare music subscriptions with sales of units of music carriers in terms of the appropriability, deadweight loss distribution of revenues between popular and less popular rights holders.

8.1 Economic surplus

Transactions in a market gives rise to an economic surplus. Measuring the surplus of consumers is complicated. The surplus can only be calculated by estimating or assuming a distribution of willingness to pay. A consumer is willing to transact in a market if his/her willingness to pay (reservation price) is at least as high as the price. Any individual willingness to pay above the price paid contributes to the *consumer surplus.*

Producer surplus seems to variously be defined as either *contribution margin* or *(economic) profits*. A producer (or seller/supplier) is willing to sell if the price received is at least as high as the costs of providing the good. To measure "costs" can be complicated. In the most basic economic models, "costs" are assumed to be the marginal costs of providing one more unit of the good. In a monopoly situation, the seller may have to reduce the price of all units sold in order to reach one more consumer. Thus, the relevant "costs" to be compared to price are different from marginal cost.[66] In yet other settings, strategic decisions on price and quantity are affected by, and affects, the behaviour of competing firms in the market. Reducing price to increase market shares or to increase sales of complementary goods and services can have short-term or long-term benefits. Thus, the "costs" of providing the good to more consumers can be lower than the marginal cost of producing them. In models featuring multiproduct cost

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[66] One usually finds monopoly profit maximimum where marginal cost equals marginal revenue. Increasing output comes at the cost of lower price, which might just as well be understood as an opportunity cost.

functions or multisided networks, there are many different notions of cost, and it becomes complicated to estimate profit maximising combinations of output, and not least, the outcome that maximises welfare.

In standard economic treatments, the behaviour of producers can be complicated due to such considerations as above. Consumers, on the other hand, are usually subject to a more light-handed treatment. As laid out is section 5.5, consumer behaviour can also be very complicated and difficult to predict.

Markets do not often work perfectly. Sometimes because politicians interfere, at other times because politicians do *not* interfere. Cost structures and market structures do not always make perfectly efficient outcomes possible. There are many types of inefficiencies, and agents often face a trade-off between them.

8.1.1 **Static efficiency**

When any kinds of goods or services are produced, there can be *productive inefficiencies.* Productive efficiency occurs when it is not possible to produce more of one good without producing less of another. Productive efficiency requires an optimal combination of inputs (technical efficiency) and production at an efficient scale.

If a consumer's reservation price is higher than the marginal cost of providing the good, but no good is provided, this leads to *allocative inefficiency*. Such situations can occur for many reasons, such as taxes, high fixed costs, the good not being available at the right time, or strategic decisions by the seller. Monopoly tends to give productive efficiency (efficient scale) but less allocative efficiency due to monopolists being able to charge above marginal cost. Price higher than marginal cost leads to a *deadweight loss.*

Even in case of perfect allocative efficiency, there may be *social inefficiency* if there are relevant externalities that harm or benefit third parties. Examples include pollution from production, distribution and consumption or network effects/congestion effects as discussed in section 5.5.

The above has only been concerned with *static efficiency,* that is short-term efficiency without regard to how agents will adjust in the longer term. Static efficiency must be seen in connection with, and sometimes balanced against, *dynamic efficiency.*

8.1.2 **Long-term efficiency**

In the short term, market power is usually inefficient. In the long term, it may be necessary in order for stakeholders to cover the costs of innovation. What is efficient in the short term is not necessarily efficient in the long term. Development of new technology, or investment in increased production capacity, gives producers a new short-term production function. Consumers may find that one way of spending money in the short run (or indeed not spending money) give them more utility in the long run. They may also have their preferences reshaped faced with new opportunities. Markets are never truly in equilibrium, and short run efficiency may receive too much attention (Blaug, 2011). In our context, the long-term efficiency we care most about is the dynamic allocative efficiency: how can we ensure that an optimal amount of resources is allocated to produce a good. This is the core question of both copyright economics and industrial organisation.

8.2 Dynamic efficiency of copyright

To provide a good at a very low price, or indeed for free, may be the most efficient in the short run. That is what creates the most economic surplus. This may lead to producers not being able to appropriate enough value to cover their costs, and fewer resources will go into the provision of the good in the future. Specifically, although recorded music can be made available in an unlimited number of copies for free, it may be dynamically inefficient if rights holders cannot be rewarded for their contribution. Revenues to rights holders and the industry can in parts be spent to provide new content to consumers. The prospects of revenues will act as an incentive to create. On the one hand, it seems very difficult to provide an optimal level of content without any form of effective copyright protection. On the other hand, current copyright legislation makes no effort to balance consumer surplus against incentives to create. Copyright economics deals with the welfare properties of copyright. I will not delve much into it here, but a thorough evaluation of copyright with the perspective of welfare economics can be found in (C. Handke, 2010b).

8.2.1 **Duration of copyright protection**

Copyright term in the US was last prolonged with the *Sonny Bono copyright term extension act* (also called the *Mickey Mouse protection act*) in 1998. Copyright term increased from lifetime of author plus 50 years to life plus 70 years. For works of corporate authorship it

increased from 75 years to (the shortest of) 120 years from time or creation or 95 years after publication. This caused a lot of controversy, and the constitutionality of the act was brought before court. The case ended up with a supreme court decision known as *Eldred v. Ashcroft,* which did not overturn the act.

Among those engaged in the dispute around *Eldred v. Aschcroft* were 17 famous economists that were united as authors of a note opposing prolongation (Akerlof et al., 2002). They argue that the welfare loss of an extension exceeds the gains. Liebowitz and Margolis (2005) reply to this. They argue that we do not have sufficient knowledge on either the demand side or the supply side to state with certainty how production of works and welfare of consumers will be affected by an extension. One may discuss who should carry the burden of evidence: In one perspective it should be those that argue in favour of prolongation, not those that prefer status quo. On the other hand, it is not unreasonable that those who argue prolongation is *unconstitutional* carry some burden of evidence.

Some contributions attempt to evaluate the effect of a copyright term extension. I will name a few: Hui and Png (2002) find no evidence that the extension led to an increase in the supply of motion pictures. Rappaport (1998) estimates the value of old copyrighted works (books, music, films) due to expire, and find that the commercial value in aggregate is modest. Png and Wang (2006), on the other hand, find that extensions of copyright in various countries is associated with an increase in film production. Their findings indicate that it is not the capitalisation effect of retrospective extension that cause this, but an increased incentive effect. The Hargreaves report argues that the likely deadweight loss exceeds any additional incentivising effects (Hargreaves, 2011).

Among contributions discussing optimal copyright term explicitly, I will mention some. Pollock (2007) establishes a formal framework for an optimal copyright term. Two years later, (Pollock, 2009) he explores the question empirically. He studies the extra production an extension leads to, and weighs this against the increase in the deadweight loss. He arrives at an optimal term of about 15 years with a 99 per cent confidence interval reaching as high as 38 years. This corresponds well with the term in the *statute of Anne.*

Landes and Posner (2002) argue that only a fraction of the investment decision is made before the product is launched. A product can be continually developed through new episodes or spin-offs. This continual investment might not have come if the work was in the public

domain, or would soon enter public domain. Thus, it is possible that the deadweight loss is less than what it would have been if all investments came before first release.

Adilov and Waldman (2006) also study optimal length of protection in cases with large investments ex post. In such cases, optimal protection duration may be infinite, or at least very long. They use Mickey Mouse as their example. Kinukawa (2006) use the Japanese anime series *Gundam* to tell much the same story. It should be mentioned that both *Mickey Mouse* and *Gundam* are registered trademarks, and that they therefore cannot be utilised freely by others after copyright has expired. The ex post investment might be in the trademark at least as much as in the copyrighted works.

Liebowitz (2007) argue that optimal copyright term may well be infinite, and documents that a fair share of revenues from a recording may stem from after the work is more than fifty years old. He uses the age distribution of sales in 2004 along with data on expansion of the British market for recorded music to calculate expected future revenue streams.

Artists are incentivised by many factors and copyright protects a wide variety of goods. It is not to be expected that any single specific protection term is optimal for all protected goods. The best one can hope for is some sort of average.

Section 5.3 discussed substitutability of formats, and the cannibalising effect of piracy is at the centre of the debate on copyright. Unlicensed copying has always posed a threat to rights holders, and this threat was particularly potent during the first decade of this century. Whether or not the decrease in revenues leads to a decrease in the flow of new works is an empirical question. The literature reviewed in section 3.4.2 gives us no reason to believe that supply of new recordings at any time has been harmed by the threat of piracy, nor that piracy has threatened the quality of productions. It seems relatively safe to assume, however, that once decreasing costs of production are accounted for, significantly weaker copyright protection will, at least in the long term, put a downward pressure on the number of new releases. This effect depends on how consumer expenditure is transformed into producer incentives. The choice of business models and distribution of revenues to marginal recordings affects this strongly.

8.2.2 **Implications of subscription services on copyright**

The transition from ownership of music to hiring music through streaming, leads to redistribution of income between artists, and possibly altered structures of incentive to create. In particular, for an unchanged pattern of listening old recordings will take a larger share of revenues than before. As revenues are now accrued upon play instead of upon sale, the new model has introduced a lag in income for the artists and publishers. This lag potentially makes copyright a less efficient system of incentive than what was previously the case, as revenue streams must be more heavily discounted. The resources taken from introduction of this permanent lag is distributed as an unexpected benefit to old recordings that have already earned their share of revenues through traditional record sales.

This chapter and the next will take the level and shape of copyright protection for given, while discussing other factors that affect distribution and incentives.

8.3 Supply chains and intermediation – the industrial organisation of subscription platforms

There are different strains of economic literature that might provide insight into the welfare implications of subscription services. In the following, I will review important contributions from the two traditions of *vertical control* and *two-sided markets* and make some suggestions about to what extent findings are relevant for music markets. Subscription services are commonly called "platforms". Within economics, a platform is usually understood as an agent that facilitates the interaction between groups of participants with "complementary businesses", e.g. buyers and sellers (Belleflamme & Peitz, 2010, p. 609). It is a matter of debate whether, or to what extent, a subscription service is a "platform" in the ordinary economic sense.
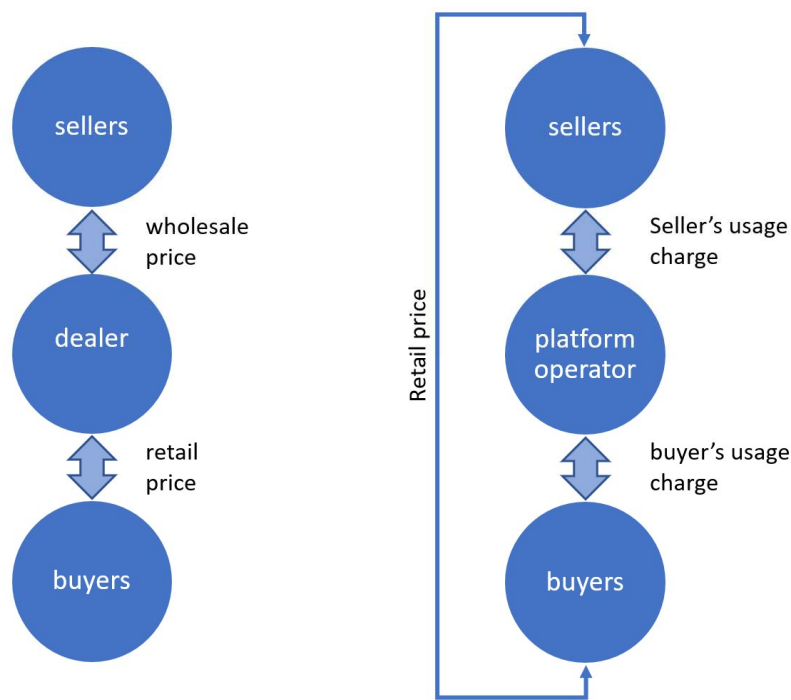
Figure 28: Dealer or platform operator

Figure 28 is from Belleflamme and Peitz (2010, p. 617) and shows transactions between the parties. The intermediary can be considered a *dealer* if it buys inputs and sells it at a price that the dealer decides. It is a *platform* if the sellers set the price and the platform operator takes a cut of that price. If the platform accommodates at least two distinct groups of users (e.g. buyers and sellers), the platform can be called a two-sided or multi-sided platform. Definitions of two-sided platforms vary, but a key characteristic of such platforms (or networks) is that they enable direct contact between sellers (e.g. rights holders) and buyers (e.g. music listeners). I.e. there must be a triangular set of relationships with transactions between platform and buyers, platform and sellers and sellers and buyers (Eisenmann, Parker, & Van Alstyne, 2006). Sellers may pay the platform for access to the buyers, and buyers may pay the platform for access to sellers. Price is commonly below cost in one relation, and the platform may even pay users on one side. The platform does not sell the goods, it only facilitates transactions between buyers and sellers.

Weyl (2010) identifies three features that models on two-sided markets tend to emphasise:

1. *Multi-product firm*: A *platform* provides distinct services to two *sides of the market*, which can be treated differently (e.g. buyers and sellers)
2. *Cross network effects*: Users' benefits from participation depend on the extent of user participation on the other side of the market, which varies with market conditions.

3. *Bilateral market power*: Platforms are price setters (monopolistic or oligopolistic) on both sides of the market and typically set uniform prices.

From the above, it is somewhat ambiguous whether music subscription services are multi-sided platforms. They do take a cut of revenues, but it is the subscription service itself that sets the subscription price. Or is it? It is highly probable that rights holders have an opinion on the pricing of subscriptions. I will return to that below. The product that is sold at a price is a subscription. The platform is responsible for the subscription, and content provided by rights holders can be considered an input into the production of subscription services. In the case of music subscriptions, as well as video subscriptions like Netflix and HBO, there are no direct transactions between buyers and rights holders. Consumers only transact with the service, and the service supplies the content. This is similar to a traditional supermarket where consumers can find products by many different producers. Although the subscription pricing model is commonly associated with platforms, and although all internet-enabled services have platform-like elements, delivering music and video through subscription services is more like the upstream to downstream linear flow of a pipe (Choudary, 2013).

Models of vertical control and models of two-sided markets do not necessarily model different types of markets. They have different emphasis. The literature on vertical control tend to focus on the volume of output in vertical oligopolistic structures. The literature on two-sided networks emphasises the number of participants in each group, and how these are matched through the actions of the intermediaries. It is not concerned with "upstream" and "downstream" but view buyers and sellers symmetrically in relation to the platform. This implies that sellers are usually modelled as atomistic with no market power, in strong contrast to the monopolists and duopolists of the models on vertical control. Modelling music subscriptions needs elements of both. The *number of users* determine the aggregate revenues of rights holders, and the *number of rights holders* determines the value of the service to users. The *volume of output* is not that important, and it is a matter of preference whether volume is measured in the number of replays, the catalogue of recordings available or the number of listeners that are using the service. Furthermore, music subscriptions are not about matching individual buyers and sellers, but giving consumers access to variety. Market power is also very important in determining consumer price and rights holder remuneration. The majors are not atomistic. These arguments weigh in favour of *not* necessarily treating subscription services as two-sided platforms.

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I agree with Weyl (2010, p. 1644) in that models of two-sided markets not so much portrays a true class of markets, but rather are a perspective, a way of modelling that captures elements of two-sidedness that are more or less important in different industries. Similarly, Rysman (2009) states *"The interesting question is often not whether a market can be defined as two-sided – virtually all markets might be two-sided to some extent – but how important two-sided issues are in determining outcomes of interest."* We may rephrase this as a question of modelling. If a market is strongly characterised by two-sidedness, then traditional vertical modelling will be utterly pointless and not produce any insights whatsoever. While I cannot see that music subscription services qualify as two-sided platforms, the literature on such platforms contribute relevant insights that is not to be found in the reviewed literature on vertical control. On the other hand, the literature on vertical control provides relevant insights without activating the complicated framework of two-sided markets.

8.4 Vertically related markets

Before searching for insights from the literature on two-sided markets, we will look at the older literature on traditional intermediaries in vertical supply chains. Tirole (1988, chapter 4) provides an introduction to the topic, and more recently Belleflamme and Peitz (2010, chapter 17). There is a rich literature on the welfare properties of different equilibria in complex supply chains. Many contributions put emphasis on how vertical integration or other forms of vertical restraints affect profits at different levels, and aggregate social welfare. None of the contributions mention services equivalent to music subscription services, and rarely any market that resemble them. This of course has a lot to do with the fact that the business model has increased greatly in importance after those papers where published. In the following I will mention various findings that I think may be applicable, and I will make suggestions on the welfare implications of various competitive states based on those findings.

The literature on vertical restraints may help us understand that rights holders and subscription services may not independently maximise profits, but may have entered contractual arrangements that benefit both groups, and possibly also increase social welfare through reducing the *double marginalisation problem* of successive mark-ups (Waterson, 1993). Double marginalisation is the phenomenon where agents at consecutive steps in the supply chain, each with market power, apply a mark-up on their price. Retail price not only becomes higher than what is socially optimal, but also higher than what would be optimal for a vertically integrated monopolistic supplier. The problem of double marginalisation is most

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pronounced if the upstream supplier is a monopolist, but it persists also with a vertical oligopoly (Belleflamme & Peitz, 2010, p. 457). The revenue sharing model where rights holders receive 70 percent of revenues, and the service the remaining 30, might be an instrument to effectively have one common mark-up for both rights holders and subscription services. If rights holders had instead charged a fixed fee per replay, or per subscriber, then subscription services could increase profits by increasing prices and thus reducing demand and introducing a vertical externality due to double marginalisation. Rights holders would prefer as low prices as possible to maximise the number of subscribers. Revenue sharing might bring the interests of rights holders and subscription service in line. If the service gets 30 percent of revenue, and has zero marginal costs associated with serving one more subscriber, then profit maximisation will bring the service to the same price as they would have adopted if they got *all* the revenues. If rights holders at the same time have a say in how high or low the price of a subscription might be, then the current pricing practice for music subscriptions resembles resale price maintenance (RPM). RPM is in effect also similar to the royalties-model briefly discussed by Tirole (1988, p. 181). Such vertical control increases profits of the service and the rights holders, and consumers may gain through lower price.

8.4.1 Differentiated services

In the case of differentiated goods with high fixed costs, for instance copyrighted works of music, society faces a trade-off between low prices and increased variety. Absent price discrimination, markets will generally not find the social optimum (Dixit & Stiglitz, 1977; Spence, 1976a, 1976b). With vertical supply structures, this effect is augmented because it works on several successive levels. Vertical price restraints may help strike this balance and improve welfare as well as the manufacturers' and retailers' profits (Gallini & Winter, 1983; Tirole, 1988, chapter 4). Thus, optimal variety and double marginalisation are two separate reasons why vertical price restraints in markets for recorded music may potentially be a good thing. Gallini and Winter (1983) suggest that price ceilings (maximum price) are more often detrimental to social welfare than price floors (minimum price) are, because price ceilings may limit product (or retailer/service) diversity.

Vertical control may increase profits of the service and the rights holders, and it cannot be ruled out that consumers may gain through lower price. Even then, however, social welfare cannot be determined without assessing the horizontal externalities that result from undercutting the prices of other services. If it leads to other services going out of business,

consumers may lose out, as the loss of variety in services may have a larger effect on welfare than the reduction in price. It is a rare coincidence if the interest of all groups of agents are perfectly aligned. Dobson and Waterson (1997) present theoretical evidence concerning how concentration at the retail level may counteract monopoly power at the (upstream) supplier level. They find that concentration at the retail level only increases social welfare if retailing services are considered very close substitutes. There are aspects of their model that does not fit with music subscriptions, so we must be careful with inferring too much. A possible implication of the model is that less variety of subscription services will harm consumer welfare and total welfare, even if it leads to lower prices. That depends entirely on how heterogeneous consumer preferences are.

8.4.2 Non-price competition among services

Subscription services do not appear to compete on price. There might be some tacit collusion, or common vertical restraints, that restrict competition. This is not the entire truth, however. The subscription services do compete fiercely for a dominant position in the market. The instrument for competition is not low consumer prices, but quality, features, awareness about its brand, and, to some extent, content (Towse, 2020). The costs of subscription services are to a very limited extent associated with running the service. Spotify's annual report for 2019 shows that "cost of revenue" was at 73 percent of revenues. Almost all of that was royalties to rights holders. Most of the remaining revenues were invested into expansion: 9 percent of revenues went to research and development and 12 percent to sales and marketing (Spotify, 2020a). The latter two categories of costs are not fixed or essential costs associated with offering the product to consumers: Except for the cost of revenue, the costs are not marginal and not truly fixed. They are investments into improving the product and into winning a market. They are what Edward Chamberlin called *selling costs*.[67] Then again, winning consumers to their service is not necessarily winning them from a rival service. New consumers of a service may well be recruited among non-subscribers. Thus, when one brand grows, the market grows. A related issue is that advertising by one subscription service raises awareness of and demand for subscription services in general. One service may free ride on another service' marketing.[68] Resale price maintenance (RPM) can be an instrument that

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[67] *"Selling costs are defined as costs incurred in order to alter the position or shape of the demand curve for a product."* (Chamberlin, 1949, p. 117)

[68] Section 7.3 of Tirole (1988) provides an introduction to competition through advertising.

rights holders use to limit price competition, exactly for the purpose of leaving services with resources with which to inform and convince consumers (Belleflamme & Peitz, 2010, p. 439; Tirole, 1988, p. 183). In other words, RPM might leave room for the selling costs associated with growing the market.

Lump-sum taxation is conventionally considered the most efficient form of tax. Likewise, an even more efficient outcome than revenue sharing and RPM could possibly be reached if rights holders charged lump-sums from service providers (e.g. a franchise fee) possibly combined with setting a price floor. Services would pay rights holders marginal cost (i.e. zero) for each digital copy distributed to consumers (Mathewson & Winter, 1984, proposition 6). This is likely to place too much risk with the subscription services, however. Furthermore, if the marginal costs associated with accommodated new consumers are negligible, then this arrangement is not likely to increase supply compared to the revenue sharing model. A lump-sum arrangement would imply that the short-run revenues of rights holders depend on the number of services rather than the size of the market.

While Gallini and Winter (1983) assume an upstream monopolist supplier, Ordover, Saloner, and Salop (1990) assume an upstream duopoly. They present a framework with two upstream firms that supply an input and two downstream firms that sell to consumers. This could in some ways resemble major record companies supplying music to subscription services with considerable market power. From their findings, we may possibly draw the conclusions that having subscription services bidding for exclusive access to content will be detrimental to both the service that win the bid, and those that lose. It is also detrimental to consumer welfare, because prices will have to increase while availability is reduced. Several features of their model differ strongly from those of music markets, however: The input supplied is a homogeneous good, this good is supplied at constant returns to scale and it is supplied through Bertrand competition in the upstream market. Thus, there is no upstream profits and no upstream mark-up. This clearly does not represent markets for music, and the applicability of their results are uncertain.

8.4.3 **Vertical integration and collusion**

Belleflamme and Peitz (2010, p. 464) model an example with five upstream and five downstream firms with the purpose of finding the effects of vertical integration on horizontal collusion between upstream firms. They find that collusion is considerably more likely if one

upstream firm is integrated with one downstream firm. This collusion will have negative welfare implications. Again, applicability for the music industry are uncertain. Belleflamme and Peitz present a model of a market with homogeneous goods, which music recordings are not. If the products of the upstream firm (recordings) are heterogeneous, the non-cooperative profits are unlikely to be zero. Thus, positive profits do not depend on collusion, and deviation from collusion has less consequences. Also, in the case of music services, the downstream service must include recordings from all upstream firms to be able to offer a good service to consumers. Therefore, costumer foreclosure (non-integrated upstream firms denied access to customers of integrated downstream firm) are highly unlikely.

The welfare implications of measures of vertical control, whether it is complete vertical integration or more limited measures such as RPM and clauses of exclusive dealings, depend entirely on specificities of the market in question. Whether the result of vertical control in the context of music subscription services is anti-competitive and detrimental to welfare, or whether it is efficiency-enhancing, cannot be determined with any certainty without modelling that incorporates those specificities.

A solution may be to establish a system of compulsory licensing for subscription services, encompassing both music recordings as well as musical works. If such a system is based on a percentage of revenues instead of a fixed rate per play, then this might eliminate the double marginalisation problem by bringing the interests of rights holders and services in line.

8.5 Multi-sided markets

The models of two-sided or multi-sided platforms are applied to different areas relevant to cultural economics. Mostly in topics typical to media economics, such as commercial broadcasting and newspapers that depend on advertisement. Ad-supported streaming services are certainly multi-sided networks, and these have also been subject to such studies. Towse (2020) emphasises advertisers when she categorises music streaming services as two-sided or multi-sided platforms. Paid subscriptions, however, do not fit all that well into the category, as discussed above. Nevertheless, even if models of two-sided networks are not perfect for subscriptions, insights gained from the models may still be relevant.

In recent years, several papers have formally modelled platforms offering a free tier and a paid subscription tier. Below, I will emphasise those contributions I have found that are most

relevant in the context of two-sided markets and welfare economics. One of less relevance that should be mentioned is by Shi, Zhang, and Srinivasan (2019). They find that it would be optimal for a monopolist platform to charge a positive price also for the low-end ad-supported service. Their model, however, only encompass same-side network effects and no cross-side network effects. Indeed, there is no "other side" with advertisers or rights holders. It is a model of a monopolist that sells two vertically differentiated products.

Bombana and Marchese (2012) study a three-sided market with advertisers, rights holders and end consumers as agents in addition to the monopolist platform. The platform offers a kind of music radio station that may have any level of advertising and any level of subscription price.[69] It can remunerate rights holders by a percentage of revenues or a fixed fee per replay or any combination. They find that a *per unit* fee from radio to rights holders always reduces the amount of music played. An *ad valorem* fee, on the other hand, has ambiguous effects, and may actually increase the fraction of music played over ads. Bombana and Marchese (2012) compare this to a similar, and more clear cut, result from Kind, Koethenbuerger, and Schjelderup (2010). The latter contribution finds that in a two-sided market with cross-side externalities, an imposed ad valorem tax may lower the price to both end users and advertisers, and lead to increased sales.[70] Bombana and Marchese (2012) conclude that for a given level and quality of service to consumers and advertisers, rights holders may appropriate more of the revenues through an ad valorem tax than through a per unit fee.

As far as I am aware, Thomes (2013) presents the first formal model of an on-demand music subscription service. He presents a model where a monopolist music streaming service can choose to offer an ad-supported service, a paid subscription service without advertisement, or both. He shows under which conditions each choice is profitable, and also the welfare implications. If consumers find advertising very annoying, only a paid subscription will be offered. If they find advertising of little nuisance, only an ad-supported service is offered. If they are in between, both services will be offered and the monopolist will segment the market. Somewhat counterintuitive, perhaps, if consumers on average find ads very annoying, they will be left with a larger surplus than they will if ads are less of a nuisance. The paper does

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[69] I guess the real-world service that is most similar to that modelled is Pandora Radio. However, the modelled service has a limited broadcasting time, which Pandora has not. It is also linear programming identical for all users. Furthermore, the service has only one tier that may or may not mix advertising with a subscription fee.

[70] On the other hand, while a tax per unit may increase product differentiation, an ad valorem tax will tend to make platforms more similar.

not include rights holders explicitly, but assumes the service may offer the music at no cost. Rights holders might potentially be represented as a third group in a multi-sided network, but they may also be thought of as a part of the monopolist music service supplier.

Zennyo (2019) explores a market where two ad-supported platforms consider also introducing a paid subscription. Dependent on fixed costs associated with establishing a subscription, either none, one or both platforms establish a paid tier. If only one does, that one will offer an ad-supported service that accommodates the most "ad-tolerant" consumers and a subscription for the most "ad-allergic" consumers. The second platform caters for those with midrange preferences. The asymmetric equilibrium mitigates platform competition. Coordination among platforms to offer asymmetric services may increase social welfare, but only by increasing join platform profits at the expense of advertisers and end users. Zennyo therefore concludes that *in terms of consumer protection, competition authorities should be cautious in the evaluation of the interplatform coordination on their business model choices.* Like the model of Thomes (2013), this model does not incorporate rights holders in any way, and the only cost of the platforms is a fixed costs incurred if they choose to establish a paid subscription tier.

Sato (2019) presents a model of a two-sided monopolist platform that offers combinations of advertising and subscription price. He finds that the under certain assumptions it is optimal to offer exactly two tiers: one with advertisements and one with none. If advertisers' benefit from transactions is high relative to the intrinsic value of the service, then the basic service is offered to consumers for free. This combination of a free ad-supported tier and a premium paid subscription is what is termed the *freemium model.* Furthermore, he finds that at the platform's profit maximum, welfare is not maximised. Advertisers pay too much and too few consumers are exposed to ads. The finding that the two-tier freemium model is a profit maximising equilibrium is robust to the introduction of a second competing platform.

8.5.1 Potentially relevant results from the seminal contributions

When there are at least two competing platforms, agents may choose to use only one or to use several. If an agent only uses one platform, the agent is said to *singlehome.* If the agent uses more than one, or all platforms, the agent is said to *multihome.* In the literature on two-sided markets it is quite common to assume that one group is singlehoming. Emphasis is often on whether or not the other group will singlehome or multihome. Armstrong (2006) uses the term

«competitive bottlenecks" about the situation where there is multihoming on one side and singlehoming on the other. If consumers are singlehoming, then a platform has a monopoly on its share of the consumer market. If a seller wishes to reach that group of consumers, then they will have to go through that platform.

It is a well-established insight from the literature on two-sided markets that the singlehoming side tends to receive preferential treatment, while the multihoming side must pay the platform for transacting with the other side. (refer e.g. Belleflamme & Peitz, 2010, p. 637) Market power in one market can affect pricing in the other market. An investigation into the two-sided nature of a market can both explain zero-pricing (ad-supported streaming services are free to consumers) and also helps identify what makes monopolisation (singlehoming) a likely outcome (Farchy, 2011; Rysman, 2009).

Caillaud and Jullien (2003) feature a model with assumptions that in some respects fit quite well with music subscriptions. Network effects and economies of scale imply that the efficient equilibrium outcome is likely to be that all groups of users are "homing" to the same platform. The authors show that also other equilibria can be reached. If costs associated with a platform are low, then there may be equilibria where all users use both of two platforms (Ibid. p. 310). They also find a range of inefficient equilibria, for instance a symmetric equilibrium where consumers singlehome between intrinsically identical platforms while sellers multihome (Ibid. p. 323). The platform is made available to consumers at a price no higher than marginal cost, while all surplus is extracted from sellers. Assumptions of the model that do not fit with music subscriptions, and therefore make inferences highly uncertain, include that both sellers (e.g. rights holders) and buyers (e.g. subscribers) are atomistic with no market power and that the only form of remuneration between platform and users is a fixed price on both sides. While both of these are fine for the consumer side, both are far from applicable to the supply side of music subscription services.

Caillaud and Jullien (2003) show that, depending on assumptions on what is feasible and on a range of parameter values, both efficient and inefficient equilibria exist. Both monopolies and duopolies may be efficient, and profits of the intermediate service depends entirely upon parameters. They may well be zero. In their words: "*Intermediation markets, and particularly Internet-based markets, therefore have some strong specificities. The design of competition policy rules with respect to such markets should thus take these characteristics into account.*

Concentration may not necessarily carry strong inefficiencies; in fact, the opposite may be true." (Ibid. p. 324)

Armstrong and Wright (2007) builds on Armstrong (2006) and Caillaud and Jullien (2003). They explore a range of combinations of assumptions, and some of these combinations bring them quite close to something suitable for music subscriptions. Multihoming sellers, singlehoming buyers, platforms that are not strongly differentiated from each other and per-transaction payments are all relevant to music subscriptions. They do not, however, combine fixed payments on the consumer side with per-transaction payments on the seller side. Also, like every other contribution I have reviewed, they do not discuss market power on the seller side. As for results, they find that a competitive bottleneck can arise endogenously as an equilibrium and that the multihoming sellers have their network benefits completely extracted.

Weyl (2010) investigates a model where users are heterogeneous in two dimensions: they have variable benefits from *membership* to a platform (in line with assumptions in Armstrong, 2006), and they have variable benefits from *each interaction* through the network (in line with Rochet & Tirole, 2003, 2006). He finds that when users have heterogeneous benefits from membership, that might invalidate one of the key findings of Rochet and Tirole. Their conclusion, termed the "seesaw principle" – that factors contributing to a high price on one side tend to contribute to a low price on the other side – hinges on the structure of heterogeneity. Although their assumptions are reasonable for a wide range of markets, the results do not necessarily hold for all two-sided networks. Tan and Wright (2018) cast doubt on some of Weyl's results, however, as they identify errors in several of the equations, or possibly just the nomenclature (Weyl, 2018). The full implications of these errors are not clear to me.

Neither music subscribers nor music rights holders have much interest in a platform where the other side is completely absent. Benefits, and heterogeneity of benefits, are derived from interactions of both sides. Armstrong's (2006) *membership* yields no utility per se. It is therefore reasonable to stick to the assumptions of Rochet and Tirole rather than Armstrong (2006). There might be other specificities or music platforms that imply the seesaw principle does not hold, but the issues raised by Weyl (2010) do not appear important for our purpose.

8.5.2 Multihoming and singlehoming on streaming platforms

Streaming services for film and TV-shows feature very incomplete catalogues. They contain only a small fraction of what exists, and to a large extent, they contain different content. Many content providers provide content to only one service, a service they in some cases own (e.g. Disney+). Some streaming services has expanded into producing their own exclusive content, for example Netflix and HBO. Consumers with a broad interest in film and television may subscribe to several services. Thus, many consumers are *multihoming* while content is in some part exclusive and in other parts available through several different services.

Subscription services for music are quite different. They all contain a very large variety of music, and they mostly contain the same variety. Content providers mostly provide content for all the services. Consumers will rarely subscribe to more than one service. Thus, consumers are (mostly) *singlehoming* and providers are (mostly) *multihoming.* This difference between the film and television on the one hand, and music on the other, is potentially very important. It means that insights obtained from studies of one may to a very limited extent be applicable to the other.[71]

8.5.3 **Fully assorted services or exclusive content**

The concepts of multihoming and singlehoming on the seller side translates into the discussion on exclusive content on subscription services. As mentioned in chapter 4, the early streaming services Pressplay and MusicNet started off as instruments for the major record companies to distribute their own content. Although they did to some degree cross-license after some time, you needed more than one service to access "all" music.[72] They resembled the present models of Netflix, HBO and Amazon Prime Video. Present day music services, however, strive towards being fully assorted and will thus to a very large extent contain the same content. Thus, multihoming on the seller side is dominating. The more similar the catalogues of the services are, the less reason will there be for consumers to pay for more than one service. I.e. when rights holders tend to multihome, then subscribers tend to singlehome. If subscribers singlehome, it forces rights holders to multihome.

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[71] The growing market of podcasts appear to have a different logic, where exclusivity is more common (Ingham, 2019a).

[72] Even combined they were not close to «all» by any measure. They only included a small fraction of the catalogues of the majors.

There have been instances of certain streaming services having exclusive access to some content for a period ("windowing") or indefinitely. That creates a different dynamic from the situation where all services provide the same content. Zhu and MacQuarrie (2003) provide an economic analysis of bundling music into subscription services that at first sight appears to be well fit to understand the dynamics of the current situation in the digital music market. However, their model is strongly affected by the singlehoming subscription services that dominated at the time: *Pressplay* and *MusicNet.* The analysis is effectively that of record companies that bundle their products. Their model therefore has more relevance to video streaming services than to music streaming services.

While incidents of exclusive licensing are witnessed, those are exceptions. Subscription services, artists and record companies all appear to be sceptical. According to Rysman (2009) there is usually little reason to seek exclusivity on one side if the other side is already exclusive, as is the case with singlehoming subscribers.

8.5.4 Why do rights holders multihome?

One of the main insights gained from the literature on two-sided markets is that if one side moves from "singlehoming" to "multihoming", while the other remains singlehoming, this is detrimental to the multihoming side, and will benefit the singlehoming side. The platform will cater the singlehoming side more strongly in order to strengthen their monopoly/monopsony power towards the multihoming side. If this is the case, then why are rights holders multihoming to many music platforms? There are a couple of different possible explanations, and several of them may interact to explain what we observe.

1. This is a transition. The beginnings of streaming services came out of a situation where unlicensed copying flourished, and consumers had better outside options than rights holders had. To get consumers on board, consumers had to get a good deal. As unlicensed services are killed off, and new habits are formed, rights holders will at some point somehow be able to collude to turn the tables.

2. There is some kind of path dependency involved. Even though the major distributors individually have market power, and consumers have not, it is not now possible to force consumers to become multihoming.

3. Competition authorities might have had issues with singlehoming, as evidenced by the US antitrust probes against Pressplay and MusicNet mentioned in chapter 4.

4. This is actually the most profitable solution that could be attained by rights holders.

While 1), 2) and 3) can all have some credibility, it is natural to investigate number 3). As mentioned in section 8.5, Weyl (2010) investigates some conditions under which the "seesaw principle", that factors contributing to good terms on one side tend to contribute to bad terms on the other side, does not apply. Although the conditions he identifies probably do not apply for music subscriptions, there is a possibility that under certain other conditions a "competitive bottleneck" is beneficial to both parties. Belleflamme and Peitz (2019) show that the conventional result that singlehoming is beneficial is not entirely general. The result may under certain circumstances be opposite. There can also be situations where sellers and buyers agree that multihoming on one side is preferable. Yet again, however, music subscription services appear to have none of the necessary traits for this exception to be relevant.[73] Armstrong (2006) finds, in a model where the platform's costs are all marginal with respect to buyers and sellers that join, that the profit-maximising price for each group is equal to the (marginal) cost of providing service, adjusted downward by the external benefit to the other group. Thus, if singlehoming subscribers provide strong utility to multihoming rights holders, then buyers are catered for and rights holders have their profits taken over by the platform. If it is rather the other way around, then rights holders are catered for.

Among the models of two-sided markets reviewed above, all those with a *seller* side feature atomistic sellers. This is an unreasonable assumption in the case of music subscriptions. Recordings are supplied by large, global distributors, or conglomerates of smaller ones, such as Universal, Sony, Warner and Merlin Network. A platform that is missing any of these huge catalogues will be at a severe disadvantage when it comes to capture consumers. Not only do platforms have a monopoly on groups of consumers, but the distributors have a monopoly on groups of works. If a large music distributor considers joining a new service in addition to those it is already using, it is not enough for the platform to cover the marginal costs of

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[73] Traits that contribute towards sellers (rights holders) gaining from the possibility of multihoming are 1) platforms facing significant costs from accommodating another seller, 2) rights holders facing significant costs of being available through another platform. (While electronic games require significant development costs for each platform a game is made available through, that is not at all the case for recorded music.) 3) Cross-group external effects are modest to both buyers and sellers. In the case of music subscriptions, cross-group external effects are clearly very important to consumers.

creators and distributors. The platform must also replace revenues lost through other platforms as consumers migrate from existing platforms to the new one. As noted by Armstrong (2006, p. 677, footnote 8), if rights holders are not atomistic, then their individual decisions affects the outcome on both sides of the market, and for all platforms involved, as they individually affect the platform's attractiveness to consumers. Even under complete multihoming, a plausible threat of leaving a service forces the service to give favourable terms. The platform might be more dependent on the major rights holders than the major rights holders are on the platform.

Armstrong and Wright (2007) find that the "competitive bottleneck" where sellers multihome and buyers singlehome might arise endogenously if buyers see the platforms as different from each other, while the sellers see them as homogeneous. That could indeed be the case for music subscriptions.

Armstrong (2006) makes it clear that per-transaction charges weakens cross-group externalities as compared to a fixed price, since a fraction of the benefit is eroded by the extra payment. If fixed costs of using a platform are negligible, this means that sellers have weak cross-group externalities. Consumers, on the other hand, paying a fixed fee, have very strong cross-group externalities. This has important implications: Armstrong and Wright (2007) state that *if magazine readers value the number of advertisements less than the advertisers value the number of readers, then competing magazine publishers will subsidize readers relative to advertisers.* In the case of music subscriptions, subscribers value rights holders higher than the other way around. We may assume both sides value the service itself to zero. Only content has value to subscribers, and only subscribers have value to rights holders. Content has a value to the subscriber equal to subscription price plus consumer surplus. Subscribers have a value to rights holders of around 70 percent of subscription price. Furthermore, growth in the number of subscribers to a service will most likely imply that a fraction of these are recruited from another service. In those cases, the cannibalisation of revenues is roughly equivalent to the new revenues for a multihoming rights holder. It therefore seems fairly safe to say that the cross-side network effects experienced by consumers are stronger than those experienced by rights holders. If that is the case, then it is the rights holders that will receive the most favourable terms.

The models of both Armstrong (2006) and Belleflamme and Peitz (2019) assume that multihoming is incomplete in equilibrium. This is ensured by the platform's ability to charge

a higher price if everyone wants aboard. To my understanding, if the singlehoming side is subsidised, then increased attendance on the singlehoming side only has value to the platform as long as long as it attracts increased attendance from the multihoming side as well. With complete multihoming on the seller side, I am therefore not able to see any reason to subsidise consumers.

Another reason for rights holders to prefer multihoming might be that it is the only way they can ensure that more than one streaming service survives. Two-sided singlehoming under network effects will usually lead to a rapid development towards monopolisation. That may not be in the rights holders' best interest, as we will return to below. Thus, market power among rights holders allows them to act strategically to ensure their long-term profits.

An additional reason may be that the groups of agents around streaming platforms are less symmetrical than what is often assumed in the models: Things must be kept simple on the consumer side, and single homing is simple. It may be more complex on the supply side that consists of professionals.

8.5.5 Entry, mergers and competitive platforms

Anderson and Peitz (2020) evaluate the welfare effects of entry and mergers of platforms, as well as advertising regulation. They allow for different platform size and incomplete coverage of the consumer market. The platform is two-sided: consumers and advertisers. There are no rights holders or sellers in the model. Entry of a new platform is unambiguously advantageous for consumer surplus. For advertisers, it has two opposing effects: The increase in total consumer participation is beneficial for advertisers, but it leads to less advertising on each platform, which is not beneficial. The overall effect is negative for advertisers if the increased competition leads to total platform profit decreasing, which it usually does. A merger of platforms leading to less competition decreases consumer surplus, but advertiser surplus tends to increase. If some cap is placed on the amount of ads in services, then this reduces advertisers' surplus and increases consumer surplus. Thus, it is in the common interest of advertisers and platforms to avoid entry, to merge platforms and to avoid caps on advertising. Consumers have the opposite interests.

8.6 Can there be only one?

There are currently many services that compete for consumers of music as well as for video. An important question for positive economics is whether it is likely that the competition will result in one mighty monopolist, or if a multitude of services is sustainable. I will discuss that question here. A question for normative economics is whether a monopoly is efficient and welfare enhancing, or if it is detrimental to welfare. There is no doubt certain *winner-takes-all* dynamics, but there may be countervailing factors. Evidence from the reviewed literature is mixed regarding welfare implications. That is discussed in section 8.8

According to Eisenmann et al. (2006) there are three conditions that makes it likely a given market will end up being served by only one platform:

1. Multihoming costs are high for at least one user side.
2. Network effects are positive and strong, at least for the user group with high multihoming costs.
3. Neither side's users have a strong preference for special features.

The first certainly applies to subscribers of music services. It does not apply to the rights holders. As for the second point: The *direct same-side* network effect will be significant for some music subscribers, while others do not relate much to other users' playlists or listening habits. In the case of video subscriptions, these network effects are probably weak. The *cross-side* network effects are very strong for end consumers, but if the content providers multihome more or less completely anyway, which is mostly the case for music subscriptions, that is of little concern.[74] The third condition, which might be expressed as the platforms not being significantly differentiated, but close to homogeneous products, might also be true for music subscriptions. If the same content is available in all services, most users are probably quite indifferent between the services.[75] There might be some switching costs related to moving playlists from one service to another, and also related to getting used to new layouts and features. But overall, the majority of end users are mostly interested in the content and the price that content is made available at.

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[74] Multihoming is not very strong among content owners in the case of video subscriptions, but vertical integration and control is quite strong in that market, something which changes the outcome.

[75] Once a choice of service is taken, there might be switching costs related to moving playlist from one service to another, and also related to getting used to new design and features. That reduces contestability, but services might nevertheless be close substitutes in the outset.

Rysman (2009) also presents three conditions, two of which are equivalent to 1 and 3 above. His last condition is that sellers are more likely to agree on a common platform if the products they supply are differentiated. This condition does not contribute to sellers choosing singlehoming rather than multihoming, however. It contributes towards singlehoming sellers choosing the same platform. As rights holders are mostly multihoming to begin with, this condition does not seem very relevant to music subscription services.

The lists of conditions could also have included the primary reason for monopoly in markets in general, namely high fixed costs and low marginal costs that give rise to a natural monopoly. This is another argument in favour of strong consolidation for music subscription services. Costs will certainly affect the efficiency of different outcomes, but may to a lesser degree affect outcome as long as the contenders are able to cover their costs.

From the above, it is evident that there are many factors that indicate a winner-takes-all outcome is likely. Are there sufficient forces that may counter this? An obvious factor is heterogeneous consumer preferences. But more important may be the strategic dispositions of rights holders. Such strategic dispositions are not considered by either Eisenmann et al. (2006) or Rysman (2009), presumably because models of two-sided markets conventionally feature atomistic users with no market power and thus no room for strategic dispositions. The consequences of a monopoly platform on rights holder revenues are not entirely straightforward to evaluate, but it seems likely that content providers may have strong aversions against excessive consolidation among music subscription services. I believe content providers will only allow a monopoly to arise if the supply chain is vertically integrated, that is, that the majors have shared ownership of a subscription service. Not only do I believe content providers think it safest to avoid a monopoly, I also believe they have the means to avoid it. It all comes down to licensing, which is the predominant cost of music subscription services.

If rights holders to a large extent allow for exclusive licensing of content, then most forces align to pave the way for strong consolidation. That is presumably an explanation of why rights holders have been reluctant to exclusive licensing. Every instance is potentially a small step towards monopolisation of platforms. The short-term gains from exclusivity may have a high long-term price.

8.7 *Should* there be only one?

Above, I have argued that it is unlikely rights holders will allow a monopoly service to form. A different question is whether *competition authorities* should allow a monopoly service to form. As many contributions reviewed in this chapter shows, monopoly may in many cases increase consumer surplus and overall welfare.

When evaluating the welfare properties of the different alternatives, the cost structure of supplying services is very important. Specifically, it is crucial how large the economies of scale are. Not only are costs of running a monopoly certainly lower than the combined costs of running many competing services. The costs may even be lower than the costs of *each individual* contending service.[76] In section 8.4.2 we looked at the costs of Spotify, and found that a large amount was what we called *selling costs,* costs that a firm would largely not have had if it had no competitors. They are costs of keeping up with the competition. Costs associated with improving the product will to some extent improve welfare, but this race, the creative destruction, may well imply too much innovation (Aghion & Howitt, 1992). Advertising may to some extent enlighten consumers on the choices they have, and may increase the total number of subscribers, but it is in parts a zero-sum game. It is a form of rent-seeking. These traits are important in any market where competition among substitutes revolves around quality and attention rather than price, and music subscription services are no exception.

Anderson and Peitz (2020) find that if a service is free to consumers, then concentration is detrimental to consumers, but beneficial for advertisers and platforms. I.e. the "see-saw principle" holds.[77] If consumers pay for the service, however, then the interest of advertisers and consumers align: they both suffer from concentration. If consumers *enjoy* ads (as they may in the case of newspapers) then once again, the see-saw may not arise. This may possibly have relevant implications for music streaming: In the case of free, ad-supported streaming, concentration harms consumers but have ambiguous effect on total welfare. Implications for paid subscriptions with no ads are somewhat more of a stretch. One implication may be that when consumers enjoy "users" on the other side (consumers enjoy content), then concentration unambiguously reduces total welfare.

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[76] In this argument I do not consider royalties as costs to the platform, but as the rights holders' share of revenues. The platform's revenues are thus ~30% or consumer payment.

[77] As always, this is subject to certain further assumptions. Those do not seem unreasonable.

Caillaud and Jullien (2003, p. 324) state that concentration is not necessarily inefficient, and that user surplus may have stronger protection in a concentrated market, *provided that there is enough contestability.* It is nice if one can get the best of both worlds: the productive efficiency of a monopoly and the allocative efficiency of competition. Baumol, Panzar, and Willig (1982, p. 289) states that an incumbent with high fixed costs can only deter entry if its profits are close to zero and that *prices are welfare-optimal, given the constraint of financial viability.*[78] The incumbent can only enjoy profits if there are substantial *sunk entry costs. (Baumol et al., 1982, chapter 8).* The very important distinction is that fixed costs must be paid by all contenders, incumbents and entrants alike, at some interval. Entry costs, on the other hand, must only be paid by entrants. Others have since shown that this result rests on an assumption that the incumbent can only slowly adapt to entry by changing its prices (Farrell, 1986; Schwartz & Reynolds, 1983).We may safely assume that an incumbent music subscription service that charge a monopoly profit can rapidly adjust its price if competition is imminent. I thus conclude that deterring entry is not too difficult in the case of subscription services, as incumbents can easily switch from profit-mode to competitive mode. Thus *potential* competition is unlikely to be sufficient.

From this, I conclude that a market that is more or less entirely conquered by a single service will not be very contestable. There are very significant *entry costs* associated with setting up a working subscription service that also succeeds in attracting consumers. These entry costs may well decrease as the technology matures, but may increase as incumbents cement their position. Even if rights holders are able and willing to license music to a start-up at a lower price, direct network effects, switching costs and economies of scale may make entry more difficult in a market with one dominant platform than in a market that is divided already.

As a consolidated market for music subscriptions is not very contestable, we may assume from Caillaud and Jullien (2003) that concentration is likely not efficient and likely detrimental to consumers.

8.8 Efficiency of all-you-can-eat bundles

Music streaming services give more people access to a wider variety of music. Available variety, including music from all over the world and all over the history of music, is a boon to

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[78] A requirement for this to be true is that the entrant is able to enter at efficient scale.

consumers. Efficiency can only increase when search costs and transaction costs are reduced. Such services also change the social aspects of music consumption in a way that is probably preferable to many consumers. Availability and social aspects aside, the business model itself has implications for efficiency, and it implies a new distribution of costs to consumers, revenues to rights holders and intermediaries, and surplus to all parties.

Systems of payment and remuneration affect the outcomes as well as the welfare properties of the outcomes of the scenarios discussed above. But even for a given market structure, methods of payment may affect the welfare. The business model, including the subscription pricing, has direct implications for efficiency even if its potential impact on the industrial organisation is not considered. We will turn to this in the remainder of the chapter and delve deep into it in the next chapter.

8.8.1 Efficiency in the consumer market

As the marginal cost of providing one more consumer with free access is negligible, the natural benchmark against which to assess short-term efficiency is if all music was supplied free of charge to all consumers.

Altmann and Chu (2001) compare flat-rate pricing and pay-per-use pricing among internet service providers. They state that flat-rate pricing is inefficient, as the users do not face the true marginal costs, something that leads to over-usage. Handke (2010a, p. 16) points out that it is possible for regulators to require the monopoly producer to introduce a two-part tariff that approximates marginal cost pricing combined with some charge to cover fixed costs. One may argue that streaming subscriptions fulfil this requirement of marginal cost pricing: The price of accessing one more song through the service is equal to marginal cost: zero. We may safely assume the marginal cost to the service is negligible. Altmann and Chu (2001) find that consumers are willing to pay a premium for not being bothered by a constantly ticking meter. They suggest a pricing plan in which users pay a flat-rate charge for basic service and a usage-based charge when accessing a higher service quality (or quantity). If marginal costs are zero, this usage-based charge should be zero.

Difference between marginal cost and price is not the real problem, though. As there are fixed costs that must somehow be covered by consumer payment, this is a situation of second-best in any case. No Pareto efficient solution exists where sellers have their costs covered. Only free access can eliminate inefficiencies in the consumer market. Barring that, this is a question

of maximising welfare. A usage-based extra charge may possibly be part of an efficient system of price discrimination. It might be efficient and considered just that those who consume most music should contribute most.

Of course, the marginal cost of including another *subscriber* is also zero to the service, and as the lump-sum charge is only imposed on subscribers (and not the general public) the price of becoming a subscriber is still inefficient.[79] We cannot get around the fact that all attainable options are second-best. The theoretical first-best is no more than a benchmark.

When music economy was based on sales of recordings, those with a high willingness to pay for music tended to spend a lot of money. Those with less willingness to pay spent less through some combination of acquiring access to fewer recordings and copying recordings from friends and radio. With subscriptions, there is thus less price discrimination. Then again, some streaming services offer several different products, which allow a greater differentiation of consumers. Those with low willingness to pay can use "free" services based on advertising, less versatility and/or low sound quality. Some services also offer an alternative with extra high sound quality. Keeping the most advanced features away from those with a limited willingness/ability to pay will introduce a new inefficiency. The subscription model does not discriminate effectively between those that listen to a lot of different music, and those that listen little. The willingness to pay is very far from exhausted for those consumers with the greatest willingness to pay, and there are many potential users that might find the price too high. Maximising welfare is thus a complicated assignment in balancing different inefficiencies.

The arguments behind the suggestions from Handke (2010) and Altmann and Chu (2001) for a two-part tariff are relevant for subscription services, even if marginal cost is negligible. Some sort of price discrimination based on usage would make the entry costs for infrequent consumers lower, and more people would benefit from the service.

8.8.2 Efficiency in the content market

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[79] The notions of "fixed" and "variable" costs may not be entirely straightforward for a streaming service that is subject to a revenue sharing model and has royalties to rights holders as the dominant "cost". "Marginal costs" of a $10 subscriber is $7 in royalties. But if they lower price to $7 price does not equal marginal costs, Marginal costs will instead decrease to $4.9. For many purposes, a price of $10 is better viewed as $3 (net) revenues and zero royalty costs. The remaining costs are largely what I called "contention costs" in section 8.4.2.

An efficient market for content makes sure that revenues are such that content for which there is (potential) demand is supplied in the first place. The market must make sure that there are incentives to create in place. While efficiency in the downstream consumer market may be adequately understood in the context of a short run model, the upstream content market can only be considered in the long-run.

The streaming platform converts fixed subscription payments into a pay per play to rights holders. I.e. streaming services makes it possible to get paid according to how much consumers in fact listen to the artist's works. Consumption of music does not directly affect revenues from consumers, but it affects distribution of revenues in the content market. For a given (short term) supply, this means of distributing revenues is a null sum game that does not add to or subtract from supplier surplus. It only redistributes. In the long term, however, this redistribution may lead to increased efficiency to the extent that the amount of listening is a good expression of the consumer's willingness to pay. The increased efficiency comes from increasing the odds of the "right" recordings hitting the market. The relation between frequency of listening and willingness to pay is uncertain, however. The individual consumer may have a high willingness to pay for the latest album of a favourite artist, although this may not be a favourite album. One may want to support a friend's musical project or some local undertaking, but not spend excessive amounts of time listening to it. One might previously have bought the record without caring too much about listening to it. With streaming services, the only way to support an undertaking is by spending time listening to it. Moreover, certain genres of music simply lend themselves better to repeated listening than others, and an album consisting of many short tracks will trigger more revenues than an album consisting of a few long tracks.

8.8.3 Overall efficiency of subscriptions

The discrepancy between consumption and willingness to pay is more obvious in the aggregate: Previously, those spending most money on music were presumably music enthusiasts with a regular income. They were thus the most important fans to cater to in order to secure an income. Under the streaming regime, it is not the monetary budget that determines who are the most important fans, but the time budget. Young people generally spend more time listening to music than others. These are thus the most important fans to cater to. Whether or not there are efficiency gains from the new business model, democratisation may be said to have taken place.

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If streaming of music approximates the only business model in the market for recorded music, the model of financing will be very close to tax financed public goods with low marginal costs. Music subscriptions are not truly public goods as they are excludable. But as music and video subscriptions become increasingly common, the price becomes almost indistinguishable from television licensing which exist in a range of countries. Such licensing is effectively a hypothecated tax.

The model presented in chapter 9 indicates that streaming services may lead to a slightly increased allocative efficiency (reduced deadweight loss) in the consumer market. The model also indicates that a larger fraction of revenues will be directed towards marginal recordings (bottom 50%), something that is likely to increase consumer surplus through increased variety. This downward redistribution is a somewhat controversial claim, as discussed in section 5.7.

A judgement on the efficiency of subscription services compared to previous business models would have to be a trade-off between short term efficiency and long-term provision of new recordings.[80] Business models and price should ideally be such that an optimal variety of products in supplied. Supplier surplus may decrease with too great variety, as it incurs costs. Consumer surplus is best served if a substantial share of revenues is paid to rights holders of marginal recordings, i.e. those that only just makes it to the market. How much variety is optimal for consumers depends on how much price is affected by the increasing average costs. That is not straightforward to determine, as products are neither supplied by a monopolist nor by a perfectly competitive market. A great deal of parameters would have to be estimated, and others assumed, in order to make a complete, quantitative comparison of efficiency.

Is it likely that an increase in the supply of new recordings will add a lot to total welfare? If it does, then willingness to pay for a subscription should increase as the size of the catalogue increases. It is perfectly possible, however, that most consumers find that the existing supply of new music, alongside what is already available, provides more than enough choice for a lifetime, even within narrow genres. Some consumers may certainly find the increase in variety enriching, as it suits their specialised demand better. But it is not self-evident that even greater variety will increase welfare.

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[80] New technology and welfare enhancing products and features should also be part of a perfect analysis.

There are several very relevant topics that have not been touched upon in this chapter, and that will not be much discussed in the next either. One issue is that bundling at different levels is common. We have seen several cases of music subscriptions bundled with other products like internet access provision, mobile phone subscriptions and cable/satellite TV subscriptions. Service applications also come pre-installed on some computers and phones. Even if products are not technically bundled/pre-installed, music can be used as a "loss-leader" to attract consumers to buy a specific product or adopt a software "ecosystem". Farchy (2011) discusses how zero-pricing can be sustainable and how the internet and cost-free copies necessitate such strategies. She mentions how profits can be made on complementary products to the free ones. All this is very relevant to discussions of music services as multi-sided platforms, but it is not emphasised in this thesis.

8.9 Modelling allocative efficiency

The discussions in this chapter should make it abundantly clear that it is not straightforward to evaluate the impact that subscription services have had on welfare. The literature on vertical control, multiproduct pricing, network effects and two-sided platforms is vast and complicated. No models I have come across have wide applicability to music subscription services. Mostly vague maybe/maybe nots can be inferred from this literature. Theoretical models specifically tailored for music subscriptions are needed. The models should be constructed based on the empirical evidence that exists, and could give more insight into probable developments in the future, and the welfare implications of those developments.

The revenue distribution system of subscription services has at least three important characteristics:

1. Rights holders are remunerated through an *ad valorem fee* (a percentage of revenues) not a *per-unit fee* (a fixed fee per play),

2. Rights holders are remunerated based on the number of replays.

3. Consumers pay a fixed subscription fee independent of usage.

The first of these three is addressed by the reviewed literature on industrial organisation. The relation between the latter two are not, which warrants the construction of the model presented in chapter 9.

For the purpose of modelling in chapter 9, I assume that the supply side, including composers, artists, record companies, distributors and subscription services, can be treated as one big integrated monopolist. Revenues are subsequently distributed to the various rights holders *within* this monopoly. While a monopoly is not an accurate representation of the market, it may be a reasonable approximation. To see this, let us assume that all recordings are available through all subscription services (complete multihoming on the selling side). Subscription services are monopolistically competitive, they face the same demands from rights holders/record companies, and they have identical fixed costs and zero profits. Rights holders receive a constant share of revenues, and we can safely assume that they have a word when it comes to the level of the consumer price. This amounts to a price floor, or resale price maintenance. Given that subscription services are fairly close substitutes, and demand for each service thus elastic, it is highly likely that a price floor given by rights holders is the instrument for vertical control that is needed for consumer price to maximise the combined profits of all services and rights holders (Gallini & Winter, 1983, p. 276). If all (groups of) rights holders offer the same terms to subscription services, which I believe they by and large do, then the aggregate of subscription services and rights holders may reasonably be modelled as one big monopoly in their relation to consumers.

This may seem incompatible with my conclusion in section 8.7 that concentration is detrimental to consumers. How can it be detrimental if competition and monopoly can be modelled the same? Well, I have argued in section 8.4 that the revenue sharing model may mitigate or eliminate the double marginalisation problem. However, if the monopolist platform is in a position to force rights holders to accept the terms dictated by the platform, then this might dynamically be equivalent to a fixed per-play remuneration for rights holders. Thus, if the platform gains market power relative to the rights holders, then the double marginalisation problem may re-emerge. Monopolisation may not necessarily harm consumers much directly. But it harms rights holders directly, and it harms consumers indirectly by re-establishing the double marginalisation problem. Thus, when I in chapter 9 assume a monopoly, it is a single entity free from the double marginalisation problem. This might be a reasonable approximation to a situation with several contending platforms, while it is less harmful to consumers than a real-world monopolistic platform subject to double marginalisation.

Previous modelling of music subscriptions has, similar to how I do it, left out rights holders, and implicitly assumed that rights holders will carve their revenues from the profits of the platform, without including the insides of that black box (Sato, 2019; Shi et al., 2019; Thomes, 2013; Zennyo, 2019). I believe there is firm theoretical justification, and also strong precedence, for treating subscription service, rights holders and other input providers as one big monopoly.

The effect of subscription services on welfare will be evaluated by measuring the magnitude of producer surplus and consumer surplus. Assuming that the preferences of consumers are fundamentally unchanged by the transition to streaming, the sum of producer surplus and consumer surplus can be used to compare efficiency. Alternatively, the size of the deadweight loss can be used to measure *in*efficiency. This rests on certain assumptions: First, there are no taxation of this market. Second, there are no relevant externalities. This might be considered an inappropriate assumption, since I spent large sections of chapter 5 discussing *demand interdependence,* which certainly falls within externalities. These externalities, however, are arguably most relevant when it comes to choices between recordings. Not so much when determining whether or not to subscribe. The most important demand externalities are therefore at a level that is not relevant for evaluating the efficiency of subscription services compared to sales. It is sufficient for the model to feature uneven distribution of revenues among rights holders in order to take demand interdependence into account. The model also sheds light on how the costs and benefits are distributed among stakeholders.

The model is one of a partial equilibrium. The efficiency evaluated in a partial equilibrium may be a good approximation to reality if substitutability or complementarity to other goods are not strong, and if the market in question is relatively small compared to the overall economy (Belleflamme & Peitz, 2010, p. 24). We may safely assume that costs associated with recorded music is only a small share of the budget of most consumers. The former is more challenging. First, as different subscription services essentially are assumed to be one and the same good supplied by a monopoly, as discussed above, there is only one market for subscriptions. We have learned from chapter 7 that there are substitutability and complementarity between different methods of accessing music. In the upcoming model, there is only one market for recorded music. The model compares steady states before and after a complete transition from sales to subscriptions. Unlicensed copying is assumed away. That is only of concern if the impact of piracy on sales is very different from the impact on

subscriptions. Admittedly, that might be the case.[81] I do not believe this in any way invalidates the model.

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[81] Conclusions concerning this cannot be drawn directly from the findings in chapter 7, as that is substitutability in markets where both sales and subscriptions co-exist.

9 Modelling a transition to subscriptions – distribution and allocative efficiency

In this chapter, I will present a model to shed light on the transition from the traditional sales of units of music recordings, to paid access to a large bundle of information goods, for instance a music subscription. I use the model for the purpose of predicting the impact on the distribution of revenues between rights holders (long-tail versus blockbusters), to see how appropriability, measured by supplier surplus is affected, and how consumer surplus is affected. This chapter extends on the brief discussion in section 2.7. *Sales* can be interpreted as sales of physical units or paid downloads. No distinction is made between singles and albums in the model below. They are just considered *recordings*. The model borrows a lot of its basics from both Bakos and Brynjolfsson (2000) and Balasubramanian, Bhattacharya, and Krishnan (2015).

In order to explore the redistribution of revenues among rights holders, one has to decompose consumers' *valuation* into two conceptually distinct features: *how often* one wants to listen and *how strongly* one wants to listen. I.e. a *usage frequency* and a *valuation-per-use.* Some consumers listen a lot, but do not have a lot of money to spend. Others (are willing to) spend a lot, but do not necessarily listen much more than average.

In the following, I present a model comparing static states of only sales and only bundled subscriptions. The bundle is assumed to be comprehensive: *All* existing recordings are available through the subscriptions. The model is useful for analysing inefficiency (deadweight loss) as well as how the new business model redistributes income between stake holders. Winners and losers can be identified, something that might be an important groundwork with policy implications.

9.1 Transition to streaming – renting and bundling

The fundamental change of business model represented by the shift from sales of individual copies to subscriptions can be divided into two phenomena: A transition from buying once-and-for-all to paying for access for a limited period (i.e. hiring) at the one hand and a transition from many goods to a single bundled good/service.

Table 20: Simple matrix of business models

	Buy	Hire
Stand-alone goods	1	2
Bundled goods	3	4

The transition from sales of copies to subscriptions is represented by a shift from (1) to (4) in Table 20. For some purposes, such as discrimination between consumers with different frequencies of use of a product, it is relevant to distinguish between a pay-per-use agreement and a pay-per-period agreement. Table 21 includes this distinction in its taxonomy of business models. As a tool for explanation, I include different ways of accessing equipment for working out in addition to the business models for recorded music. The reason for choosing working out as an example is not that it has much in common with recorded music, but it is an example where I was able to exemplify all six categories.

Table 21: Taxonomy of business models – Working out and Recorded music

		To own (A)	Per-use (B)	Per-period ©
Working out	Stand-alone (1)	A1 Buy spinning bike, weights, treadmill etc.	B1 Rent apparatus for single use.	C1 Rent equipment for a period
	Bundle (2)	A2 Buy a gym (or membership for life)	B2 Pay for each visit to gym	C2 Gym membership
Recorded music	Stand-alone (1)	A1 CD or download	B1 Pay-per-play; jukebox	C1 Rental CD; DRM download
	Bundle (2)	A2 Buy music collection	B2 [not defined]	C2 Streaming subscription

Table 21 contains six different business models, most of them have been employed for recorded music. A1 corresponds to paid downloads or physical records from brick-and-mortar shops. B1 represents any pay-per-use service. The traditional jukebox belongs in this

category. Ad-funded streaming services may also be placed in this category, if ads one has to suffer are considered a per-play payment. C1 represents rental CDs. This is not a common model globally, but Asai (2011) points out that renting of music CDs has been common in Japan, just like DVD-rental all over the world. This is also evident from the statistics of The Recording Industry Association of Japan, which reports there being 1844 record rental shops in Japan in 2019. The number of shops was at its maximum in 1989 with 6213, and has been decreasing steadily since (RIAJ, 2020, p. 19). In the non-tangible world, certain goods and services that are subject to Digital Rights Management may only be accessible for a limited period.[82] C1 is more important for other information goods such as software or newspaper subscriptions.

A2 is not a common business model, but *eMusic* provided a download-to-own subscription service. Boxed sets of CDs (or MP3-downloads) are also bundles on a smaller scale. One may also place the album format here, if singles and single track downloads are considered the stand-alone goods. B2 is not a possible model for music distribution under my definitions of units and per-use. A bundle available under pure pay-per-use (with payment per song) is not bundled.[83] Finally, C2 represents the à la carte streaming subscription model.

Previous papers in economics have compared such models, although not necessarily specifically for the music industry.

Difference between *to own* and *per-period* is a question of discounting the relevant number of future period payments and utilities. The difference between *per-period* and *per-use*, or between a fixed-fee subscription and metered pricing, is a question of *frequency per period* (usage rate). If the frequency per period is fixed, i.e. as in a journal or newspaper subscription, then per-use and per-period amount to the same. The difference between *to own* and *per-use* is a question of both discounting and the frequency of use.

A↔B – Purchase ↔ Pay-per-use: This transition has been analysed by, among many others, Balasubramanian et al. (2015). They model how consumers will divide themselves between

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[82] It is a matter of definition whether a subscription is a sale of a bundle or paid access to some good/service. The answer to this has to do with the degree of durability of the good. A newspaper subscription (especially online subscription) is paid access while a book club subscription is a series of unit sales if you are allowed to skip titles, and a bundle sale if you are not. See related discussion in Styvén (2007).

[83] A pay-per-use bundle may make sense in other markets, such as newspapers. If a single use can encompass more than one good, then the bundle is still a bundle.

buying, renting and not consuming information goods under various assumptions on competition. The choice between purchase and pay-per-use of a single good does not differ substantially from the choice between purchase and pay-per-use of a bundle.[84]

A↔C – Purchase ↔ Pay-per-period (renting): This choice has been thoroughly analysed through many decades, often in light of issues such as monopoly power, planned obsolescence/limited durability. Possibility of resale and sharing of a good is vital to the outcome. Coase (1972) gave us the *Coase conjecture* that a monopolist may have to sell durables at a low price if it cannot credibly limit output. This can be mitigated through renting instead of selling or through making the product less durable. While the latter is not relevant to digital goods with unlimited durability, Coase points out that shortened durability is very similar to leasing, as the consumer will repeatedly have to buy a replacement.

B↔C: Pay-per-play ↔ Pay-per-period (fixed-fee subscription): Fishburn and Odlyzko (1999) analyse competition between two firms that offer the same information service but use different fee arrangements: pay-per-play or fixed-price subscriptions. Equilibria are only found under special assumptions. In those cases, the provider of fixed-fee subscriptions tends to do slightly better than the other. Altmann and Chu (2001) explore how combining a flat-rate charge for a basic service with a usage-based charge for an expanded service can be advantageous for both suppliers and users.

1↔2 – Stand-alone goods ↔ Bundled goods: The choice between bundles and stand-alone goods is an old subject in economics. Stigler (1963) and Adams and Yellen (1976) provide early examples. Bakos and Brynjolfsson have provided analyses of bundling of information goods (Bakos & Brynjolfsson, 1999, 2000). They show how bundling, given certain assumptions, may maximise supplier profits by both extracting surplus from consumers and by minimising deadweight loss. Competition strongly favours the supplier that is able to supply the largest bundle. Their analyses can be applied equally well to purchase or pay-per-period. Chuang and Sirbu (1999) compare purchase of single academic articles to journal subscriptions. Aguiar and Waldfogel (2018) presents a model specifically for music streaming

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[84] Bundling may affect elasticities of substitution between the good/service in question and its potential substitutes. Thus, it may affect the market power of the retailer/service provider towards both rights holders and consumers. The difference is likely a question of degree, not of qualitative outcome.

services. They compare the alternative of a la carte and bundled options, and pit these to models against each other in a market where consumers can choose between them.

These are the vertical and horizontal comparisons. What we primarily want to compare is the diagonal A1↔C2. A formal model needed for analysing this transition from sales to bundle subscriptions should combine elements from models of the vertical comparison (specifically Bakos and Brynjolfsson, 1999, 2000) and elements from models of the horizontal comparison (specifically Balasubramanian et al, 2015).

9.1.1 **Music for sale, music for hire**

Rights holders' payment from music consumption has traditionally been subject to the consumers' discrete choice of buying/not buying. A music subscription means rights holders are paid according to how much consumers in fact listen to their works, i.e. rights holders are paid according to a model of *pay-per-use.* When the payment per use is calculated from a big pool where all listeners' payments and listening are aggregated into one, then we call this the *pro rata-model*, refer section 4.4.4.

Consumers of subscriptions, on the other hand, pay for *access* to music. If you at one point decide not to spend more money on music, you have no music left. If you had instead purchased records, you would still own the music you had previously bought. When not considering the bundling that is *also* involved in subscriptions, and if constant preferences are anticipated by the agents, then the key variable for consumers in the choice between buying and hiring is the discount rate of future payments and utility.

If a consumer every month buys recordings while considering a transition to streaming services, the gains from a transition may decrease, as the collection grows larger. This collection will be of little use after a transition. A subscriber that ends the subscription will not have access to any music, and will have to build a collection from scratch. The consumer will lose access to all that music he/she has learned to love. There is thus a lock-in effect – that gradually grows stronger – regardless of what option you choose. This is true regardless of the bundling, which we will return to below. To make a correct choice between buying recordings and renting access one needs to have correct expectations, not only of one's future preferences, but also of future prices.

While renting music is generally assumed to be a new phenomenon related to internet streaming services, this has also existed for CDs. According to Asai (2011) this model was widely adopted in Japan since the early eighties.

On the *supply* side, the subscription model resembles the pay-per-use model of information goods as described by Balasubramanian et. al. (2015). There is an important difference on the *demand side*: Music subscriptions are not pay-per-play but *pay-per-period* independent of use.

9.1.2 **Bundling goods**

In parallel with a transition from purchase to paid access, streaming services also bundle all recordings in its library into one good. You do not pay for access to a single track or album, but for the entire library.

From the seller's point of view, bundling can be very attractive under certain circumstances. Bundling allows the seller better to predict demand: Predicting a single consumer's valuation of a single good is difficult. But every consumer is likely to value at least parts of the bundle highly, especially if the bundle is large. Bakos and Brynjolfsson (2000) show how bundling goods may increase the share of the willingness to pay that can be extracted by the seller.

Product bundling is a common feature of imperfectly competitive markets. This is particularly true for information goods, such as computer software and cable or satellite TV.

Product bundling is most successful, from the seller's point of view, when:

- there are economies of scale in production (marginal cost of production is low),
- there are economies of scope in distribution (marginal cost of bundling is low,
- production set-up costs are high,
- bundling simplifies consumers' decision making and consumption,
- consumers have heterogeneous demands (preferences for different varieties),
- consumers have similar total valuation of all goods combined,
- perfect price discrimination is not possible,
- the number of goods included is high, and
- the number of consumers is high.

Among these, the point about consumers having similar total valuation is likely the strongest assumption to make in the case of music. When bundling is taken into consideration, the choice faced by consumers is more complex than the own/access choice for many other goods. An adequate comparison might be choice between buying a treadmill for home use and paying monthly fees to use all facilities at the gym. The key variable for consumers in the choice between single goods and a bundle is *usage diversity.*

9.2 The basics concepts – a discrete introduction

The purpose of the model presented in this chapter is *not* to understand the dynamics of a transition from one business model to another. It is to compare the consequences of a complete transition from the one to the other. I.e. comparative statics. While the model uses a continuous framework, I will start with introducing some basic concepts using discrete notation, as that is more intuitive to grasp.[85]

9.2.1 The consumer

We start by looking at a single consumer in a market with exogenous prices. In one setting, consumers demand 0 or 1 unit of each work of music available. In the second setting, they may choose to pay for access to *all* works, or they will not have access to any. Valuations for each good are heterogeneous among consumers. We use v_{ik} to denote a consumer k's valuation of good i. Consumer k's valuation of recording i is equal to the valuation per play, ϕ_k multiplied with the frequency of play, θ_{ik}.

$$v_{ik} = \phi_k \times \theta_{ik} \qquad (1)$$

Consumer k's valuation of the entire bundle is:

$$v_k = \sum_i \phi_k \theta_{ik} \qquad (2)$$

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[85] A *discrete framework* involves a countable number of recordings, consumers and firms. A *continuous framework* involve infinitely many infinitesimal agents. It is common to standardise their number to 1. While this is difficult to grasp for non-economists, it is mathematically very practical.

The consumer does not have a given budget constraint[86], but will, in the case of sales, purchase any good with a valuation $v_{ik} > p_u$. In the case of subscriptions, (s)he will subscribe if $v_k = \sum_i v_{ik} > p_s$.[87]

Sales of units:

$$u_{ik} = \begin{cases} 1 \; if \; v_{ik} > p_u \\ 0 \; if \; v_{ik} < p_u \end{cases} \qquad (3)$$

Subscriptions:

$$s_k = \begin{cases} 1 \; if \; v_k > p_s \\ 0 \; if \; v_k < p_s \end{cases} \qquad (4)$$

9.2.2 The supplier

Revenues to rights holder of recording i:

Sales of units:

$$\pi_{ui} = p_u \times \sum_k u_{ik} \qquad (5)$$

Subscriptions:

$$\pi_{si} = p_s \sum_k s_k \times \frac{\sum_k s_k \theta_{ik}}{\sum_l \sum_j s_l \theta_{jl}} \qquad k, l \in [0, \Omega] \qquad (6)$$

where the numerator is the sum of all plays of recording i by all subscribers and the denominator the sum of plays of all recordings by all subscribers.

9.2.3 In aggregate

Total valuation of all goods:

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[86] E.g. because music has a limited and flexible share of total budget spent on all goods.

[87] Subscript u indicates *unit*. Subscript s indicates *subscription*.

$$V = \sum_i \sum_k v_{ik} = \sum_i \sum_k \phi_k \theta_{ik} \qquad (7)$$

Total revenues from all recordings

Sales of units:

$$\pi_u = p_u \times \sum_i \sum_k u_{ik} \qquad (8)$$

Subscriptions:

$$\pi_s = p_s \times \sum_k s_k \qquad (9)$$

9.3 Initial assumptions of the model

Assumptions

1) Subscription services, record shops and everything upstream are collectively considered "suppliers". The supply side is modelled as a monopoly.

2) There are no (short run) costs associated with the provision of recordings

3) The distributor, or service provider, takes no share of revenues and there are no taxes. Consumer expenditure is distributed directly among rights holders according to the pro rata model.

4) The components of valuations (ϕ_k and θ_{ik}) are independently and identically distributed random variables.

5) Demand interdependence is constant and does not affect the total valuation of all recordings. It only affects the distribution of attention.

6) An increase in market size increases valuation of all recordings proportionately.

7) We will treat the supply of recordings as exogenous and constant.

8) We assume that suppliers of recordings will set identical prices on all recordings. This may be because they have insufficient a priori knowledge of where on the stochastic distribution of popularity a particular recording will be, or of the price elasticities of demand facing them, or that differential pricing is impractical.

9) Only one of two business models can exist: sales of units of music recordings or rented access through subscription services.

10) Resale is not possible.

11) The usage frequency is measured over an infinite time horizon, but the future is discounted.

12) All consumers and suppliers have the same discount rate.

13) A consumer will either subscribe in all periods or zero periods. Utility is constant.

14) Prices are constant over time.

Some justification for number 1 is needed. A monopoly is not *assumed,* but I assume the markets have traits that imply this modelling is not entirely unreasonable, at least when it comes to subscription services. The argument is made in section 8.9 at page 192. This assumption might possibly be more of a stretch when it comes to sales.

Corollary 1

> It follows from 4) that for a given market size, the valuations for individual goods do not change as the number of goods consumed changes: consumers' valuations are i.i.d. for all goods, and thus purely additive. There are no diminishing returns to variety in the model, i.e. different varieties (e.g. music recordings) are not at all substitutes to each other.

In this choice we follow Balasubramanian et al. (2015). The assumption is also common in the bundling literature, according to Bakos and Brynjolfsson (2000). Diminishing returns to variety would be very complex to incorporate into this model. In the real world, recordings will to some degree be substitutes, and the utility of a given variety will decrease if the consumer has access to many different varieties. By comparing relative sizes, i.e. *shares* of surplus and revenues, the assumption of additivity is of somewhat less concern.[88]

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[88] The presence of substitutability decreases each consumer's total valuation of the goods, and thus decreases profits for the supplier. (Bakos & Brynjolfsson, 1999, 2000) However, the presence of substitutability *increases* the supplier's *incentive to bundle*. (Belleflamme & Peitz, 2010, p. 266). I expect that if non-additive valuation was incorporated in this model, we would get the same results as those: Profits would be lower than I estimate here, both in the case of sales and subscriptions. But bundling would be relatively more profitable to suppliers compared to sales of recordings. Consumer surplus would be lower than estimated here, both for sales and subscriptions. But the consumers' *share* of total valuation would be *higher* than I have estimated in the case of sales, and *lower* than I have estimated in the case of subscriptions. In other words: total valuation and surplus would be less for all if there was substitutability. The difference in appropriability between the business models would increase.

Furthermore: I expect non-additivity to lead to higher concentration of revenues towards the head of the income distribution of rights holders. This effect might be less strong for subscriptions.

As we change assumptions on the distributions, variables will be normalised differently. The *size* of the pie cannot be compared across the assumptions. Only (at best) across business models.

Corollary 2

> If follows from assumptions 5) and 6) that demand interdependence does not constitute relevant externalities in the context of the model and therefore does not invalidate welfare implications from a partial equilibrium model.

Corollary 3

> It follows from assumptions 11)-14) that the price of a streaming subscription, p_s, can be considered the net present value of all future subscription payments, and the listening frequency is discounted likewise. Thus, only one period needs to be considered.

9.4 The variables of the continuous framework

The discrete framework in section 9.2 above is useful for a rough understanding of the model. The model is more useful in discrete setting, however, where distributions follow functions that can be integrated over.

The variables

θ_{ik}: Consumer k's frequency of use of recording i.

ϕ_k: This is a consumer specific variable. It denotes the valuation per play of music, much of which is due to the fact that some people have more money than others, but not more time to consume the music. The variable does not vary between recordings, as we assume different valuations of recordings will express itself through replay *frequency*.

d_k is another consumer specific variable. It is a diversity measure, and it measures the number of recordings consumer k has positive preferences over. The number of different recordings is the only variable that separates the avid listeners from the less active.

c_i is a recording specific variable. It is a popularity/quality measure that gives the number of strictly positive valuations of recording *i*.

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There are n varieties[89] available in the market, and Ω consumers.[90] A consumer k can be referred to by its traits d_k or ϕ_k depending on context. A recording can be referred to by c_i. Recordings and consumers do not have a natural ordering. The order depends on the trait in question. We will therefore, wherever possible, refer to the traits and not the recordings and consumers.

Maximum valuation-per-use (ϕ_k), maximum frequency of play of a recording (θ_{ik}) and maximum amount of recordings in the set that the consumer has positive preferences over (d_k), are all normalised to unity. These three are distributed $\sim U[0,1]$ (uniformly from zero to one).

Assumptions on distributions of variables

1. ϕ, θ, d and c are uncorrelated with each other.
2. Utility-per-play, ϕ is i.i.d. uniformly across $[0,1]$. The density is given by the amount of consumers: Ω. The realisations of the variable are consumer specific.
3. Consumer k has a strictly positive valuation of a subset $d(k)$ from the n existing recordings. The rest are valued at zero. d is i.i.d. uniformly and normalised to $U[0,1]$.[91] The density is given by the number of consumers: Ω. As d is normalised to a maximum of 1, n is also normalised, although only specified as $n \geq 1$. Although the *size* of the individual subsets are uncorrelated, the *elements* are correlated: Some recordings have a higher probability of being picked to each bundle of strictly positive valuations.
4. The correlation between valuations is approximated by assuming that a recording i is present in $c(i) \leq \Omega$ preference bundles. We have that $\int_{k=0}^{\Omega} d(k)\, dk = \int_{i=0}^{n} c(i)\, di = \frac{\Omega}{2}$ as both of these areas measure the amount of strictly positive valuations of recordings by consumers. Each of the n recordings has a value $c(i)$. Thus if we assume c is $\sim U[0, \frac{\Omega}{n}]$ then we get the density $\frac{n^2}{\Omega}$.

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[89] In the case of music, these can be considered individual tracks or albums. We assume an identity between a work, a recording and a release. The implications of this model also has relevance for films and TV-series, except that the consumption of such goods happen in more discrete increments, and the continuous model specification we will adopt might therefore be slightly less suitable.

[90] Both the number of recordings and the number of consumers are in the order of millions, such that their distributions can be assumed continuous.

[91] Maasø (2014b) finds that the 10 percent heavy users stream 18.5 times as much as the 10 percent lightest users. In our model, only d_k differentiates between heavy users and less heavy users. Using a uniform distribution, the heavy users are predicted to stream 19 times as much, so as far as our knowledge goes, this is an adequate assumption.

We assume that the non-zero valuations are all independent, but knowing whether a consumer values a recording at zero or positively increases our knowledge of the probability that another consumer values the same recording positively.

5. Frequency of play, $\theta(i,k)$ is $\sim U[0,1]$. The density is given by the total amount of non-zero valuations: $\int_{k=0}^{\Omega} d\ dk = \frac{\Omega}{2}$. Consumers that values a recording more than another recording will listen to their favourite more frequently. Thus, frequency is assumed to catch all consumer-specific variation in valuation.[92]

While the notation θ_{ik} is conventionally used for discrete variables, and $\theta(i,k)$ for continuous variables, I have below used them interchangeably as the discrete notation is more compact.

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[92] Maasø (2014c) finds that artists with a high *passion index* generally will do better in a user-centric model of distribution of revenues. This implies that those who listen a lot to an artist listen to few artists. I.e. a negative correlation between $\theta(i,k)$ and $d(k)$. However, this is calculated *per artist* and does not necessarily hold *per recording*.

$\phi(k)\sim U[0,1]$	$d(k)\sim U[0,1]$	$\theta\sim U[0,1]$	$\theta(k|i)\sim U[0,1]$	$\theta(i|k)\sim U[0,1]$	$c(i)\sim U[0,\Omega/n]$
$\phi(k)$	$d(k)$, $A=\dfrac{\Omega}{2}$	θ	$\theta(k|i)$	$\theta(i|k)$	$c(i)$, $A=\dfrac{\Omega}{2}$
$f(\phi)$	$f(d)$	$f(\theta)$	$f(\theta|i)$	$f(\theta|k)$	$f(c)$
$F(\phi)$	$F(d)$	$F(\theta)$	$F(\theta|i)$	$F(\theta|k)$	$F(c)$
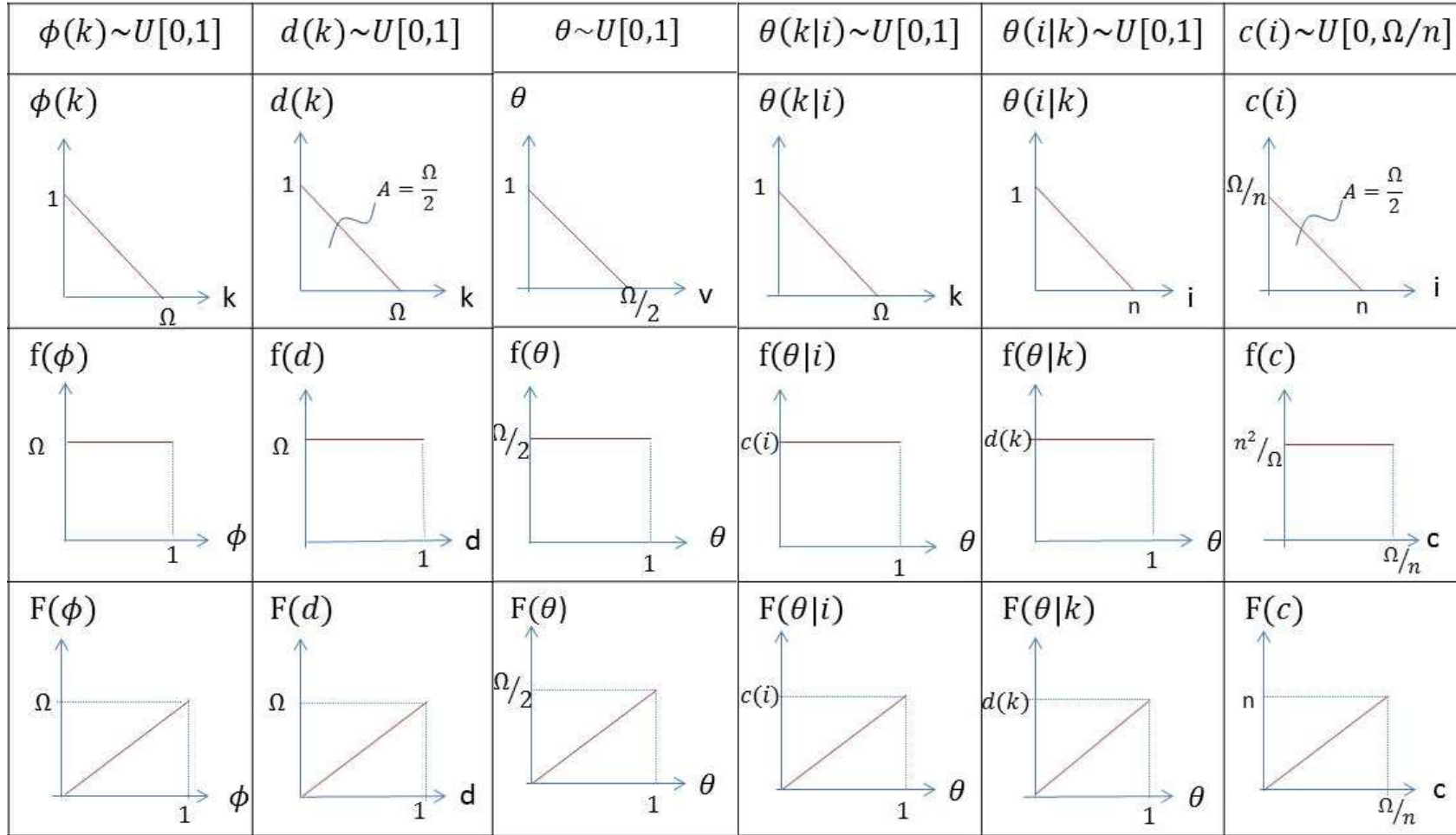
Figure 29: Distributions of the variables

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9.5 Sales of copies of music recordings

This section calculates the values the model predicts in the case of sales. We will subsequently turn to subscriptions.[93]

9.5.1 Distribution of valuations – sales

Total valuation of all recordings by all consumers:

We can find total valuation as the volume under $v(\phi, \theta) = \phi\theta$ over the region $R(v > 0) = \{\phi, \theta | 0 < \theta < 1, 0 < \phi < 1\}$ multiplied with the total amount of valuations $\frac{\Omega}{2}$:

$$V = \frac{\Omega}{2} \int_{\phi=0}^{1} \int_{\theta=0}^{1} \phi\theta \ d\theta \ d\phi \qquad (10)$$

$$= \frac{\Omega}{2} \int_{\phi=0}^{1} \frac{1}{2}\phi\theta^2 \ d\phi \ \bigg|_{\theta=0}^{\theta=1} = \frac{\Omega}{2} \int_{\phi=0}^{1} \frac{1}{2}\phi \ d\phi = \frac{\Omega}{2}\frac{1}{4}\phi^2 \ \bigg|_{\phi=0}^{\phi=1}$$

$$V = \frac{1}{8}\Omega \qquad (11)$$
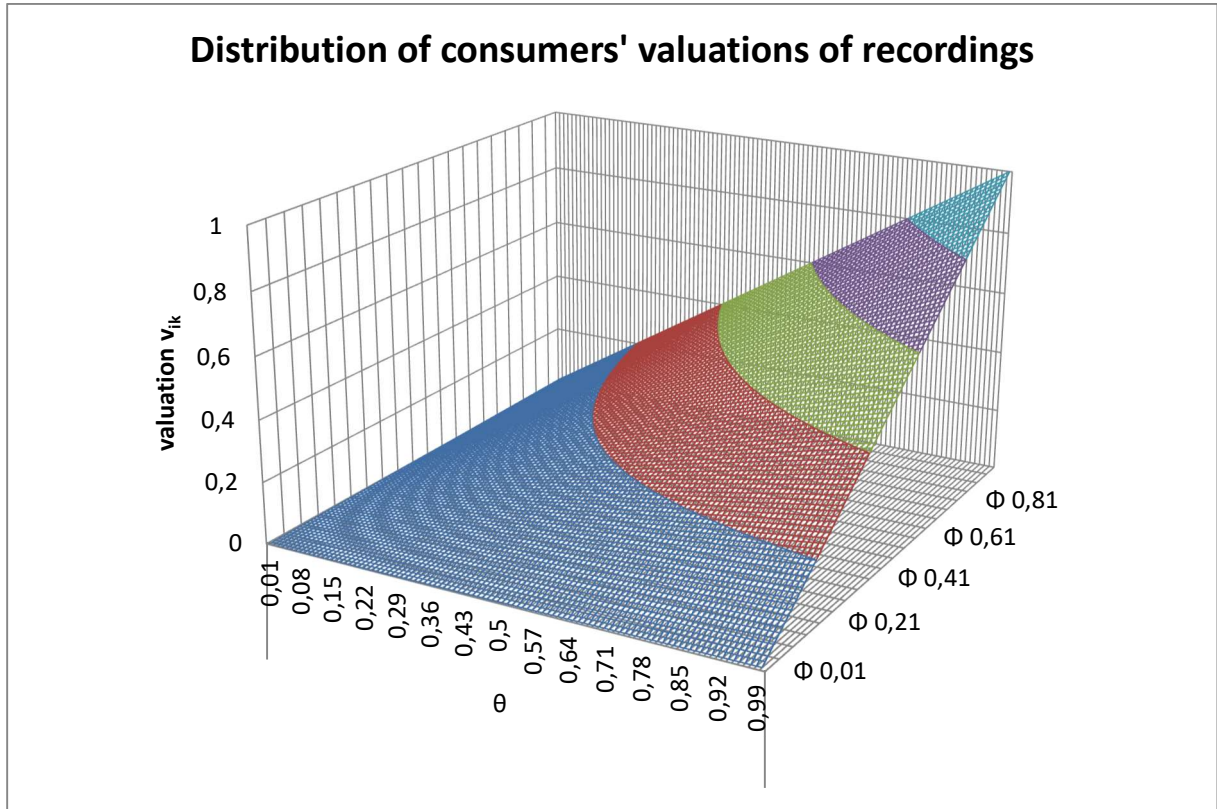
Figure 30: Valuation v as a function of ϕ and θ.

Probability of buying

As we assume that valuation is a product of independently and uniformly distributed factors distributed between zero and one, the joint probability density is, for uncorrelated distributions, equal to the product of the marginal distributions:

$$f(\phi, \theta) = f_\phi(\phi, \theta) f_\theta(\phi, \theta) = 1 \times 1 = 1$$

To find the probability of buying we must calculate the area where valuation is above price p_u. We integrate the probability function over the region $R(v > p_u) = \{\phi, \theta \mid p_u/\phi \leq \theta \leq 1, p_u \leq \phi \leq 1\}$:

$$P(v > p_u) = \int_{\phi = p_u}^{1} \int_{\theta = p_u/\phi}^{1} 1 \; d\theta \; d\phi \qquad (12)$$

To see how the limits of integration are found: consider Figure 31, where we have exemplified with $p_u = 0.3$.
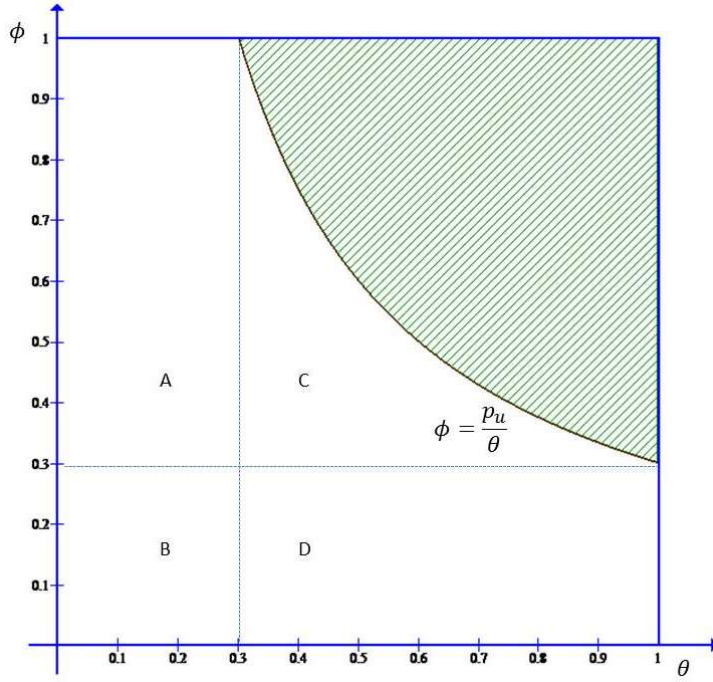
Figure 31: distribution of ϕ and θ. Area shaded implies $v_{ik} > p_u$.

The integral in (12) solves as:

$$P(v > p_u) = 1 - p_u + p_u \ln(p_u) \qquad (13)$$

Combined with equation (3) we have:

$$P(u_{ik} = 1) = 1 - p_u + p_u \, ln(p_u) \qquad (14)$$

We may then multiply with the total amount of non-zero valuations, $\frac{\Omega}{2}$ to get the amount sold:

$$count(u_{ik} = 1) = \frac{\Omega}{2}(1 - p_u + p_u \, ln(p_u)) \qquad (15)$$

It may also be useful for reference to find the marginal distribution of valuations. As

$$P(v > p_u) = 1 - p_u + p_u \, ln(p_u) \rightarrow F(v) = P(v < p_u) = -1 + p_u - p_u \, ln(p_u)$$

we have

$$f(v) = P(v = p_u) = \frac{\partial P(v < p_u)}{\partial p_u} = -\ln(p_u) \qquad (16)$$

9.5.2 Distribution of surplus – sales

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Supplier surplus

We can find price by maximising monopolist surplus[94] with respect to price:

$$\max_{p_u} \pi_u = \max_{p_u} p_u \times count(u_{ik} = 1) = \max_{p_u} p_u \frac{\Omega}{2}(1 - p_u + p_u \ln(p_u)]) \qquad (17)$$

$$\frac{\partial \pi_u}{\partial p_u} = \frac{\Omega}{2}(1 - p_u + 2p_u \ln(p_u)) = 0$$

This solves as:[95]

$$p_u \approx 0.285 \qquad (18)$$

(for any non-zero value of Ω .) Inserting into (17) and (14) this gives:

$$\pi_u = 0.0509\Omega \qquad (19)$$

$$P(u_{ik} = 1) = 0.358 \qquad (20)$$

Thus, at price 0.285, suppliers have a profit of 0.051Ω. 36 percent of the non-zero valuations result in purchased recordings.

Consumer surplus

We can express consumer surplus as the total valuation for all consumers with valuation above price p_u, net of *supplier profits* π_u. Figure 32 is an attempt at visualising this. The volume under the graph is total economic surplus. For $p_u = 0.3$ the supplier profits π_u are the volume behind the vertical surface, i.e. the base area of the graph multiplied with price. Consumer surplus is area under the graph that *above* $p_u = 0.3$.

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[94] "Profits", "surplus" and "revenues" can be used interchangeably, as there are no costs in this model.

[95] Numerical calculations are carried out with more decimals than reported.
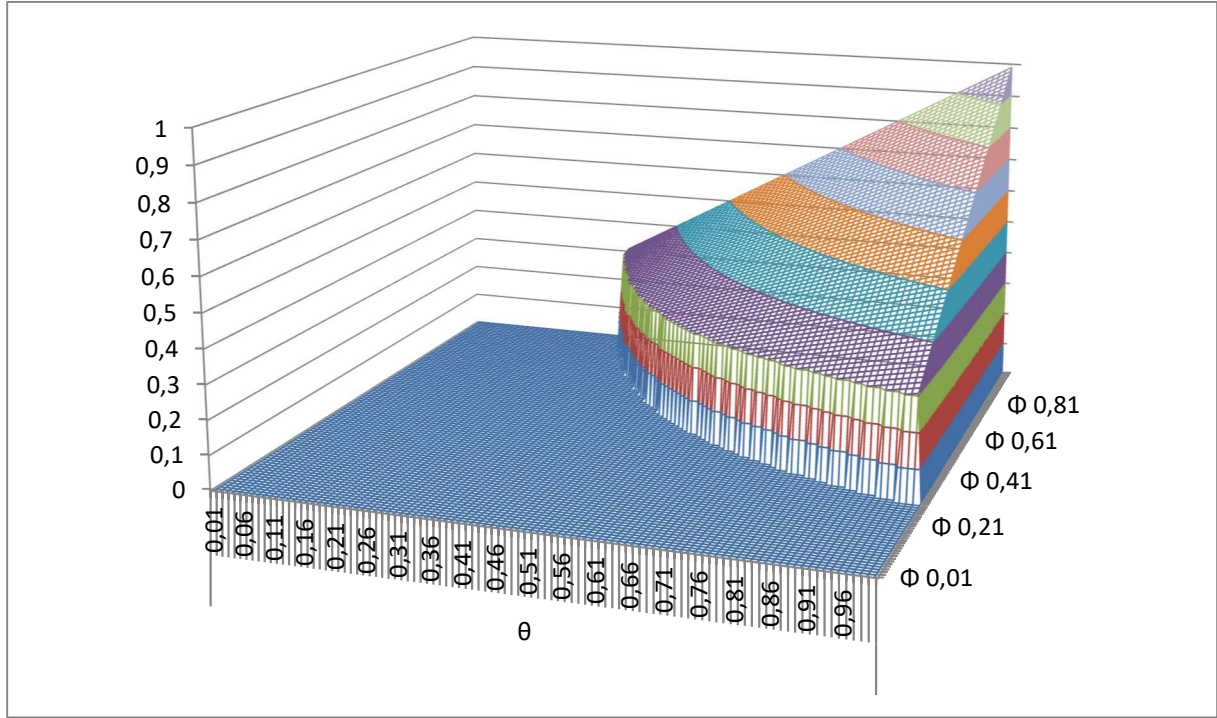
Figure 32: Consumer surplus and supplier surplus

$$CS_u = V_{p_u} - \pi_u = \frac{\Omega}{2} \int\limits_{\phi=p_u}^{1} \int\limits_{\theta=p_u/\phi}^{1} \phi\theta \ d\theta \ d\phi - \pi_u \qquad (21)$$

We need to calculate V_{p_u} (total valuation for consumers with valuation above p_u, the total volume in Figure 32) as the volume under $v(\phi, \theta) = \phi\theta$ over the region $R(v > p_u) = \{\phi, \theta | \ p_u/\phi \leq \theta \leq 1, \ p_u \leq \phi \leq 1\}$:

$$V_{p_u} = \frac{\Omega}{2} \int\limits_{\phi=p_u}^{1} \int\limits_{\theta=p_u/\phi}^{1} \phi\theta \ d\theta \ d\phi \qquad (22)$$

$$V_{p_u} = \frac{\Omega}{8} (1 - p_u^2 + 2p_u^2 \ln(p_u)) \qquad (23)$$

Inserting $p_u \approx 0.285$

$$V_{p_u} = 0.0894\Omega \qquad (24)$$

$$CS_u = V_{p_u} - \pi_u = 0.0894\Omega - 0.0509\Omega = 0.0385\Omega \qquad (25)$$

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Deadweight loss

Deadweight loss is an inefficiency: it is the consumer valuation of a good that would be sold if goods were priced at marginal cost, but that is not sold because price is above marginal cost. In our case marginal cost is zero, thus all valuations below price will be deadweight loss.

When calculating deadweight loss we calculate total valuation below the price. I.e. the volume under the valuation function where the valuation is below price, i.e. over the region $R(v < p_u) = \{\phi, \theta | \ p_u < \theta < 1, \ 0 < \phi < p_u/\theta\}$. Again, this must be multiplied with the amount of non-zero valuations $\frac{\Omega}{2}$:
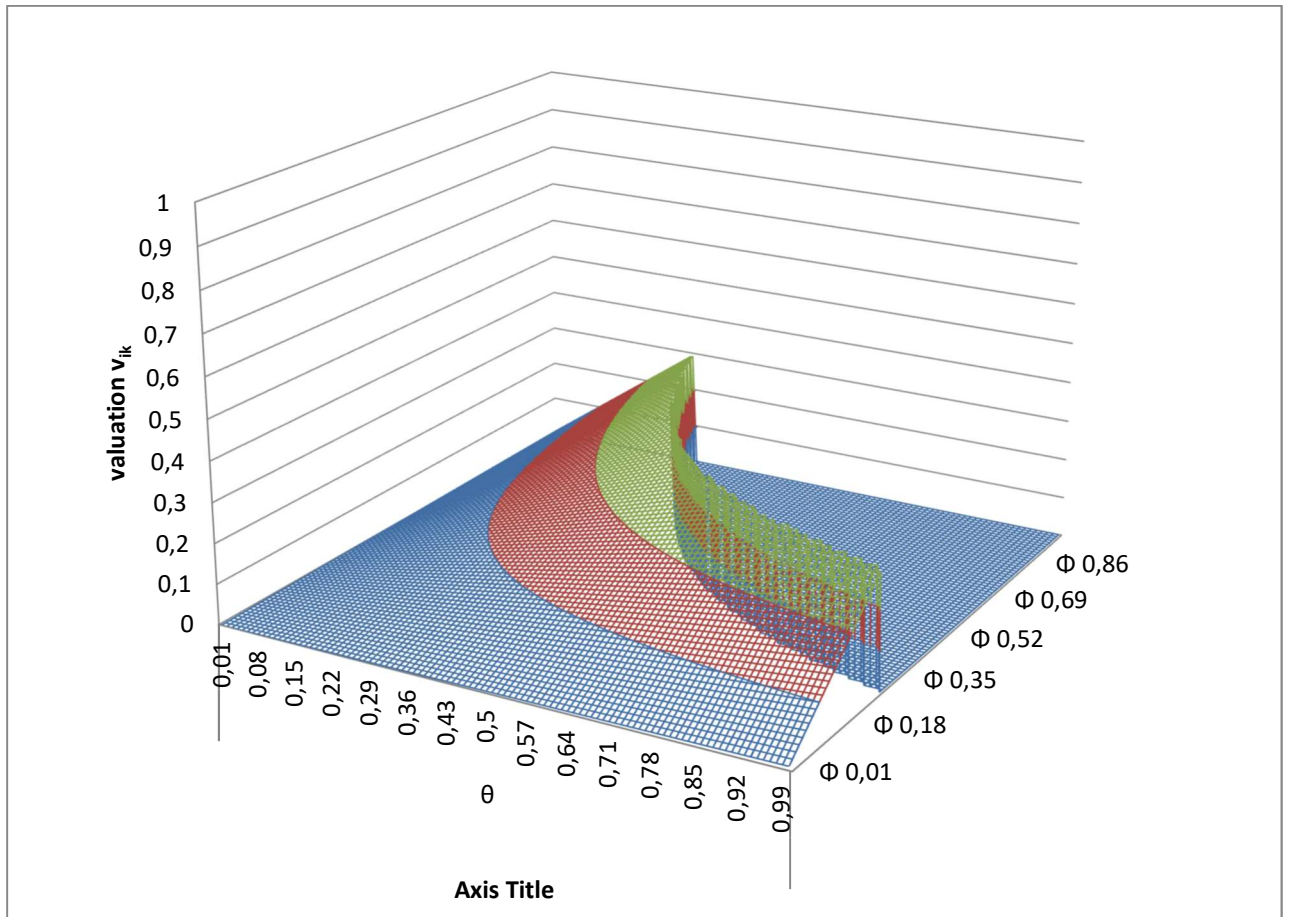
Figure 33: Deadweight loss

$$DW_u = \frac{\Omega}{2}\left[\int_{\theta=p_u}^{1}\int_{\phi=0}^{p_u/\theta}\phi\theta \ d\phi \ d\theta + \int_{\theta=0}^{p_u}\int_{\phi=0}^{1}\phi\theta \ d\phi \ d\theta\right] \qquad (26)$$

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The first integral of (24) covers $p_u < \theta$ (corresponding to C+D in Figure 31) and the second $p_u > \theta$ (corresponding to A+B in Figure 31). This solves as:

$$DW_u = \frac{\Omega}{4} p_u{}^2 \left(\frac{1}{2} - \ln(p_u)\right) \qquad (27)$$

Inserting $p_u \approx 0.285$:

$$DW_u = 0.0356\Omega \qquad (28)$$

Of course, deadweight loss can also be calculated residually from $V - CS_u - \pi_u = DW_u$

$$0.125\Omega - 0.0385\Omega - 0.0509\Omega = 0.0356\Omega$$

As the measured "size of the pie" will change as assumptions are changed below, it is convenient to calculate the distribution of surplus as shares of the total valuation.

Thus, combining (11), (19), (25) and (28), we can find the numbers expressed as shares of total valuation:

Consumer surplus' share of total valuation from sales of all goods:

$$\frac{CS_u}{V} = \frac{0.0385\Omega}{\Omega/8} = 0.308 = 30.8\ \%$$

Supplier surplus' share of total valuation from sales of all goods:

$$\frac{\pi_u}{V} = \frac{0.0509\Omega}{\Omega/8} = 0.407 = 40.7\ \%$$

Deadweight loss' share of total valuation from sales of all goods:

$$\frac{DW_u}{V} = \frac{0.0356\Omega}{\Omega/8} = 0.285 = 28.5\ \%$$

Under these circumstances $Prob(u_{ik} = 1) = 35.8\ \%$ of the non-zero valuations result in sales. (Refer equation (14)/(20).)

9.5.3 Distribution of revenues between recordings – sales

In our continuous framework we reinterpret (5) as:

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$$\pi_{ui} = \frac{P(u_{ik} = 1) \times c(i)}{\int_{j=0}^{n} P(u_{jk} = 1) \times c(j) \, dj} \pi_u \qquad (29)$$

where $c(i) = \frac{\Omega}{n} - \frac{\Omega}{n^2} i$. Based on $c(i)$ being uncorrelated with θ and thus valuation, we have that all recordings face the same probabilities of a given valuation being above price, i.e. $P(u_{ik} = 1) = P(u_{jk} = 1)$. Therefore $P(u_{jk} = 1)$ is a constant that can be separated from the integrand, and the equation simplifies:

$$\pi_{ui} = \frac{c(i)}{\int_{j=0}^{n} c(j) dj} \pi_u \qquad (30)$$

The denominator is, as explained in section 9.4, $\Omega/2$. Thus:

$$\frac{\pi_{ui}}{\pi_u} = \frac{2}{\Omega} c(i) \qquad (31)$$

We can calculate the share of profits associated with the 10 percent most popular recordings as:[96]

$$\frac{\pi_{u,10\%}}{\pi_u} = \frac{2}{\Omega} \times \int_{i=0}^{0.1n} c(i) \, di \qquad (32)$$

$$\frac{\pi_{u,10\%}}{\pi_u} = 19\% \qquad (33)$$

The share of profits associated with the bottom 50 percent:

$$\frac{\pi_{u,b50\%}}{\pi_u} = \frac{2}{\Omega} \times \int_{i=0.5n}^{n} c(i) \, di \qquad (34)$$

$$\frac{\pi_{u,b50\%}}{\pi_u} = 25\% \qquad (35)$$

9.6 Subscriptions

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[96] The top 20 percent will in this model receive 36 percent of revenues. That is considerably less than the 80 percent that is predicted from a Pareto distribution. Below, we will adjust assumptions to increase this share.

Next, we turn to subscriptions to see if the model predicts different implications for distribution of surplus if this emerging business model took over completely.

9.6.1 Distribution of valuations – subscriptions

We will calculate the same distributions of surplus as above in order to compare some implications of the different models. The joint distribution of frequency-of-play and utility-per-play is the same as before. Bear in mind that as we change the assumed distributions of some variables, the normalisation is different. The *shares* can be compared across assumptions, but *levels* cannot.

In the previous section, we were interested in each consumer's valuation of each recording. Now, we are interested in each consumer's valuation of *all recordings* bundled together. This adds a dimension and subtracts a dimension from the previous. We now care about how the total amount of listening is distributed across consumers. We have assumed that each consumer's frequencies of play of each recording are uniformly distributed from zero to one, but consumers may play a different amount of recordings. To take this into account, we include the previously defined variable $d(k)$. As we are not interested in the valuations of the individual recordings, we can replace the frequency dimension θ with its average value $\bar{\theta} = 1/2$.[97] This implies that consumer k's valuation of the entire bundle can be expressed as $V(k) = \int_{i=0}^{n} \phi(k)\theta(i,k) = \phi(k)d(k)\bar{\theta}$, i.e. valuation per play times number of recordings times average frequency of play per recording. Consumers that opt for a subscription are those with $V(k) = \phi(k)d(k)\bar{\theta} > p_s$. Thus, the cut-off is determined by $d(k) = \frac{p_s}{\bar{\theta}\phi}$. It also follows that $V(k)$ is distributed between 0 and ½, while in the case of sales $v(i,k)$ was distributed between 0 and 1.

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[97] When *n* variables independently distributed $U[0,1]$, are averaged over, we have, according to the Bates distribution $E(\bar{\theta}) = 1/2$ and $var(\bar{\theta}) = 1/(12n)$. Thus for a reasonably high *n* variance around the mean is negligible. I.e. $\frac{1}{n}\sum_{i=1}^{n} \theta_{ik} = \overline{\theta_k}$ will tend to the global mean $\bar{\theta}$ as *n* tends to infinity. For those consumers with few non-zero valuations variance will be higher, but we assume that the total valuation of these consumers are in any case too low to pay for a subscription, and their exact stochastic valuation is of less importance to the total valuation across all consumers and recordings. Thus we choose to use a deterministic distribution for our purposes, a distribution which gives $\bar{\theta} = 1/2$ for all k. With the continuous function, this is an identity.

Under the current assumptions, there is a strong symmetry between the two business models, resulting in all results below being identical to those for sales above. That is a useful benchmark to compare with results under alternative assumptions later on.

Total valuation of all recordings by all consumers:

The total valuation should intuitively be the same independent of distribution model, and that is indeed the case: We can find total valuation as the volume under $V(k) = \phi d\bar{\theta}$ over the region

$R(V(k) > 0) = \{\phi, d | 0 < \phi < 1, 0 < d < 1\}$ multiplied with the total number of consumers Ω:

$$V = \Omega \int_{\phi=0}^{1} \int_{d=0}^{1} \phi d\bar{\theta} \; dd \; d\phi \qquad (36)$$

$$= \Omega \int_{\phi=0}^{1} \frac{\bar{\theta}}{2} \phi d^2 \; d\phi \Big|_{d=0}^{d=1} = \Omega \int_{\phi=0}^{1} \frac{\bar{\theta}}{2} \phi \; d\phi = \Omega \frac{\bar{\theta}}{4} \phi^2 \Big|_{\phi=0}^{\phi=1}$$

$$V = \frac{1}{8}\Omega \qquad (37)$$

as $\bar{\theta} = 1/2$.

Probability of buying

As we assume that valuation per play and taste for variety are independently and uniformly distributed between zero and one, the joint probability is one everywhere:

$$f(d, \phi) = f_d(d)f_\phi(\phi) = 1 \qquad (38)$$

The share of consumers opting for a subscription can be found as:

$$P(s_k = 1) = P(V(k) > p_s) = \int_{\phi=\frac{p_s}{\theta}}^{1} \int_{d=\frac{p_s}{\theta\phi}}^{1} 1 \; dd \; d\phi \qquad (39)$$

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$$= \left[\phi - \frac{p_s}{\bar{\theta}} \ln(\phi) \right] \bigg|_{\phi = \frac{p_s}{\bar{\theta}}}^{\phi = 1}$$

$$P(s_k = 1) = 1 - \frac{p_s}{\bar{\theta}} + \frac{p_s}{\bar{\theta}} \ln \left(\frac{p_s}{\bar{\theta}} \right) \qquad (40)$$

We may then multiply with the number of (potential) consumers Ω to get the number of subscriptions:

$$count(s_k = 1) = \Omega \left(1 - \frac{p_s}{\bar{\theta}} + \frac{p_s}{\bar{\theta}} \ln \left(\frac{p_s}{\bar{\theta}} \right) \right) \qquad (41)$$

9.6.2 Distribution of surplus - subscriptions

Supplier surplus

We can find price by maximising monopolist surplus with respect to price, given
$P(s_k = 1) \leq 1$:

$$\max_{p_s} \pi_s = \max_{p_s} p_s \times count(s_k = 1) = \max_{p_s} p_s \Omega \left(1 - \frac{p_s}{\bar{\theta}} + \frac{p_s}{\bar{\theta}} \ln \left(\frac{p_s}{\bar{\theta}} \right) \right) \qquad (42)$$

$$\frac{\partial}{\partial p_s} \Omega \left(p_s - \frac{p_s{}^2}{\bar{\theta}} + \frac{p_s{}^2}{\bar{\theta}} \ln \left(\frac{p_s}{\bar{\theta}} \right) \right) = 0$$

$$= \Omega \left(1 - \frac{p_s}{\bar{\theta}} + 2 \frac{p_s}{\bar{\theta}} \ln \left(\frac{p_s}{\bar{\theta}} \right) \right) = 0 \qquad (43)$$

As $V(k)$ is distributed between 0 and ½, and profit maximising price cannot be higher than the highest valuation, we must look for a local maximum within this range. Inserting $\bar{\theta} = 1/2$, this solves as:

$$p_s \approx 0.142 \qquad (44)$$

Inserting into (42) gives a profit:

$$\pi_s = 0.0509\Omega \qquad (45)$$

and into (40) gives:

$$P(s_k = 1) = 0.358 \qquad (46)$$

Thus, at price 0.142, suppliers have a profit of 0.051Ω. 36 percent of consumers will subscribe to the service.

Consumer surplus

Total consumer surplus can be calculated as:

$$CS_s = V_{p_s} - \pi_s = \Omega \int_{\phi=\frac{p_s}{\theta}}^{1} \int_{d=\frac{p_s}{\theta\phi}}^{1} \phi d\bar{\theta} \ dd \ d\phi - \pi_s \qquad (47)$$

We need to calculate V_{p_s}:

$$V_{p_s} = \Omega \int_{\phi=\frac{p_s}{\theta}}^{1} \int_{d=\frac{p_s}{\theta\phi}}^{1} \phi d\bar{\theta} \ dd \ d\phi \qquad (48)$$

$$= \Omega \left(\frac{\bar{\theta}}{4} - \frac{1}{4\bar{\theta}} p_s{}^2 + \frac{1}{2\bar{\theta}} p_s{}^2 \ln\left(\frac{p_s}{\bar{\theta}}\right) \right)$$

Inserting $\bar{\theta} = 1/2$:

$$V_{p_s} = \frac{\Omega}{8} (1 - 4p_s{}^2 + 8p_s{}^2 \ln(2p_s)) \qquad (49)$$

Inserting $p_u \approx 0.142$ and $\bar{\theta} = 1/2$:

$$V_{p_s} = 0.0894\Omega \qquad (50)$$

$$CS_s = V_{p_s} - \pi_s = 0.0894\Omega - 0.0509\Omega = 0.0385\Omega \qquad (51)$$

Deadweight loss

We calculate deadweight loss residually:

$$DW_s = V - CS_s - \pi_s = 0.125\Omega - 0.0385\Omega - 0.0509\Omega = 0.0356\Omega \qquad (52)$$

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Combining (45), (50), (51) and (52), we can find the numbers expressed as shares of total valuation:

Consumer surplus' share of total valuation in the case of subscriptions:

$$\frac{CS_S}{V} = \frac{0.0385\Omega}{\Omega/8} = 0.308 = 30.8\,\%$$

Supplier surplus' share of total valuation in the case of subscriptions:

$$\frac{\pi_S}{V} = \frac{0.0509\Omega}{\Omega/8} = 0.407 = 40.7\,\%$$

Deadweight loss' share of total valuation in the case of subscriptions:

$$\frac{DW_S}{V} = \frac{0.0356\Omega}{\Omega/8} = 0.285 = 28.5\,\%$$

In this benchmark case, total valuation is unchanged between business models. A comparison of shares of surplus is therefore also a comparison of the absolute surplus appropriated by the stakeholders.[98] Under these circumstances $Prob(s_k = 1) = 35.8\,\%$ of people will subscribe to the service. (Refer equation (40)/(46)

9.6.3 **Distribution of revenues between recordings – subscriptions**

In our continuous framework we reinterpret (7) as:

$$\pi_{si} = \frac{\int_{k=0}^{\Omega} s_k \theta_{ik}\ dk}{\int_{j=0}^{n} \int_{l=0}^{\Omega} s_l \theta_{jl}\ dl\ dj}\pi_s \qquad k,l \in [0,\Omega] \qquad (53)$$

The numerator is the total amount of plays of recording i. The denominator is the total amount of play of all recordings. First: In the case of sales the purchase decision u_{ik} is correlated with θ_{ik}. But as mentioned, the shape and range of the distribution of θ is identical across consumers, only the number of valuations/recordings varies. Therefore s_k is not correlated with θ_{ik}, we can factor the numerator and denominator into:

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[98] As mentioned previously, both future payments and future replays are discounted with the same factor, so the one period considered represents net present value of benefits and costs to consumers and suppliers.

$$\pi_{si} = \frac{\frac{1}{\Omega}\int_{k=0}^{\Omega} s_k \; dk \times \int_{k=0}^{\Omega} \theta_{ik} \; dk}{\frac{1}{\Omega}\int_{l=0}^{\Omega} s_l \; dl \times \int_{j=0}^{n}\int_{l=0}^{\Omega} \theta_{jl} \; dl \; dj} \pi_s \qquad k, l \in [0, \Omega] \qquad (54)$$

and the decision to subscribe (s_k and s_l) cancels out.[99]

We can then replace the numerator: $\int_{k=0}^{\Omega} \theta_{ik} \; dk = c(i)\bar{\theta}$. Why? Recall that $\bar{\theta} = 1/2$ is the average number of potential plays across the non-zero valuations. The amount of plays can be expressed as the average expected number of plays times the number of non-zero valuations of recording i.

The denominator is the total amount of potential plays of all recordings by all consumers (subscribers or not). This is the same as the average amount of plays per person per recording ($\bar{\theta}$) times the amount of non-zero valuations. Thus

$$\int_{i=0}^{n}\int_{k=0}^{\Omega} \theta_{ik} \; dk \; di = \bar{\theta} \int_{k=0}^{\Omega} d(k) \; dk \qquad (55)$$

From the distribution of $d(k)$ we can find $d(k) = 1 - \frac{1}{\Omega}k$, and this simply solves as

$$= \frac{\Omega}{2}$$

This is inserted into the denominator:

$$\pi_{si} = \frac{c(i)\bar{\theta}}{\bar{\theta}\frac{\Omega}{2}} \pi_s = \frac{c(i)}{\Omega/2} \pi_s$$

$$\frac{\pi_{si}}{\pi_s} = \frac{c(i)}{\Omega/2} = \frac{2}{\Omega}c(i) \qquad (56)$$

exactly as for sales. The share of profits associated with the top 10 percent and bottom 50 percent are as for sales:

---

[99] When s_k is deleted from numerator and denominator the amount of plays is not limited to the actual replays through the subscription service, but includes the non-realised valuations of those that do not subscribe. We refer to this as the number of potential plays.

$$\frac{\pi_{s,10\%}}{\pi_s} = 19\%$$

$$\frac{\pi_{s,b5\ \%}}{\pi_s} = 25\%$$

9.7 Differences in replayability

Rights holders are paid from subscription services according to how much consumers listen to their works. This implies a permanent redistribution from music that does *not* lend itself easily to repeated listening, to that which does. The losers may be within certain genres or have a fan base that have a considerable budget available, but limited time.

Differences in replayability imply that θ_{ik}, the frequency of listening, will have a recording-specific element of "replayability" that is common across consumers. I.e. there is a correlation in frequency across recordings. We will now decompose θ into a recording specific factor and a random factor:

$$\theta_{ik} = \alpha_i \beta_{ik}$$

where α_i is a measure of how well suited a recording is for repeated listening. We will call this variable *replayability.* This composition of listening frequency implies that the variation is no longer uniformly distributed, but has a distribution where some consumer/recording combinations have a lot of replays, while there is a longer tail that sees few replays.

Maasø (2014a) shows, using data from Wimp (now Tidal), that during a nine week period 86 percent of recordings (tracks) that are listened to are listened to only once by the user. 14 percent of recording/listener combinations are streamed more, and this accounts for 72 percent of the amount of listening.[100] This implies that we should use a distribution such that the majority of user-recording combinations has a low value, and the head of the distribution is narrow. Therefore, we choose θ_{ik} to be the product of the two variables, and not the sum.[101]

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[100] The length of the tail that is not listened to at all is not specified.

[101] Using this distribution, 14 percent of the recording/listener combinations make up for 37.6 percent of the listening. Therefore, our assumed distribution is considerably less top-heavy than what Maasø finds for this nine week period.

We find the distribution as:

$$F(\theta) = P(\Theta < \theta) = 1 - \int\limits_{\beta=\theta}^{1} \int\limits_{\alpha=\theta/\beta}^{1} 1 \; d\alpha \; d\beta \qquad (57)$$

$$P(\Theta < \theta) = \theta - \theta \ln(\theta) \qquad (58)$$

$$f(\theta) = \frac{\partial P(\Theta < \theta)}{\partial \theta} = -\ln(\theta) \qquad (59)$$

9.7.1 Distribution of valuations – sales

From (12) we have:

$$P(v > p_u) = \int\limits_{\phi=p_u}^{1} \int\limits_{\theta=p_u/\phi}^{1} 1 \; d\theta \; d\phi \qquad (12)$$

As the marginal probability of θ is no longer 1 but $-\ln(\theta)$, this probability becomes:

$$P(v > p_u) = \int\limits_{\phi=p_u}^{1} \int\limits_{\theta=p_u/\phi}^{1} -\ln(\theta) \; d\theta \; d\phi \qquad (60)$$

Integrating over θ we get:

$$P(v > p_u) = \int\limits_{\phi=p_u}^{1} 1 - \frac{p_u}{\phi} \; d\phi + \int\limits_{\phi=p_u}^{1} \frac{p_u}{\phi} \ln\left(\frac{p_u}{\phi}\right) d\phi \qquad (61)$$

The first integral is simple and solves as $1 - p_u + p_u \ln(p_u)$. The second must be solved with integration by substitution, $u = \ln\left(\frac{p_u}{\phi}\right)$, $du = -\frac{1}{\phi}d\phi$:

$$\int \frac{p_u}{\phi} \ln\left(\frac{p_u}{\phi}\right) d\phi = -\int p_u u \; du = -\frac{1}{2} p_u u^2$$

Inserting $u = \ln\left(\frac{p_u}{\phi}\right)$:

$$= -\frac{p_u}{2} \ln\left(\frac{p_u}{\phi}\right)^2$$

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Applying the limits of integration:

$$= -\frac{p_u}{2} ln(p_u)^2$$

Thus:

$$P(v > p_u) = P(u_{ik} = 1) = 1 - p_u + p_u \, ln(p_u) - \frac{p_u}{2} ln(p_u)^2 \qquad (62)$$

We continue as in section 9.5.1:

Supplier surplus

We can find price by maximising monopolist surplus with respect to price, surplus given as the product of price, number of non-zero valuations and probability of purchase:

$$\max_{p_u} \pi_u = \max_{p_u} p_u \frac{\Omega}{2} \left(1 - p_u + p_u \ln(p_u) - \frac{p_u}{2} \ln(p_u)^2 \right) \qquad (63)$$

$$\frac{\partial}{\partial p_u} \frac{\Omega}{2} \left[p_u - p_u{}^2 + p_u{}^2 \ln(p_u) - \frac{p_u{}^2}{2} \ln(p_u)^2 \right] = 0$$

This solves as:

$$p_u \approx 0.166 \qquad (64)$$

Inserting into back into the profit function this gives:

$$\pi_u = 0.0223\Omega \qquad (65)$$

$$P(u_{ik} = 1) = 0.268 \qquad (66)$$

Thus, at price 0.166, suppliers have a profit of 0.022Ω. 27 percent of the non-zero valuations result in a purchase. One implication of this model specification should be pointed out: As $v = \alpha_i \beta_{i,k} \phi_k$, and the maximum value of each variable is 1, a recording with $\alpha_i < p_u$ will not be purchased by any consumer. As α_i is linearly distributed, this will be the case for a fraction p_u of the recordings, i.e. 16,6 percent.

Total valuation of all recordings by all consumers

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We can find total valuation as the volume under $v(\phi, \theta) = \phi\theta$ over the region $R(v > 0) = \{\phi, \theta | 0 < \theta < 1, 0 < \phi < 1\}$ multiplied with the total amount of valuations $\frac{\Omega}{2}$. The value function must now be multiplied with the density function, $f(\theta) = -\ln(\theta)$, which is no longer uniform:

$$V = \frac{\Omega}{2} \int\limits_{\phi=0}^{1} \int\limits_{\theta=0}^{1} \phi\theta \times (-\ln(\theta)) \; d\theta \; d\phi \qquad (67)$$

$$= -\frac{\Omega}{2} \int\limits_{\phi=0}^{1} \frac{1}{2}\phi\theta^2 \ln(\theta) - \frac{1}{4}\phi\theta^2 \; d\phi \left.\begin{matrix}\theta = 1\\ \theta = 0\end{matrix}\right. = -\frac{\Omega}{2} \int\limits_{\phi=0}^{1} -\frac{1}{4}\phi \; d\phi = \frac{\Omega}{16}\phi^2 \left.\begin{matrix}\phi = 1\\ \phi = 0\end{matrix}\right.$$

$$V = \frac{1}{16}\Omega \qquad (68)$$

which is half of what we had without differences in replayability. Note that this is solely due to variables being normalised differently.

Consumer surplus

Consumer surplus is total valuation for all consumers with valuation above price p_u, net of supplier profits π_u.

$$CS_u = V_{p_u} - \pi_u = -\frac{\Omega}{2} \int\limits_{\phi=p_u}^{1} \int\limits_{\theta=p_u/\phi}^{1} \phi\theta \times \ln(\theta) \; d\theta \; d\phi - \pi_u \qquad (69)$$

We need to calculate V_{p_u} as the volume under $v(\phi, \theta) = \phi\theta$ over the region $R(v > p_u) = \{\phi, \theta | \; p_u/\phi \le \theta \le 1, \; p_u \le \phi \le 1\}$:

$$V_{p_u} = -\frac{\Omega}{2} \int\limits_{\phi=p_u}^{1} \int\limits_{\theta=p_u/\phi}^{1} \phi\theta \times \ln(\theta) \; d\theta \; d\phi \qquad (70)$$

$$V_{p_u} = -\frac{\Omega}{8} \left[-\frac{1}{2} - p_u{}^2 \ln(p_u) + \frac{1}{2}p_u{}^2 - 2p_u \int\limits_{\phi=p_u}^{1} \frac{p_u}{\phi} \ln\left(\frac{p_u}{\phi}\right) d\phi \right] \qquad (71)$$

The latter part is solved with integration by parts and integration by substitution:

$$u = ln\left(\frac{p_u}{\phi}\right), \qquad v' = \frac{p_u}{\phi}, \qquad v = p_u \times ln(\phi), \qquad du = -\frac{1}{\phi}d\phi, \qquad dv = \frac{p_u}{\phi}d\phi$$

$$\int ln\left(\frac{p_u}{\phi}\right) \times \frac{p_u}{\phi}d\phi = ln\left(\frac{p_u}{\phi}\right) \times p_u \, ln(\phi) + \int p_u \, ln(\phi) \times \frac{1}{\phi}d\phi \qquad (72)$$

What comes before the integral on the right side is zero both for $\phi = p_u$ and $\phi = 1$. It may therefore be dropped. The last integral is solved with integration by substitution, $u = ln(\phi)$, $du = \frac{1}{\phi}d\phi$.

$$\int p_u \, ln(\phi)\frac{1}{\phi}d\phi = \int p_u u \times \frac{1}{\phi}\phi \, du$$

$$\frac{p_u}{2}u^2 = \frac{p_u}{2}ln(\phi)^2$$

Inserting back into (72):

$$\int ln\left(\frac{p_u}{\phi}\right) \times \frac{p_u}{\phi}d\phi = \frac{p_u}{2}ln(\phi)^2$$

then into (71):

$$V_{p_u} = -\frac{\Omega}{8}\left[-\frac{1}{2} - p_u{}^2 \, ln(p_u) + \frac{1}{2}p_u{}^2 - 2p_u\left[-\frac{p_u}{2}ln(\phi)^2 \, \bigg|\begin{matrix}\phi = 1\\\phi = p_u\end{matrix}\right]\right]$$

$$V_{p_u} = \frac{\Omega}{8}\left[\frac{1}{2} + p_u{}^2 \, ln(p_u) - \frac{1}{2}p_u{}^2 - p_u{}^2 ln(p_u)^2\right] \qquad (73)$$

With $p_u \approx 0.166$:

$$V_{p_u} \approx 0.0435\Omega \qquad (74)$$

Inserting into (69) along with the estimated profits:

$$CS_u = 0.0435\Omega - 0.0223\Omega = 0.0212\Omega \qquad (75)$$

Deadweight loss

We find the deadweight loss residually as $DW_u = V - CS_u - \pi_u$

$$DW_u = \frac{1}{16}\Omega - 0.0212\Omega - 0.0223\Omega = 0.0191\Omega \qquad (76)$$

9.7.2 Distribution of surplus – sales

Thus, combining (65), (68), (75) and (76), we can find the numbers expressed as shares of total valuation:

Consumer surplus' share of total valuation from sales of all goods:

$$\frac{CS_u}{V} = \frac{0.0212\Omega}{\Omega/16} = 33.9\,\%$$

Supplier surplus' share of total valuation from sales of all goods:

$$\frac{\pi_u}{V} = \frac{0.0223\Omega}{\Omega/16} = 35.6\,\%$$

Deadweight loss' share of total valuation from sales of all goods:

$$\frac{DW_u}{V} = \frac{0.0190\Omega}{\Omega/16} = 30.5\,\%$$

Under these circumstances $P(u_{ik} = 1) = 26.8\,\%$ of the non-zero valuations result in sales. Refer (62)/(66).

9.7.3 Distribution of revenues between recordings – sales

From (29) we have:

$$\pi_{ui} = \frac{P(u_{ik} = 1) \times c(i)}{\int_{j=0}^{n} P\big(u_{jk} = 1\big) \times c(j)\,dj}\,\pi_u \qquad (29)$$

In section 9.5.3 we had that all recordings faced the same probabilities of a given valuation being above price, i.e. $P(u_{ik} = 1) = P\big(u_{jk} = 1\big)$. The inclusion of α_i means that this is no longer the case. $P\big(u_{jk} = 1\big)$ now *cannot* be separated from from the integrand and simplified away. We have to calculate distribution of revenues somewhat differently from previously. The denominator is the total number of purchases, which is given by $\frac{\Omega}{2}P(u = 1)$. The real

difference from section 9.5.3 is that the probabilities in the numerator and denominator are not the same. $P(u_{ik} = 1)$ has to be found conditional on α_i.

$$P(u_{ik} = 1|\alpha_i) = P(\alpha_i \beta_{ik} \phi_k > p_u|\alpha_i) \qquad (77)$$

Recording i will have the profit

$$\pi_{ui} = P(\alpha_i \beta_{ik} \phi_k > p_u|\alpha_i) \times c(i) \times p_u$$

$$= P\left(\beta_{ik}\phi_k > \frac{p_u}{\alpha_i}\Big|\alpha_i\right) \times c(i) \times p_u \qquad (78)$$

$\beta_{ik}\phi_k$ follows the same distribution as $\theta_{ik}\phi_k$ did in section 9.5. Therefore:

$$P\left(\beta_{ik}\phi_k > \frac{p_u}{\alpha_i}\Big|\alpha_i\right) = \begin{cases} 1 - \frac{p_u}{\alpha_i} + \frac{p_u}{\alpha_i} \ln\left(\frac{p_u}{\alpha_i}\right), & \alpha_i \geq p_u \\ 0, & \alpha_i < p_u \end{cases} \qquad (78)$$

which corresponds to (13) as found in section 9.5.1. 16.6 percent of recordings have $\alpha_i < p_u$ which implies $v < p_u$ and no sale.
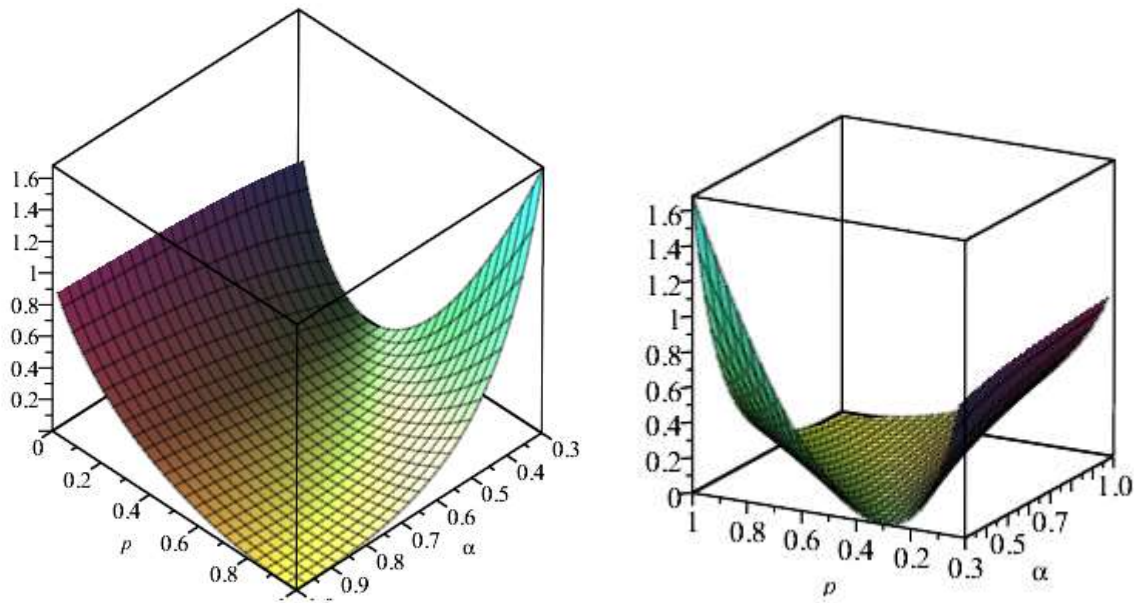
Figure 34: Profits associated with sales of recording i, as a function of price (p) and recording specific trait (α)

Thus:

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$$\pi_{ui} = \begin{cases} \left[1 - \dfrac{p_u}{\alpha_i} + \dfrac{p_u}{\alpha_i} \ln\left(\dfrac{p_u}{\alpha_i}\right)\right] \times c_i \times p_u, & \alpha_i \geq p_u \\ 0, & \alpha_i < p_u \end{cases} \qquad (79)$$

Profits associated with sales of recording i is shown in Figure 34, which is the same figure from two different angles. The figure only makes economic sense where $\alpha_i \geq p_u$, and the maximum value of profits is 1.

Total profits are given by price times the number of positive valuations times the probability of a positive valuation resulting in a purchase:

$$\pi_u = p_u \times \frac{\Omega}{2} P(u = 1) \qquad (80)$$

Thus:

$$\frac{\pi_{ui}}{\pi_u} = \begin{cases} \dfrac{P(\alpha_i \beta_{ik} \phi_k > p_u | \alpha_i) \times c_i \times p_u}{p_u \times \dfrac{\Omega}{2} P(\alpha_i \beta_{ik} \phi_k > p_u)}, & \alpha_i \geq p_u \\ 0 & \alpha_i < p_u \end{cases}$$

$$\frac{\pi_{ui}}{\pi_u} = \frac{2}{\Omega} c_i \times \begin{cases} \dfrac{1 - \dfrac{p_u}{\alpha_i} + \dfrac{p_u}{\alpha_i} \ln\left(\dfrac{p_u}{\alpha_i}\right)}{P(u = 1)}, & \alpha_i \geq p_u \\ 0, & \alpha_i < p_u \end{cases} \qquad (81)$$

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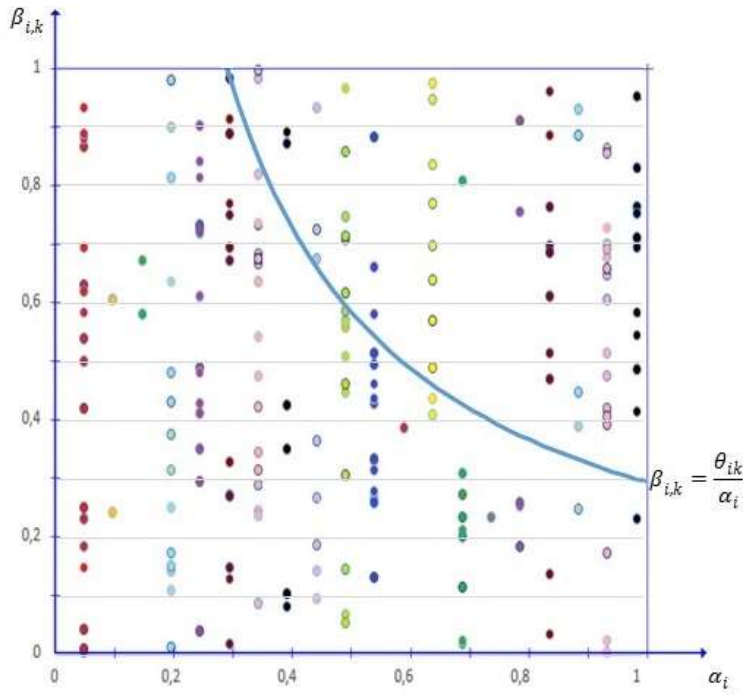
Figure 35: Interaction of α$_i$ and β$_{ik}$ in constituting θ$_{ik}$, and how c$_i$ is relevant

Figure 35 shows how α_i, the recording specific trait *replayability,* affects how high the stochastic term β_{ik} needs to be in order to reach a given level of θ_{ik}. Each colour represents a recording. The number of dots of a given colour represents c_i, the number of consumers that have a positive valuation of the given recording. Note that it is assumed that α_i, β_{ik} and c_i are independently distributed. The dots are ideally uniformly distributed throughout the area, while c_i(the number of dots of a colour) is uniformly distributed across $[0, \Omega/n]$ (represented as $U[1,20]$ in the figure). Let the blue curve represent the value of θ just high enough to result in a valuation above price=0.3 (and thus a purchase) for consumers with $\phi = 1$. The density of actual purchases increases towards the top left, as more values of ϕ are sufficient for purchase as α_i and β_{ik} increases in value.

As α_i, β_{ik} and c_i are independent, c_i is distributed $U[0, \Omega/n]$ also when only considering those recordings i with $\alpha_i \beta_{ik} \phi_k > p_u \rightarrow u_{ik} = 1$.

Now, the distribution of π_{ui} is the joint distribution of $P(\alpha_i \beta_{ik} \phi_k > p_u | \alpha_i)$ and c_i. To identify the most profitable recordings, we must locate the threshold values of i and j. (I.e. the threshold is the least profitable among the most profitable.

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$$\frac{\pi_{ui}}{\pi_u} = \frac{2}{\Omega}c(i) \times \begin{cases} \dfrac{1 - \dfrac{p_u}{\alpha_i} + \dfrac{p_u}{\alpha_i}ln\left(\dfrac{p_u}{\alpha_i}\right)}{P(u=1)}, & \alpha_i \geq p_u \\ 0, & \alpha_i < p_u \end{cases} \qquad (82)$$

We still have $\alpha_i = 1 - \frac{1}{n}i$ when recordings are sorted from highest to lowest α_i. We also have $c_j = \frac{\Omega}{n} - \frac{\Omega}{n^2}j$ when recordings are sorted from highest to lowest c_j. As α_i and c_i are uncorrelated, and the number of recordings is close enough to infinite, we can insert and integrate the expression over i and j. As we have profits as a function of i and j directly, recordings are uniformly distributed over the domain.

$$\frac{\pi_{ui}}{\pi_u} = \frac{2}{\Omega} \times \frac{\left[1 - \dfrac{p_u}{1-\frac{1}{n}i} + \dfrac{p_u}{1-\frac{1}{n}i}ln\left(\dfrac{p_u}{1-\frac{1}{n}i}\right)\right] \times \left[\dfrac{\Omega}{n} - \dfrac{\Omega}{n^2}j\right]}{P(u=1)}, \qquad i \leq n(1-p_u) \qquad (83)$$

The marginal recordings will have values of i and j such that they will be at the 10th percentile, counting from the *most* popular (lowest i). The iso-profitcurve made up by these recordings will border an area of $\frac{1}{10}n^2$ as the total variation of recordings make up an area n^2.

This area is given by:

$$\int_{i=0}^{i_{10}} \int_{j=0}^{j_{10}(i)} 1 \, dj \, di = \frac{1}{10}n^2 \qquad (84)$$

The upper limit of integration of i is the value of i that goes along with $j = 0$ to put us on the relevant iso-profitcurve. $j_{10}(i)$ then gives the iso-profitcurve. I.e. i_{10} is a constant while j_{10} is a function of i. We call this j that defines the 10th percentile j_{10}, and solve (83) for it. (The Ω's cancel out.)

$$j_{10}(i) = n^2\left(\frac{1}{n} - \frac{\pi_{10}/\pi_u}{\dfrac{2}{P(u=1)}\left[1 - \dfrac{p_u}{1-\frac{1}{n}i} + \dfrac{p_u}{1-\frac{1}{n}i}ln\left(\dfrac{p_u}{1-\frac{1}{n}i}\right)\right]}\right), \qquad i \leq n(1-p_u) \qquad (85)$$
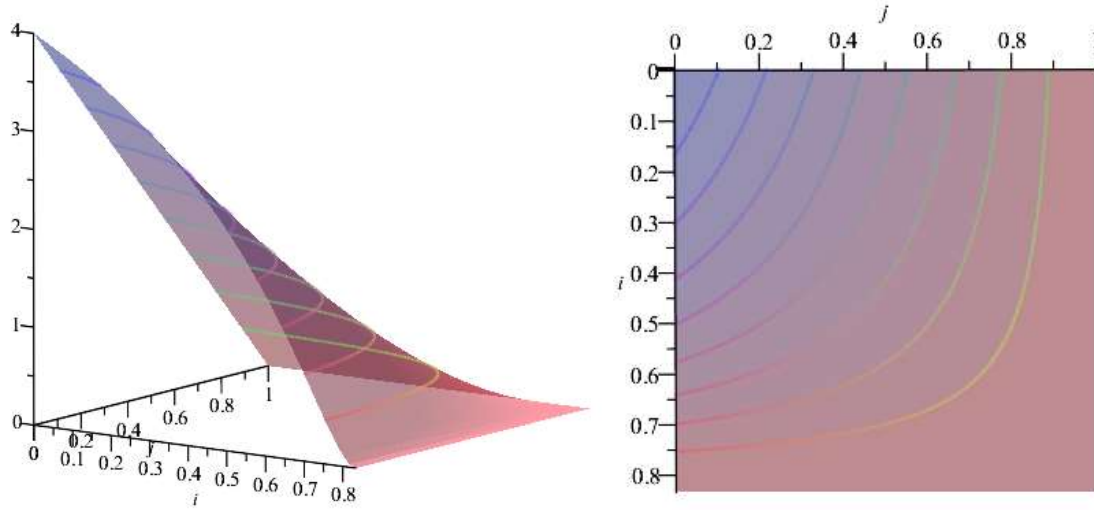
Figure 36: Profits as a function of i and j, sorted on descending value of α_i and c_i respectively

i cannot be solved for, but i_{10} is also given by (83) with $j = 0$. Both i_{10} and $j_{10}(i)$ are thus only functions of the profits and n.

We insert arbitrary values of π_{10}/π_u into these functions and use Maple to calculate the horizontal area bordered by the iso-profit curve. The inserted level of profits is modified manually until the area equals $\frac{1}{10}n^2$. That gives us the limits of integration, and we can integrate the profit function over this same domain:

$$\frac{\pi_{u,10\%}}{\pi_u} = \frac{1}{n} \int_{i=0}^{i_{10}} \int_{j=0}^{j_{10}} \frac{\pi_{ui}}{\pi_u} \, dj \, di \qquad (86)$$

The fraction $1/n$ is there to compensate for integrating over the same variable (recordings) twice.

To double check that our line of reasoning makes sense, we check that

$$\frac{\pi_{u,100\%}}{\pi_u} = \frac{1}{n} \int_{i=0}^{n(1-p_u)} \int_{j=0}^{n} \frac{\pi_{ui}}{\pi_u} \, di \, dj = 1$$

which it does. Finally, Maple gives us the solution:

$$\frac{\pi_{u,10\%}}{\pi_u} = 30.6\%$$

The share of profits associated with the bottom 50 percent is calculated in a similar manner:

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$$\frac{\pi_{u,b50\%}}{\pi_u} = 9.4\%$$

9.7.4 Distribution of valuations – subscriptions

Contrary to section 9.6.1, where each consumer's frequencies of play of recordings were uniformly distributed from zero to one, they are now, as in section 9.7.2, distributed according to

$$f(\theta) = -\ln(\theta)$$

This change has very limited impact on the solutions for subscriptions. The results are found as in section 9.6.1. Specifically, it is still true that we can replace θ_{ik} with its mean $\bar{\theta}$. While the average of θ_{ik} across consumers with our new assumptions will be different for each *recording*, the average of θ_{ik} across recordings will, through the law of large numbers, be the same for all *consumers* and will thus be the global mean $\bar{\theta}$.

Instead of $\bar{\theta} = 1/2$ we now have $\bar{\theta} = \int_{\theta=0}^{1} \theta \times f(\theta) = 1/4$. It follows from $V(k) = \phi(k)d(k)\bar{\theta}$, as given in section 9.6.1, that the maximum value of $V(k)$ is now ¼ and the search for a profit maximising price is restricted to a local optimum in $[0, \frac{1}{4}]$.

p_s, π_s, CS_s, DW_s and V_{p_s} are all exactly half of what they are in section 9.6.1.

9.7.5 Distribution of surplus – subscriptions

The distribution of surplus gives the same results as we got in section 9.6.2, as the effects of the change in $\bar{\theta}$ cancel out. Consumer surplus' share of total valuation in the case of subscriptions:

$$\frac{CS_S}{V} = 30.8\%$$

Supplier surplus' share of total valuation in the case of subscriptions:

$$\frac{\pi_S}{V} = 40.7\%$$

Deadweight loss' share of total valuation in the case of subscriptions:

$$\frac{DW_s}{V} = 28.5\ \%$$

Under these circumstances 35.8 % of people will subscribe to the service.

9.7.6 Distribution of revenues between recordings – subscriptions

From section 9.6.3 we have:

$$\pi_{si} = \frac{\frac{1}{\Omega}\int_{k=0}^{\Omega} s_k \ dk \times \int_{k=0}^{\Omega} \theta_{ik} \ dk}{\frac{1}{\Omega}\int_{l=0}^{\Omega} s_l \ dl \times \int_{i=0}^{n}\int_{l=0}^{\Omega} \theta_{il} \ dl \ di} \pi_s \qquad k,l \in [0,\Omega] \qquad (54)$$

and the decision to subscribe or not (s_k and s_l) cancels out as before. The denominator can be replaced with $\bar{\theta}\frac{\Omega}{2}$ as before, but the numerator is different due to θ_{ik} now having a recording specific factor α_i. We can now replace the integral in the numerator with the number of valuations of the recording multiplied with, not the global means of θ but, the recording specific means of θ:

$$\int_{k=0}^{\Omega} \theta_{ik} \ dk = c_i \bar{\theta}_i \qquad (87)$$

We go on:

$$c_i \bar{\theta}_i = c_i \frac{1}{\Omega}\int_{k=0}^{\Omega} \alpha_i \beta_{ik} \ dk = c_i \alpha_i \frac{1}{\Omega}\int_{k=0}^{\Omega} \beta_{ik} \ dk = \frac{c_i \alpha_i}{2}$$

The last equation comes from of $\beta \sim U[0,1]$.

Thus we have:

$$\pi_{si} = \frac{\frac{c_i \alpha_i}{2}}{\bar{\theta}\frac{\Omega}{2}} \pi_s$$

$\bar{\theta} = 1/4$ as stated in section 9.7.4.

$$\frac{\pi_{si}}{\pi_s} = \frac{4}{\Omega} \alpha_i c_i \qquad (88)$$

We reinterpret this as a plane on i and j. We insert for α_i and c_i to get:

$$\frac{\pi_{si}}{\pi_s} = \frac{4}{\Omega}\left(1 - \frac{1}{n}i\right)\left(\frac{\Omega}{n} - \frac{\Omega}{n^2}j\right) \qquad (89)$$

We proceed very similarly to what we did in section 9.7.3. We use Maple to find:

$$\frac{\pi_{s,10\%}}{\pi_s} = 28.8\%$$

And for the bottom 50 percent:

$$\frac{\pi_{s,b50\%}}{\pi_s} = 15.2\%$$

9.8 Outcome with non-linear popularity distribution

9.8.1 **Superstars**

The phenomenon of superstars happens when a lot of people for some reason listen to the same artists. This was extensively discussed in section 5.5. There is an interdependence between the individual valuations of artists. Such a phenomenon can be modelled using several different microeconomic foundations. Whether the demand interdependence is caused by bandwagon effects, informational cascades, herd behaviour, network effects or social pressure makes no distinction for this model. More important is the extent and shape of the interdependence. All of the mentioned effects may justify the adjustments made in this section.

The stronger the bandwagon effect, informational cascades or network effects, the more top-heavy will the popularity distribution be. We will now change the distributional assumption 4 on page 207 so that we do not have a uniform distribution of popularity, but one with a high, narrow head and a thin tail. Maasø (2014b), (2014c) gives us a popularity distribution from WiMP in Norway, but this is calculated on the level of artist and not the level of recording. So it does not have direct relevance here. We assume that the recordings are distributed along

popularity c_i according to an exponential distribution.[102] Thus $c_i = -\frac{\Omega}{2n} \ln\left(\frac{i}{n}\right)$. The total area under the popularity function is:

$$\int_{i=0}^{n} c_i \, di = -\frac{\Omega}{2n} \int_{i=0}^{n} \ln\left(\frac{i}{n}\right) di = \lim_{\epsilon \to 0} \frac{\Omega}{2n} \int_{i=\epsilon}^{n} \ln\left(\frac{i}{n}\right) di = \lim_{\epsilon \to 0} -\frac{\Omega}{2n}\left[i \times \ln\left(\frac{i}{n}\right) - i \, \Big|_{i=\epsilon}^{i=n}\right]$$

$$= \lim_{\epsilon \to 0} \frac{\Omega}{2n}\left[n + \epsilon \times \ln\left(\frac{\epsilon}{n}\right) - \epsilon\right] \qquad (90)$$

This is an improper integral, as the logarithm of zero is not defined. But $\epsilon \times \ln\left(\frac{\epsilon}{n}\right)$ tends to zero as ϵ tends to zero and we have that $\int_{i=0}^{n} c_i \, di = \frac{\Omega}{2}$ and also that $c_n = 0$. As these two traits of the function are identical to the linear case, the function is convenient.

Note that $c(i)$ approaches infinity as $i \to 0$. While infinite popularity sounds good, it is also impossible. But that is not of concern as long as we will only use the function to calculate profits for the top 10, top 20 and bottom 50 percent of recordings.

9.8.2 Superstars with no differences in replayability

This section assumes that superstars only differ from others by appealing to more consumers, and not by being better suited for repeated listening. This change affects both business models the same way. We begin by using the assumptions on individual frequency of listening from sections 9.5 and 9.6, thus we will again have the same result for both models. This change in popularity distribution does not affect the distribution of valuation between supplier surplus, consumer surplus and deadweight loss, nor the purchase/participation rate. It only affects distribution of revenues between recordings.

We can now calculate the new share of profits associated with the 10 percent most popular recordings as:

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[102] We have the exponential cumulative distribution $F(c_{rel}) = 1 - e^{-c_{rel}n}$ where $c_{rel} = \frac{\Omega}{2}c$, i.e. a popularity measure where scale is factored out. If n observations are distributed, then $F(c_{rel,i}) = 1 - \frac{i}{n}$ where i is the ith observation when they are distributed along *descending* value of c_{rel} (and c).

$$\frac{\pi_{u,10\%}}{\pi_u} = \frac{2}{\Omega} \times \int_{i=0}^{0.1n} c_i \, di = -\frac{2}{\Omega} \times \frac{\Omega}{2n} \int_{i=0}^{0.1n} \ln\left(\frac{i}{n}\right) di \qquad (91)$$

$$\frac{\pi_{u,10\%}}{\pi_u} = 0.1 - 0.1 \times \ln(0.1) \approx 33{,}0\%$$

Bottom 50 percent:

$$\frac{\pi_{u,b50\%}}{\pi_u} = \frac{2}{\Omega} \times \int_{i=0.5n}^{n} c_i \, di = -\frac{2}{\Omega} \times \frac{\Omega}{2n} \int_{i=0.5n}^{n} \ln\left(\frac{i}{n}\right) di \qquad (92)$$

$$\frac{\pi_{u,b50\%}}{\pi_u} = 0.5 + 0.5 \times \ln\left(\frac{1}{2}\right) \approx 15{,}3\%$$

This result is implied irrespective of business model.

9.8.3 **With differences in replayability – sales**

We now employ the new assumptions from section 9.7 and section 9.8.2 at the same time. I.e. we allow some music to be more suited for repeated listening than other music, and also a top-heavy distribution of popularity. The distribution of valuation between supplier surplus, consumer surplus and deadweight loss, and the purchase/participation rate, are all as in section 9.7. Again, we concentrate on the distribution of revenues between recordings.

We start from equation (81)

$$\frac{\pi_{ui}}{\pi_u} = \frac{2}{\Omega} c_i \times \begin{cases} \dfrac{1 - \dfrac{p_u}{\alpha_i} + \dfrac{p_u}{\alpha_i}\ln\left(\dfrac{p_u}{\alpha_i}\right)}{P(u=1)}, & \alpha_i \geq p_u \\ 0, & \alpha_i < p_u \end{cases} \qquad (81)$$

We still have $\alpha_i = 1 - \frac{1}{n}i$ when recordings are sorted from highest to lowest α_i. But, contrary to section 9.7.3 we now have $c(i) = -\frac{\Omega}{2n}\ln\left(\frac{i}{n}\right)$ when recordings are sorted from highest to lowest c_i. As α_i and c_i are uncorrelated, and the number of recordings is high enough to be considered infinite, we can insert and integrate the expression over i and j.

$$\frac{\pi_{ui}}{\pi_u} = \frac{2}{\Omega} \times \frac{\left[1 - \frac{p_u}{1-\frac{1}{n}i} + \frac{p_u}{1-\frac{1}{n}i} ln\left(\frac{p_u}{1-\frac{1}{n}i}\right)\right] \times \left[-\frac{\Omega}{2n} ln\left(\frac{j}{n}\right)\right]}{P(u=1)}, \qquad i \le n(1-p_u) \qquad (93)$$
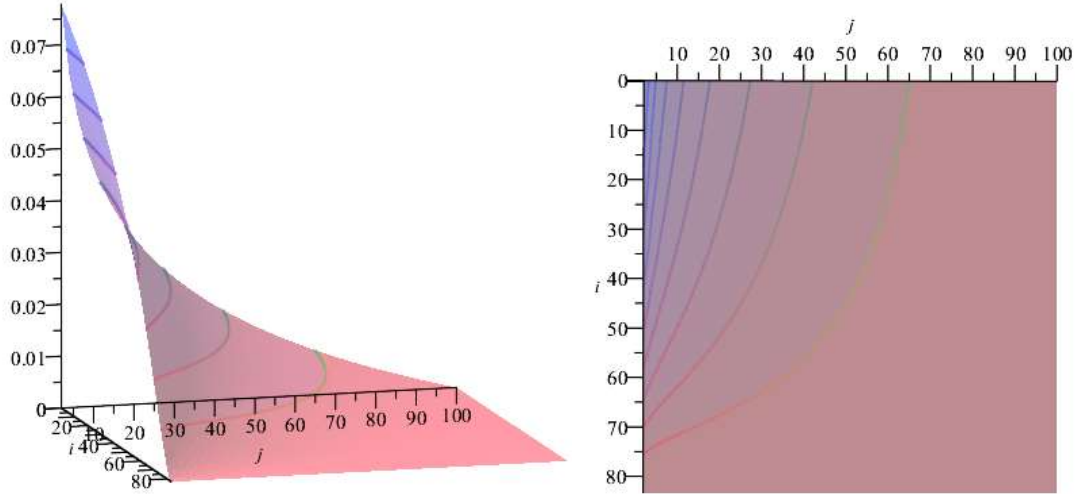
Figure 37: Profits as a function of i and j, sorted on descending value of α_i and c_i respectively

Again, we use Maple to find the horizontal area bordered by the top 10 percent, bottom 50 percent and, for a change, the top 20 percent:

$$\frac{\pi_{u,10\%}}{\pi_u} = 43.8\%$$

$$\frac{\pi_{u,20\%}}{\pi_u} = 65.3\%$$

$$\frac{\pi_{u,b50\%}}{\pi_u} = 5.9\%$$

9.8.4 With differences in replayability – subscriptions

Very similarly to section 9.7.6, we find the distribution of revenues between recordings. We start from equation (88):

$$\frac{\pi_{si}}{\pi_s} = \frac{4}{\Omega} \alpha_i c_i \qquad (88)$$

Inserting our new distribution of c_i along with the old distribution of α_i:

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$$\frac{\pi_{si}}{\pi_S} = \frac{4}{\Omega}\left(1 - \frac{1}{n}i\right)\left(-\frac{\Omega}{2n}ln\left(\frac{j}{n}\right)\right) \qquad (94)$$
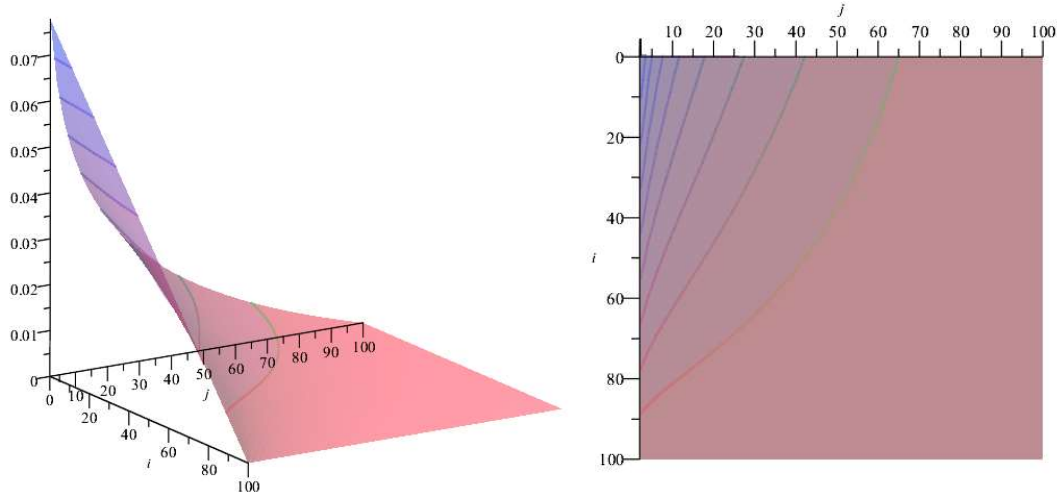
Figure 38: Profits as a function of i and j, sorted on descending value of α_i and c_i respectively

We use Maple to find:

$$\frac{\pi_{s,10\%}}{\pi_s} = 40.7\%$$

$$\frac{\pi_{s,20\%}}{\pi_s} = 60.9\%$$

$$\frac{\pi_{s,b5\ \%}}{\pi_s} = 10.1\%$$

9.9 Conclusions

Table 22 sums up the results I have presented in this chapter.

Table 22: Distribution of surplus among consumers, suppliers and deadweight loss, and among popular and less popular works.

Frequency θ_{ik}	Popularity c_i		Sales, percent	Subscriptions, percent
No correlation	Linear		Section 9.5	Section 9.6
		Consumers' share	30.8	30.8
		Suppliers' share	40.7	40.7
		Deadweight loss	28.5	28.5
		Surplus (CS+SS)	0.0894Ω	0.0894Ω
		Top 10%' share	19	19
		Bottom 50%' share	25	25
		Opting in	35.8	35.8
Correlation	Linear		Section 9.7.2 - 9.7.3	Section 9.7.4 - 9.7.5
		Consumers' share	33.9	30.8
		Suppliers' share	35.6	40.7
		Deadweight loss	30.5	28.5
		Surplus (CS+SS)	0.0435Ω	0.0447Ω
		Top 10%' share	30.6	28.8
		Bottom 50%' share	9.4	15.2
		Opting in	26.8	35.8
No correlation	Non-linear		Section 9.8.2	Section 9.8.2
		Consumers' share	30.8	30.8
		Suppliers' share	40.7	40.7
		Deadweight loss	28.5	28.5
		Surplus (CS+SS)	0.0894Ω	0.0894Ω
		Top 10%' share	33.0	33.0
		Bottom 50%' share	15.3	15.3
		Opting in	35.8	35.8
Correlation	Non-linear		Section 9.8.3	Section 9.8.4
		Consumers' share	33.9	30.8
		Suppliers' share	35.6	40.7
		Deadweight loss	30.5	28.5
		Surplus (CS+SS)	0.0435Ω	0.0447Ω
		Top 10%' share	43.8	40.7
		Top 20%' share	65.3	60.9
		Bottom 50%' share	5.9	10.1
		Opting in	26.8	35.8

Consumers vs suppliers

In the base case with neither correlation in listening frequency nor non-linear popularity distribution, consumer surplus as a share of total valuation is 31% regardless of business model. Suppliers' surplus is at 41%. Allowing some music to be better suited for repeat listening than other music (correlated listening frequency) reduces suppliers' share and increases consumers' share in the case of sales, while these are unaffected in the case of subscriptions. Non-linear popularity does not change anything in this regard. As there is nothing in the assumptions concerning supply or demand that alter valuation between business models, "the size of the pie" can be measured by the sum of consumer surplus and supplier surplus.[103] The model, with the assumptions made on distributions, implies that the size of the pie does not change significantly between business models. This result rests very strongly on the assumption of additive valuations, i.e. that recordings are not substitutes and that increasing variety features constant returns. Thus the direct comparison of total welfare is more dependent on strong assumptions than the other results.

Balasubramanian et al. (2015) finds that consumer surplus is always higher under selling than pay-per-use, while supplier surplus is higher under pay-per-use (assuming low transaction costs). This is in line with my findings for subscriptions when listening frequency is correlated across consumers, i.e. some recordings are better suited for repeat listening. We may add that deadweight loss is higher under selling.[104]

Bakos and Brynjolfsson (2000) finds that "bundling substantially reduces the average deadweight loss and leads to higher average profits for the seller. As *n* increases, the seller captures an increasing fraction of the total area under the demand curve, correspondingly reducing both the deadweight loss and consumer's surplus relative to selling the goods separately." They specify that "although the *per-good* consumers' surplus converges to zero as the bundle grows, the *total* consumers' surplus from the bundle may continue to grow". As I, contrary to Bakos and Brynjolfsson (2000), let people differ in their total valuation of the

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[103] When comparing *across assumptions*, this is not true, as the components of valuations are normalised differently.

[104] The present model is unnecessarily complicated for analysing pay-per-play, but it accommodates it. I have only done some calculations for the base case of no correlation of listening frequency and linear popularity. I find that Consumer surplus makes up ¼, Supplier surplus ½ and deadweight loss makes up ¼, very much in line with Balasubramanian et al.

sum of goods, consumer surplus does not converge to zero, it converges to the above results.[105]

In the base case, bundling makes valuation less heterogeneous by levelling out the effect of listening frequency (θ_{ik}). With the assumed uniform distributions, this effect is exactly offset by the assumption that some listeners are interested in more recordings than others, something which makes the valuation of the bundle *more* heterogeneous. I have, contrary to Bakos and Brynjolfsson (2000), assumed that some consumers have a significantly higher total valuation than others. I believe that is a decisive advantage of this model.

According to the model, "suppliers" are more likely to benefit more from a transition to subscriptions than consumers are. Some may raise their eyebrows over this. The distribution of revenues between service providers, record companies, artists and composers is outside the scope of the model. Furthermore, as the real world is currently in a state where consumers can choose between sales and subscriptions, and where the threat of unlicensed copying still lurks in the shadows, service providers are probably not able to charge anything close to the monopoly prices assumed by this model. The present model supports previous theoretical findings that access to bundles is a greater advantage to suppliers than to consumers, although this might be mitigated by factors that are difficult to model. Some of these factors may be transitional (price of subscriptions are likely to increase towards the modelled level only as market saturation draws close) while others may be permanent (reduction of search and transaction costs).

Head vs tail

In the base case, the 10% most popular recordings get 19% of the revenues. The 50% least popular get 25%. The share of revenues appropriated by the head increases with each adjustment to the model. Correlated listening frequency leads to stronger inequality in the case of sales. With correlated frequency and non-linear popularity, the top 10% get 44% in the case of sales, compared to 41% in the case of subscriptions. The bottom 50% get 6% in the case of sales, compared to 10% in the case of subscriptions. The top 20% lose as much from the transition to subscriptions as the bottom 50% gain. The extremely long and thin tail

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[105] In my model, the number of goods is infinite and bundling is complete. So, every scenario of this model compares to convergence in Bakos and Brynjolfsson (2000).

of digital music is difficult to capture with a simple function, and large parts of this extreme tail is non-existing in the case of physical sales. The numbers calculated here can therefore not be compared directly to the distribution of listening in a given service. That comparison would be as unequal as comparing distribution of physical sales to the distribution of digital sales, as discussed in section 5.7.1.

If all rights holders are paid a fair share of streaming revenues, proportional with the number of streams, then subscriptions are likely to benefit owners of less popular recordings. There are three reasons for this, two of which are captured by the model: (1) Producer surplus increases, (2) a larger share of that surplus is captured by the tail, and (3) in real life, the marginal recordings are practically non-existent in brick-and-mortar stores. It is important to add that many, possibly most, of those recordings in the tail are old recordings that might sit in the catalogues of the major record companies and remunerate only the descendants of dead artists.

This interesting outcome on distribution of revenues is the result of correlation in the individual valuation of individual recordings (specifically, some music is better suited for repeat listening). I consider the model specification with correlated listening patterns and top-heavy popularity distribution the most realistic. The other results serve to show that the findings concerning distribution of revenues are to some extent vulnerable to changes in assumptions.

Implications

This chapter has made an effort to line up the key concepts and implications of streaming subscription services and model it all rigorously. The results are in line with previous contributions, but I apply it specifically to the business model of subscriptions to large bundles of information goods. It is my hope that I have added to the literature, and that it can be part of the foundations of future research. There are important redistributional effects of the new business model, which may in turn affect creation and welfare. New technology and new business models therefore potentially have important policy implications.

PART IV
Final discussions, conclusions and recommendations

10 Wrapping up the discussions

The last decade has taken us from a situation where sales of CDs and paid downloads were threatened by file sharing, to a new situation where all of those are close to being eradicated by music subscription services supplemented with various free streaming services.

Subscriptions are well suited for consumers that have broad interest in music. With a subscription, each consumer can more easily adopt a broader pattern of listening than they had before. At an aggregate level, however, this does not necessarily add up to less concentrated demand towards artists. Streaming may potentially have strengthened the superstar phenomenon even if each consumer consumes a greater variety, if listeners increasingly listen to the same music. With the terms from chapter 5, we can state that *concentration of demand* can be strong in spite of *cultural omnivorousness* if *demand interdependence* is strong and/or *consumer heterogeneity* is low. Technical features, such as recommendation systems, may affect the result.

Fads and fashions may be important in connection with subscription services. Following fads and frequently switching favourite music has no monetary costs. Those that are followers of fashion in the first place, will be more attracted towards subscriptions. Subscriptions may potentially also have an opposite effect, as consumers are free from the curation of radio stations and record shop owners, and thus are not only free to follow fashion, but also free to *not* follow fashion.

The economic sustainability of the subscription streaming model is debated. Although the markets have had a decade to mature, it seems services still struggle to make a profit. Streaming services typically pay around 70 percent of revenues to rights holders. These revenues are distributed among rights holders. Revenues to rights holders are on the rise, but there are concerns about how those revenues are distributed.

This thesis provides a study into proliferation of services and subscriptions and the effect the services have had on other formats as well as the profits and utility of some of the agents involved. Different formats for music storage have coexisted and rivalled each other through most of the last hundred years. Yet, the transition from sales of copies of recordings to the system of temporary paid access to music is arguably the most revolutionary transition of them all. More so than the transition from tangible to intangible formats. The transition

implies new ways of accessing, e.g. that consumers depend on being online. Most importantly, the model of a fixed consumer payment per month combined with rights holder remuneration per play potentially leads to significant redistribution.

I have discussed a range of characteristics of the markets for recorded music and the nature of the changes in the industry and consumer demand. I have applied a broad range of economic theory to the questions, and discussed the relevance of different contributions. The thesis contains empirical evidence on the substitutability of formats, i.e. to what extent various ways of acquiring and consuming music cannibalise each other. A theoretical model is developed in order to evaluate the distribution of revenues between various stakeholders.

10.1 Who are the music subscribers?

In chapter 6, I presented some findings concerning the characteristics that are typical for music subscribers. The data come from a survey of a representative panel in the Netherlands in 2013. Subscribers to music services turn out to consume more music, more books and more films through any mode available. They are on average more than ten years younger than non-subscribers are, and they have a stronger tendency towards academic schooling.

The most important take-away from the cluster analyses conducted is that consumers *do not* fit neatly into distinct clusters. The one group that stands out from the rest throughout the tests attempted is that of the *non-consumers*. The *heavy users* also tend to get a separate cluster, while *pirates* and *bookworms* come and go as specifications of the analysis changes. Even the one relatively strong cluster of non-consumers varies quite a lot in how many observations belong to it. At this level, *univores* is not an important category, and I thus find no support for an important distinction between omnivores and univores in terms of choice of media. The main distinction is between those that consume music, film and books on the one hand, and those that do not consume much of anything on the other. There is slightly stronger evidence for *technological univores,* i.e. that some people prefer one and only one technological format, but univores is not an important concept either in terms of variants of technology nor different media.

10.2 Transition of formats

In this thesis, I have tried to evaluate how formats of music substitute for each other. The results are shown in chapter 7. The direction of the causal effect is mostly undetermined, but the problem of unobserved heterogeneity is hopefully taken care of. The analysis shows, in line with the investigation into who the music subscribers are, that those who consume music in some format, tend to consume it in other formats as well. It also shows that those who consume music also tend to consume books and films. The fact that some people are more interested in culture, and that some have more money to spend than others, implies that there is an unobserved heterogeneity present, and this complicates analyses of substitutability. I have utilised two different approaches in an attempt to overcome this obstacle. The results indicate that paid downloads and free music both are complements to physical recordings, while piracy and subscriptions, unsurprisingly, are substitutes. Subscriptions appear to be complementary to paid downloads, which is a surprising result. Physical recordings and free music are possibly *also* complements to downloads, while piracy is a substitute to paid downloads.

Contradictory and surprising results may indicate that substitutability is not the most important concept in this context. The more important question concerns development over time. New technology produces new products and services, and preferences may change. Over time, a good may replace another good that many individuals perceived as complementary to it. Thus, development on a macro level may be difficult to detect on an individual level, especially at a given point in time.

10.3 Treading the fine line

The review in chapter 8, of previous contributions on the industrial organisation of supply chains and multi-sided markets, yields some results that might be applicable to music subscription services. The revenue sharing model might constitute a form of vertical control that may counter the *double marginalisation problem* associated with supply chains with market power in consecutive stages. The revenue sharing model, which can be considered an *ad valorem fee*, is likely the solution that is most profitable to rights holders. The effect on consumer utility is ambiguous. Consumer price may increase, and because of that, a greater variety of services may be supported (Gallini & Winter, 1983; Tirole, 1988, chapter 4). Revenue sharing may not be the most beneficial to individual streaming platforms.

Allowing music rights holders (record companies, publishers and copyright collectives) to set a price floor or a price ceiling for music subscription services increases profits of rights holders. Profits are likely to increase also for service providers as price competition is reduced. The effect on consumer welfare is ambiguous. It depends on whether competition, absent price regulation, yields a price that is too high (in which a ceiling is beneficial to consumers and a floor might be detrimental) or if it brings too little variety (in which case a price floor is beneficial to sufficiently many consumers and a price ceiling might be detrimental (Gallini & Winter, 1983). Entry of new services is likely in the best interest of consumers as it increases variety. Price will be lower, as long as the effect of increased competition outweighs the effect of less efficient scale. Mergers of existing services are likely not in the interest of consumers (Anderson & Peitz, 2020).

The two-tier freemium model may be the platforms' profit-maximising strategy for a reasonably general set of assumptions (Sato, 2019). If competing platforms choose different business models, then social welfare may increase, but only by increasing platform profits, mostly at the expense of advertisers and consumers (Zennyo, 2019).

Music listeners may find advertising a nuisance and may not pay enough attention to it for it to have strong marketing effect. This contributes to ad-supported streaming services not being profitable alone. They must be offered as an alternative to paid subscriptions. The ad-supported tier has the dual function of serving a share of the market with low willingness to pay, and to allow people to experience streaming before they are potentially converted into paying subscribers. It is possible that the most important function of ads is to be a nuisance, i.e. to increase the relative value of the premium tier. Marketing may only be a secondary function. An ad valorem fee might entail less advertising than if platforms paid a fixed fee per replay or per consumer to rights holders (Bombana & Marchese, 2012).

A competition among services to bid for exclusive content to music recordings is likely to be detrimental to both the winners and the losers of the auctions (Ordover et al., 1990). It is also detrimental to consumers. There might possibly be something to gain for rights holders in the short run, but such a practice may quickly push consumers towards unlicensed alternatives and may also lead to consolidation towards monopoly among subscription services.

Network effects and economies of scale are strong factors that work towards the market consolidating on one common service (Eisenmann et al., 2006; Rysman, 2009). I am able to

identify two counteracting forces: These are consumer heterogeneity on the one hand, and the strategic dispositions of powerful representatives of rights holders on the other. The former can be eliminated by a consolidated service operator providing several differentiated variants to satisfy the various preferences of consumers. This implies that, to my understanding, the only real force that can keep the market contestable in the long run is the strategic dispositions of rights holders. While individual artists and independent record companies might gain from signing exclusive deals, it is unlikely that the major record companies will gain from this in the long run. The minor agents are not coordinated and will not individually affect the balance of the system. The majors will affect that balance, however, and it does not take any coordination, only a little bit of foresight, so see that contributing to a war of exclusivity might cause them harm. As long as the licensing decisions are strongly influenced from the top of the major record companies, I believe we will have a competitive market with several strong music streaming services.

The main structures of the current model may well be the best to ensure high rights holder revenue and happy consumers at the same time. Changes to the status quo may easily lead to monopolisation or to services with too incomplete catalogues of content. This may spur consumers to switch to unlicensed alternatives which are certain to pop up.

Rights holders are unlikely to appreciate a monopolised streaming service unless they control that service, for instance that the major record companies have shared ownership of a subscription service. I believe the majors have the means to ensure contestability through the terms at which they license music. If rights holders increasingly allow for exclusive licensing of content, then most forces align to pave the way for strong consolidation. That is most likely the reason rights holders have been reluctant to exclusive licensing.

10.4 Distributional aspects of subscription services

The transition from sales of units of music to paid access to music subscription services can be decomposed into two separate changes. One is a transition from stand-alone goods to bundles and the other is from ownership to renting. As discussed in chapter 9, this implies that there are two quite separate traditions in economics that are highly relevant to understand the changes that has been underway in music markets through the last decade. The model presented in chapter 9 incorporates features from these two traditions, and I have presented

implications that the transition has, subject to assumptions on characteristics of demand. The model predicts that suppliers of music are likely to benefit more from a complete transition to subscriptions than consumers are. Under the most plausible assumptions explored in the model, artists that reside in the long tail will gain from the transition. The bottom 50% of the popularity distribution receives at least 10% of revenues from subscriptions, compared to 6% in the case of sales. The 10% most popular 41% in the case of subscriptions compared to 44% in the case of sales. I fail to see any reason why the subscription model and the big pool revenue sharing model would harm niche artists compared to a situation with sales of units. If such effects are present, they are presumably either a result of artists' contracts with record companies or of altered consumer preferences, neither of which subscription services can be blamed for.

11 Implications, predictions and recommendations

11.1 Implications for policy

While *policy* is often thought of as something shaped at the level of national or international politics, relevant policies may be shaped by any type of organisation. I believe that the findings of this thesis have implications for the policies of governments as well as other stakeholders. Below, I will sketch some recommendations.

It took a decade or so to convince and coordinate stakeholders to make their content available for streaming services (Silver, 2013). When an agreement finally emerged, this agreement may not be easy to change. The same inertia that made the agreement difficult to arrive at, may also make the agreement resistant to change. If changes are found to be necessary or welfare enhancing, they may have to be imposed by authorities, as the stakeholders themselves are unlikely to agree on fundamental changes.

11.1.1   What governments should do

Recouping an initial investment takes much longer with streaming services than with sales, since payment-per-replay has replaced initial purchase. In all likelihood, revenue streams have been redirected from young and active artists to well-established, and even the heir of dead, artists. This is a direct consequence of the payment-per-play royalty model. An implication is that the effect copyright has on incentives to create have been weakened. While the threat of piracy pushed authorities to strengthen copyright law enforcement globally, the current revolution appears not to have led to any revision of copyright law being considered. If copyright term was already too long, then that is even truer now. A shorter copyright term would to a larger extent distribute revenues to creators that still create. This might be the only way to move revenues from old to new content.[106]

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[106] This argument assumes revenue distribution works the same way as now, except that works in the public domain is left out of the denominator of the big pool model. It is possible to think of alternatives, such as using the collected revenues for grants to active artists.

I believe governments should consider these two suggestions that might improve efficiency and perceived fairness of the copyright system:

- Revenues should predominantly be paid to music that is relatively new, in order to stimulate creation of new works. Royalties-per-play introduces a permanent lag in revenues for rights-holders, something that weakens incentives to create. Furthermore, the transition to a new model leads to a one-time redistribution of expected revenue streams: Productions that got its investments covered by record sales decades ago additionally capture a sizeable share of revenues today. This is inefficient and will also be considered unfair by many. This suggestion may be difficult to implement without drastic changes to copyright law.

- The relevant authorities should consider applying compulsory licensing schemes to both music recordings and musical works. If these licensing schemes are based on percentages of revenue, this will avoid the double marginalisation problem while also ensuring profits are distributed between stakeholders in a just and welfare enhancing manner. The advantages of such *ad valorem* fees are argued in chapter 8.

Competition authorities have a difficult task in judging when market power is detrimental to welfare and what forms of mergers, integration and collusion should be avoided. Proper modelling of the specific markets is necessary, as well as more data. Nevertheless, I would hereby postulate a few preliminary hypotheses on what is most important for regulators to regulate.

- Collusion among rights holders may not be the biggest threat, unless they undermine the interests of other rights holders, such as independent record companies. If collecting societies or record companies become too greedy, then government bodies may have to replace certain relevant voluntary licenses with new statutory licenses.

- Vertical integration in which major record companies buy streaming services, or the other way around, seems to bring a lot of problems. A unified effort from the major record companies to buy and build one monopolist service will likely yield both a too high price and too low variability to consumers. If each major company acquires a different streaming service, it seems likely they will not fully cross-license and services will become complementary to each other instead of substitutes. This is

expensive and cumbersome for consumers, and many may resort to unlicensed alternatives.

- No acquisitions leading to mergers between major streaming services should be allowed. Competition is needed in order to keep prices down, royalties up and consumer choice up.

Governments have a very important role to play. However, many issues considered in this thesis requires international solutions. Convincing and coordinating governments in order to change international treaties is a slow and tedious process at best. But certain issues can be solved through voluntary adoption by the platforms themselves.

11.1.2 **How platforms should change**

Platforms should probably introduce subscription tiers based on the number of streams replayed. There might be a charge per replay above a certain threshold, or one may have several tiers, say max 5 hours per month, max 50 hours per month, and max 500 hours per month. It will thus be possible for services to extract a larger share of the willingness to pay, while also accommodating better those with a low willingness to pay. Rights holders would get a less variable compensation per play, and consumers will probably experience the new model as more just. It would mitigate possible problems with multiple users sharing the same subscription, and it will also make the fraudulent use of streaming bots much less profitable (refer section 4.4.4). Such practice constitutes a very significant threat to the current business model. Price differentiation would reduce the differences between the *pro rata* model and the *user-centric* model in terms of revenue distribution. It is difficult to see the downsides of such a policy, except that it might potentially push a few avid listeners to unlicensed services. It might, however, be difficult to coordinate streaming services into adopting such a model. Even if it succeeds, it might possibly be considered illegal collusion.

If platforms cannot be coordinated into adoption of the model, and if price difference between tiers is significant, consumers that stream little would be the only ones to use tiered services while all the avid listeners would stick to the all-you-can-eat services. It is difficult to evaluate how such a splitting of the market would harm or profit services. It depends on negotiations with rights holders and it would surely affect the image of services that only appealed to those least interested in music.

Differentiating the music content of the services is likely to lead to stronger cross-side network effects and a push towards monopolisation. Bidding for exclusive content may be detrimental to the profits of both the service winning the bid and those that lose, even in the short run. In the long run, one service may win the market, but that may be a shrinking market as extensive exclusivity is likely to push consumers towards unlicensed services.

Differentiation through services being part of a larger ecosystem of hardware and software might also have troubling implications for the long-term contestability of markets. I have not discussed that much in this thesis. Other ways of differentiating platforms, however, may not lead down the same path. In general, differentiated services *increase* the likelihood that many services are able to contest the market in the long run. Sustainable specialisation probably includes differentiation along fidelity, recommendation systems, design and image. Such specialisation may be profitable to all platforms and have an ambiguous effect on consumer welfare.

11.1.3 **What rights holders should require**

Licensing music to only one service exclusively increases the chances of one service triumphing over the others. That will lead to the service being able to execute more market power towards consumers, advertisers, record companies and collecting societies. Having a single monopolist service is likely less socially efficient than having several contenders. The fixed costs are very unlikely to be high enough to outweigh the costs associated with a monopoly. Rights holders probably have the motives and the means to avoid monopoly.

In the long run, exclusivity either leads to services that are very different from each other in terms of repertoire, and thus considered as complementary goods by consumers, or it leads to consolidation towards a monopoly. In both cases, the price consumers must pay to access "all" music might be prohibitively high, and consumers will gravitate towards unlicensed alternatives.

The free, ad-supported tier of subscription services is disliked by many rights holders, as it yields little revenues. If this tier was abolished, it would also have to have consequences for YouTube, which is a strong competitor that operates with terms that differ from those of music subscription services. Removing the free tier would likely require the introduction of more than one paid tier in line with discussions in section 11.1.2**Error! Reference source not**

found., or those with a low willingness to pay will migrate to unlicensed alternatives. An alternative might to remove the tier completely might be to restrict it to only be available to new users for a limited period.

Active creators, along with record companies and publishers without a vast catalogue of old recordings, would probably gain from a substantial decrease in the duration of copyright. The very substantial revenues paid by subscription services could to a much larger extent be paid to active creators instead of to the heirs of dead creators. The major rights holders of catalogue content would do a huge favour to artists and society in general if they agreed to cut the length of copyright protection on recorded music.

12 Future research

Most of the readers of this thesis will agree that it is important to make good music as available as possible to as many as possible, while also ensuring fair remuneration for rights holders. Regarding the specific measures that should be taken, there will be heated disagreements, however. Researchers should advocate the relevant measures that will secure well-functioning music markets in the future. In order to do that, there is a range of questions that are important to find answers to. This thesis provides some answers. Some are only answered very tentatively. And some questions are only posed.

The duration of copyright protection is a question as old as copyright. Very long copyright protection might not provide optimal incentives to create music when combined with the new business model that has emerged as dominant. This much I have argued in the present thesis. Exactly how decisive this is, as well as the optimal length of copyright protection, we cannot say without knowledge of how revenues are distributed along the age of recordings. Such research is reviewed in section 5.8, but it is conducted on data prior to streaming took over. This field of research should receive renewed attention.

The previously much-heralded belief in micro-payments have not come to fruition. On the contrary, fixed subscription fees are the order of the day. It is far from certain that this will last. Further research is needed in order to understand why micro-payments are not popular or practical, the conditions under which these may become more utilised and the welfare implications of micro-payments replacing subscriptions.

In Chapter 8, I discuss market power, pricing strategies, collusion and potential welfare properties of different outcomes. All that is very uncertain conjectures, as it is based on modelling that does not take into account the specificities of the music subscription business model. Fundamental assumptions that must be in place include singlehoming consumers, multihoming rights holders and market power both among platforms and rights holders.

Chapter 4 documents the large differences between countries when it comes to the adoption of streaming services as well as the development of revenues from recorded music. I have not had access to comparable data more recent than 2015. By looking at more recent data, as well as future data, one should be able to do interesting research on what is just different stages of development and what is genuine, differences between markets.

Another alley of research that should be explored further is which characteristics of streaming services appeal to consumers. Reduced search costs and transaction costs, flexibility, ease of use, editorial recommendations, social aspects of sharing playlists et cetera. I discuss all of those in this thesis, but not in any detail. It is also important, not least for the services, to know exactly how important more or less comprehensive catalogues are. In this thesis, I assume that completeness, or a very wide selection, is crucial to consumers, at least in the most popular acts and/or the genres the individual cares about. This I assume. It is not something I know. I would like to see research on this.

Given access to the right data, it would be very interesting to investigate how much different music each user listens to, and how different users are from each other. How concentrated listening is around superstars is a function of both these two factors. While the findings from such an inquiry is difficult to compare with anything pre-streaming, it is interesting both to see a cross-section and to see how these characteristics develop into the future.

In section 5.5 I discussed various forms of demand interdependence and their relevance for music subscription services. While the various effects can be very difficult to disentangle from each other empirically, attempts should be made at doing just that. Understanding of which characteristics (network effects, bandwagon effects, informational effects etc.) are important, and possibly even estimates of some of the parameters, would be of great value when assessing services as multi-sided markets. My own assessment of the applicability of models of two-sided markets and vertical supply chains (chapter 8) rests on anecdotes and my best guesswork. Some of that guessing should be replaced by estimates.

13 Final remarks

What is fair and efficient payment and remuneration for music is a question that has been an issue of heated debate, not to mention costly judicial processes, throughout the last few centuries. Musicians and producers put labour and creativity into the recordings, and it is very difficult to quantify fair shares of revenues even from a single recording, and even more so from the grand total of recordings. Composers have not created their works in a vacuum, but have always been inspired by those before them. Some add more novelty than others do, and novelty may or may not be rewarded by the markets. Accusations of knockoffs and conflicts around plagiarism abound.

I was familiar with some of this complexity when I first started working on this thesis. I chose to explore this landscape, and in particular the then novel streaming services that were establishing themselves as important methods of music distribution. At the time, little research was done on music streaming, and almost none by economists. The important questions showed up as realisations along the way. Quite a few years have gone by, and quite a bit of research has since been done on the topic of music subscriptions. While the field has become more crowded, and there is less free space for me, the literature has helped me in my own work and allowed me to plow deeper than I otherwise would. I have still found areas that are unexplored, and my thesis has added light to some of those areas.

I believe the most important insight I have gained from working with this thesis is that a transition from selling units to renting access, while paying rights holders per play, involves a major redistribution of the gains from market transactions. A lot of attention has been directed towards superstars versus niche, global versus local, commercial versus artistic, but very few appear to direct attention to what I believe is the most important channel of distribution, namely that from new to old content. Academics and stakeholders mostly appear to have overlooked this fact, or they prefer not to talk publicly about it. While I do not have access to any data that can validate my hypothesis, it can be deduced that such redistribution will be very important, unless consumers' listening is directed towards new music to a much greater degree than what was the case previously. I have no reason to believe that is the case. Bar significant changes to consumers'patterns of listening, the payment-per-play system has very important redistributional effects, and harms new music in general.

Subscription services have played a pivotal role in reducing unlicensed copying and bringing revenues back to rights holders. It might therefore be argued that a direct comparison of sales with subscriptions is not all that relevant. Streaming should rather be compared with piracy. That is a completely valid point. However, while the challenges of piracy were met with new legislation and quite firm enforcement, the challenges of streaming have triggered no such reactions. It is therefore warranted and necessary to point out while revenues have returned to the music industry, it has not returned to the same stakeholders that lost them in the first place.

Streaming services have in many respects been a great boon to consumers. At the current price level, and while a free ad-supported tier is widely available, consumers have great access to music at reasonable terms. That is not certain to continue to be the case. As streaming services grow to global dominance, price of services may rise to substantially higher levels.

The consequences of the innovation studied in this thesis most likely brings more advantages than disadvantages. While some have won and some have lost, the winners probably have won more than the losers have lost. The catch is that welfare is unevenly distributed, and no universal measure of welfare exists. Paretian welfare economics does not consider *who* wins and who loses. The framework differentiates between equity and efficiency in a manner that may not be justified.

The inevitable redistribution associated with subscription services is similar to that which inevitably occurs in relation to *any* technological change. When novelties conquer markets, then that is usually welfare enhancing. Complaining about the consequences of change may therefore be seen as reactionary and just an act of protecting one's self-interest. However, this is not just about technological change. Selling things is not old fashioned. Paying artists only based on the number of replays they can stack up, is just one of many possible remuneration models, given the new technology.

The most important questions related to the economics of cultural industries have answers that rely heavily on value judgements. Examples are equality in opportunity, the importance of culture to human development or the value of heritage and cultural diversity. Those judgements are not traditionally economist' to make. However, we can enlighten the judgments with facts and interpretation. Given certain societal objectives, we can also weigh

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in and suggest specific policy measures. It is my hope that some of the suggestions I have made in this thesis may be considered.

Appendices

Appendix 1

Appendix explaining Figure 6: *Global recorded music sales/revenues 1969-2019. (USD billion, retail value, current exchange* rate)

No long time series of global revenues from recorded music has been available to me. Figure 6 is put together using several bits of data. C. Handke (2010a) includes a time series that covers 1969-2005. IFPI (2010) covers 1997-2009; IFPI (2012) covers 1997-2011; IFPI (2016b) covers 2005-2015; IFPI (2017) covers 1999-2016; IFPI (2018) covers 1999-2017; IFPI (2019) covers 2001-2018; IFPI (2020) covers 2001-2019, and RIAJ (2015) covers 1999-2014. There are discrepancies between the numbers for several reasons, and the overlapping series will help us calibrate the numbers approximately towards some common standard.
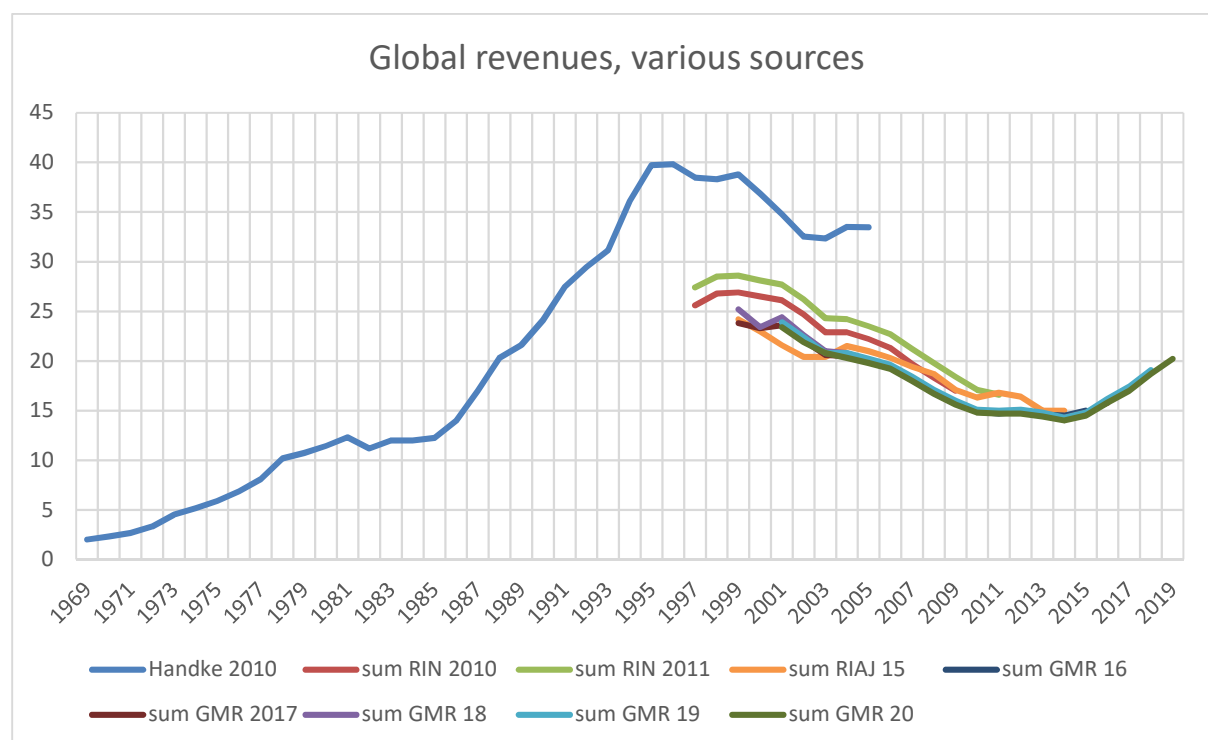

Figure 39: Global revenues from recorded music, numbers as given in sources.

The most obviously deviating series is from Handke 2010. This is the only series among these that presents the estimated *retail* value of music. The other series show *trade value*, or *wholesale value,* that is the record companies' revenue net of discounts, returns and taxes.

Before I estimate the retail value of the latest years, I need to do some other adjustments. The data differ along several dimensions.

When adding together the global revenues from music, revenues must be converted from the different currencies revenues come in. This is simple enough for a given year: you just convert it using some annual average of the exchange rate (or you can do more complex conversions). When you wish to present a time series you have a problem as the exchange rates develop over time. If you wish to conserve the ups and downs of the individual countries you need to convert all years using the same, *constant exchange rate*. This is what IFPI has done since 2010 (at least). If you compare time series statistics of revenues from different editions of *Recording Industry in Numbers/Global Music Report*, you will notice that numbers for every previous year is revised as exchange rates develop from year to year. This method has its drawbacks. For instance, Venezuela has experienced very strong inflation through the period, and thus the dollar value of sales is recorded as strongly increasing, although that has not really been the case. It is the value of the currency that has plummeted.

The alternative is to calculate value into USD at each year's exchange rate. This is called the *current exchange rate*. (The exchange rate is *current* with the sales, not with the observer.) This also has its drawbacks. In particular if you wish to look at revenue streams for each separate country. The ups and downs of the recorded sales will be subject to changes in the relative value of USD to local currency. This *may* have to do with differences in inflation, but many other factors play a role. IFPI has previously used current exchange rate in their statistics.

The numbers I have at my disposal makes it easier to bring recent data in line with old data (retail value, current exchange rates) than the other way around. The data from RIAJ are already reported in current exchange rates. Some cross-calculation between the different numbers reported in GMR indicate that differences between RIAJ and GMR can mostly be explained by different use of exchange rates, so I trust RIAJ-data. 2015 and 2016 are not reported in RIAJ (2015), but they are reported in GMR 2016 and GMR 2017 respectively, each with current exchange rates.

To estimate the global *retail* value from the global *trade* value I use those years for which I have access to both. RIN 2010 and RIN 2011 as well as a press release from 2006 concerning 2005 sales (IFPI, 2006). The ration retail/trade in RIN 2011 is 1.40. in RIN 2010 it is 1.49. in

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the 2006 press release it is 1.61. RIAJ 2015 and Handke overlap for the years 1999-2005, and this can be used for control. For all these years the ratio retail/trade falls within 1.56-1.61 with no trend. In the graph I use the numbers from Handke between 1969 and 2005. For the years 2006-2014 I use numbers from RIAJ 2015, multiplied with the following factors to take into account the difference between retail and trade value: 2006: 1.61; 2007: 1,57; 2008: 1.54; 2009: 1.49; 2010: 1,40. I have used 1.40 for the years after 2010. There appears to be a falling trend in the ratio retail/trade value, but I have not extrapolated on this trend. As subscriptions have picked up pace, we may presume the difference between retail and trade value are becoming similar to the inverse of the share of revenues appropriated by the industry. I.e. 100 %/70 % ≈ 1.43. An assumption as good as anything is that the growth of subscriptions thus will stabilise the retail-to-trade-value fraction as 1.4. Another question is how to treat performance revenues and synchronisation revenues in this context, as those are not retailed to consumers. I will not discuss this, and just treat those revenues the same as other revenues from recorded music.

The measure of inflation used to calculate the real value of sales is the CPI for the US economy as reported by the US Bureau of Labor Statistics.[107] While it may seem suboptimal to apply a US inflation index to global data, I believe it is perfectly satisfactory. The US market is a nontrivial part of the global total. More importantly, as we calculate the global value using exchange rates for each year, much of the difference in inflation between countries will be captured by fluctuations in exchange rates, at least in the long run. Thus it should be ok to use US price levels to deflate numbers that are measured is US dollars.

The result of these adjustments are presented in Figure 6.

From our various data series there are a number of records that should be identical, but are not. This is most likely due to updates and corrections that happen after the first version of statistics is published. In such cases I trust the most recent source.

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[107] CPI-All urban consumers (current series), annual averages. **Series Id:** CUUR0000SA0L1E
https://data.bls.gov/timeseries/CUUR0000SA0L1E

Appendix 2

Table 23: Correlation between consumption levels per age group.

age_cat	Variable	Pearson correlation coefficient					Prob > |r|				
		physical	download	free	pirate	subs_t2	Pphysical	Pdownload	Pfree	Ppirate	Psubs_t2
15-24	physical	1.000	0.397	0.169	0.109	0.051	_	0.000	0.000	0.012	0.239
15-24	download	0.397	1.000	0.189	0.155	0.179	0.000	_	0.000	0.000	0.000
15-24	free	0.169	0.189	1.000	0.217	0.225	0.000	0.000	_	0.000	0.000
15-24	pirate	0.109	0.155	0.217	1.000	0.050	0.012	0.000	0.000	_	0.249
15-24	subs_t2	0.051	0.179	0.225	0.050	1.000	0.239	0.000	0.000	0.249	_
25-34	physical	1.000	0.228	0.264	0.121	0.077	_	0.000	0.000	0.008	0.091
25-34	download	0.228	1.000	0.129	0.129	0.161	0.000	_	0.004	0.005	0.000
25-34	free	0.264	0.129	1.000	0.192	0.234	0.000	0.004	_	0.000	0.000
25-34	pirate	0.121	0.129	0.192	1.000	0.005	0.008	0.005	0.000	_	0.915
25-34	subs_t2	0.077	0.161	0.234	0.005	1.000	0.091	0.000	0.000	0.915	_
35-44	physical	1.000	0.155	0.196	0.140	0.039	_	0.000	0.000	0.000	0.300
35-44	download	0.155	1.000	0.237	0.144	0.221	0.000	_	0.000	0.000	0.000
35-44	free	0.196	0.237	1.000	0.211	0.364	0.000	0.000	_	0.000	0.000
35-44	pirate	0.140	0.144	0.211	1.000	0.056	0.000	0.000	0.000	_	0.142
35-44	subs_t2	0.039	0.221	0.364	0.056	1.000	0.300	0.000	0.000	0.142	_
45-54	physical	1.000	0.154	0.159	0.038	0.026	_	0.000	0.000	0.264	0.447
45-54	download	0.154	1.000	0.258	0.105	0.289	0.000	_	0.000	0.002	0.000
45-54	free	0.159	0.258	1.000	0.167	0.299	0.000	0.000	_	0.000	0.000
45-54	pirate	0.038	0.105	0.167	1.000	0.111	0.264	0.002	0.000	_	0.001
45-54	subs_t2	0.026	0.289	0.299	0.111	1.000	0.447	0.000	0.000	0.001	_
55-64	physical	1.000	0.146	0.194	0.105	0.037	_	0.000	0.000	0.001	0.235
55-64	download	0.146	1.000	0.205	0.164	0.205	0.000	_	0.000	0.000	0.000
55-64	free	0.194	0.205	1.000	0.156	0.331	0.000	0.000	_	0.000	0.000
55-64	pirate	0.105	0.164	0.156	1.000	0.125	0.001	0.000	0.000	_	0.000
55-64	subs_t2	0.037	0.205	0.331	0.125	1.000	0.235	0.000	0.000	0.000	_
65+	physical	1.000	0.309	0.228	0.064	0.129	_	0.000	0.000	0.019	0.000
65+	download	0.309	1.000	0.274	0.171	0.295	0.000	_	0.000	0.000	0.000
65+	free	0.228	0.274	1.000	0.180	0.302	0.000	0.000	_	0.000	0.000
65+	pirate	0.064	0.171	0.180	1.000	0.135	0.019	0.000	0.000	_	0.000
65+	subs_t2	0.129	0.295	0.302	0.135	1.000	0.000	0.000	0.000	0.000	_

Table 24: Correlation between consumption levels per educational level

education_re	Variable	Pearson correlation coefficient					Prob > |r|				
		physical	download	free	pirate	subs_t2	Pphysical	Pdownload	Pfree	Ppirate	Psubs_t2
havo/vw	physical	1.000	0.253	0.117	0.069	0.040	_	0.000	0.006	0.109	0.345
havo/vw	download	0.253	1.000	0.297	0.221	0.296	0.000	_	0.000	0.000	0.000
havo/vw	free	0.117	0.297	1.000	0.365	0.325	0.006	0.000	_	0.000	0.000
havo/vw	pirate	0.069	0.221	0.365	1.000	0.095	0.109	0.000	0.000	_	0.026
havo/vw	subs_t2	0.040	0.296	0.325	0.095	1.000	0.345	0.000	0.000	0.026	_
hbo	physical	1.000	0.168	0.218	0.097	0.063	_	0.000	0.000	0.001	0.033
hbo	download	0.168	1.000	0.235	0.155	0.240	0.000	_	0.000	0.000	0.000
hbo	free	0.218	0.235	1.000	0.265	0.351	0.000	0.000	_	0.000	0.000
hbo	pirate	0.097	0.155	0.265	1.000	0.136	0.001	0.000	0.000	_	0.000
hbo	subs_t2	0.063	0.240	0.351	0.136	1.000	0.033	0.000	0.000	0.000	_
mbo	physical	1.000	0.276	0.245	0.170	0.091	_	0.000	0.000	0.000	0.002
mbo	download	0.276	1.000	0.285	0.210	0.235	0.000	_	0.000	0.000	0.000
mbo	free	0.245	0.285	1.000	0.269	0.348	0.000	0.000	_	0.000	0.000
mbo	pirate	0.170	0.210	0.269	1.000	0.078	0.000	0.000	0.000	_	0.008
mbo	subs_t2	0.091	0.235	0.348	0.078	1.000	0.002	0.000	0.000	0.008	_
primary	physical	1.000	0.220	0.269	0.140	0.208	_	0.000	0.000	0.003	0.000
primary	download	0.220	1.000	0.276	0.264	0.319	0.000	_	0.000	0.000	0.000
primary	free	0.269	0.276	1.000	0.545	0.429	0.000	0.000	_	0.000	0.000
primary	pirate	0.140	0.264	0.545	1.000	0.308	0.003	0.000	0.000	_	0.000
primary	subs_t2	0.208	0.319	0.429	0.308	1.000	0.000	0.000	0.000	0.000	_
vmbo	physical	1.000	0.314	0.202	0.139	0.038	_	0.000	0.000	0.000	0.184
vmbo	download	0.314	1.000	0.243	0.224	0.247	0.000	_	0.000	0.000	0.000
vmbo	free	0.202	0.243	1.000	0.315	0.193	0.000	0.000	_	0.000	0.000
vmbo	pirate	0.139	0.224	0.315	1.000	0.122	0.000	0.000	0.000	_	0.000
vmbo	subs_t2	0.038	0.247	0.193	0.122	1.000	0.184	0.000	0.000	0.000	_
wo	physical	1.000	0.100	0.090	0.001	-.011	_	0.039	0.065	0.982	0.815
wo	download	0.100	1.000	0.207	0.089	0.143	0.039	_	0.000	0.067	0.003
wo	free	0.090	0.207	1.000	0.256	0.265	0.065	0.000	_	0.000	0.000
wo	pirate	0.001	0.089	0.256	1.000	-.002	0.982	0.067	0.000	_	0.966
wo	subs_t2	-.011	0.143	0.265	-.002	1.000	0.815	0.003	0.000	0.966	_

Nederlandse samenvatting

Door eenvoudig te klikken en te swipen hebben veel mensen tegenwoordig toegang tot een groot aandeel van alle muziek die ooit is opgenomen. Muziekstreamingdiensten bieden deze muziek aan tegen een vaste maandelijkse kostprijs, of soms zelfs gratis als men de reclame tussen de liedjes weet te tolereren. Aan de andere kant van de inkomstenbron krijgen componisten, artiesten en platenmaatschappijen een kleine vergoeding telkens wanneer hun muziek wordt afgespeeld.

In de afgelopen tien jaar zijn muziekstreamingdiensten een groot deel van de globale muziekindustrie gaan innemen. Vandaag hebben streamingdiensten meer dan de helft van de globale inkomsten uit opgenomen muziek.

Discussies over digitalisering gaan meestal over de omzetting van eerdere, tastbare producten naar niet-tastbare producten. Vanuit economisch oogpunt is dat waarschijnlijk niet het meest belangrijke dat er gebeurd is met reproduceerbare, culturele producten deze eeuw. Wellicht meer fundamenteel is de transitie van het kopen van goederen naar het betalen voor toegang tot diensten.

De overgang naar muziekabonnementen is een overgang van het kopen van kopieën van opnames die men voor altijd bezit, naar het huren van muziek voor een beperkte periode. Dit heeft een aantal belangrijke gevolgen. Aangezien inkomsten nu verworven worden gebaseerd op het spelen van muziek, en niet op het kopen van muziek, heeft dit nieuwe model een vertraging geïntroduceerd in het inkomen van artiesten en uitgevers. Nieuwe opnames genereren minder inkomsten dan voorheen. Inkomsten vanuit nieuwe opnames worden verdeeld als onverwachte winst op oude opnames die hun aandeel van inkomsten al eerder hebben verworven door middel van traditionele platenverkoop.

Deel II van dit proefschrift onderzoekt de markt van de kant van de consument. Ik geef economische interpretaties over hoe en waarom muziek wordt aangeschaft en geconsumeerd. Culturele goederen in het algemeen, en muziek meer specifiek, hebben bepaalde karakteristieke eigenschappen waardoor ze vaak van veel andere goederen kunnen worden onderscheiden. Dit deel is empirisch. Ik gebruik data van een Nederlandse enquête uit 2013, toen streamingdiensten nog in hun commerciële kinderschoenen stonden. Ik onderzoek verschillende aspecten van muziek consumenten en de media die zij consumeren in deze

overgangsperiode. Abonnees blijken meer muziek, meer boeken en meer films op alle beschikbare manieren (legaal en illegaal, tastbaar en niet-tastbaar) consumeren. Ze zijn gemiddeld meer dan tien jaar jonger dan zij die niet zijn geabonneerd, en zijn iets vaker man. Ze hebben vaak een hoge opleiding, ofwel ze zijn bezig met een hogere opleiding. Probeer ik consumenten te groeperen, dan is het enige belangrijke verschil dat ik vind dat tussen consumenten en niet-consumenten. Ik onderzoek ook hoe en in welke mate verschillende manieren van toegang tot muziek elkaar vervangen. Aan de hand van twee benaderingen – een instrumentele variabelen benadering en een meer experimentele benadering met factor analyse – probeer ik substitueerbaarheid tussen de verschillende manieren van consumptie te bepalen. Abonnementen blijken een substituut zijn voor fysieke formaten; ze hebben een onduidelijk relatie met piraterij, en verrassend genoeg, blijken complementair met betaalde downloads. Het is moeilijk te weten welke resultaten te generaliseren zijn in tijd en geografie, en welke niet.

Deel III van dit proefschrift kaart welvaartseconomieën en industriële organisatie aan. Ik geef een overzicht van de relevante overwegingen met betrekking tot welvaart en efficiëntie in de context van muziek abonnementen, en vervolg met een overzicht van de economische literatuur over verticaal gerelateerde markten en tweezijdige markten. The relevantie van de verschillende contributies aan muziek-abonnement diensten wordt uiteengezet. Ik beweer dat het onwaarschijnlijk is dat een enkele abonnementsdienst sterk dominant zal worden, tenzij de belangrijkste rechtshouders een heel aanzienlijk deel van de dienst bezitten. Als een abonnementsdienst die geen eigendom is van de rechthebbende dominant wordt, dan meen ik dat het in het beste belang van de rechthebbende is om het marktaandeel van die service onder controle te houden, en dat de rechthebbende de middelen hebben om dat te doen. De bestaande formele analyse is niet geschikt genoeg om concrete conclusies te trekken voor muziekstreamingdiensten.

Ik ga verder met een formeel model dat ik gebruik om de allocatieve efficiëntie en distributiekarakteristieken van respectievelijk abonnementen en verkopen te vergelijken. Daaruit blijkt dat aanbieders van muziek gezamenlijk waarschijnlijk een iets groter deel van de taart verwerven met abonnementen. Het model geeft ook aan dat de meest populaire artiesten een kleiner aandeel van inkomsten verwerven onder het abonnement businessmodel dan dat ze zouden doen onder het verkoopmodel bij ongewijzigde consumentenvoorkeuren.

Het belangrijkste inzicht dat ik heb opgedaan met dit proefschrift, is dat een overgang van het verkopen van eenheden naar het verhuren van toegang, waarbij rechthebbende worden betaald wanneer de muziek wordt afgespeeld, een grote herverdeling van middelen betekent. Academici en belanghebbenden lijken dit feit meestal over het hoofd te hebben gezien, of ze praten er liever niet in het openbaar over. Veel aandacht is besteed aan supersterren versus niche, globaal versus lokaal en, commercieel versus artistiek. Veel minder aandacht is gericht op wat ik het belangrijkste redistributiekanaal vind: dat tussen nieuwe en oude inhoud. Indien consumentenvoorkeuren fundamenteel onveranderlijk zijn gebleven, indien hun patronen van het luisteren naar muziek gelijkaardig zijn aan wat ze waren vóór streaming bestond, dan zullen inkomstenstromen op nieuwe manier worden herverdeeld.

Curriculum Vitae

Sigbjørn Hjelmbrekke holds an MPhil in economics from University of Oslo. He works as a lecturer in economics and research methods at the University of South-Eastern Norway, an institution that also funded this PhD-project. Before he started this PhD, and to a lesser degree after, he worked at Telemark Research Institute with various projects of commissioned research. It was here that he first encountered cultural economics through research projects on book trade, concert promotors and marching bands. Teaching duties at the University of South-Eastern Norway have included lectures on the music industry, book trade, copyright and digitisation. He has also been involved with teaching cultural economics at Oslo Metropolitan University.

Portfolio

Completed coursework:

ECON5103 Advanced Econometrics – Panel data (University of Oslo, 2010)

ECON5102 Advanced Econometrics – Microeconometrics (University of Oslo, 2012)

Value of Culture – Summer School in Cultural Economics (Creare, 2013)

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