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The impacts of piracy and supply chain contracts on digital music channel performance

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ABSTRACT

We explore the impact of piracy on digital music supply chain profitability under different contract arrangements. Consumers' piracy risk cost is divided into two cases: 1) linear piracy cost and 2) fixed piracy cost. We also analyze two contract types: 1) fixed fee contract and 2) per song contract. Our findings indicate that the magnitude of profit loss depends on the type of consumers' piracy risk cost and the type of contract. In addition, changes in consumers' piracy risk cost change the distribution of the profit between the record label and the retailer. As the investment in piracy controls increases, the retailer keeps a larger share of the profit surplus leaving the record label with a smaller share. We demonstrate that a fixed fee full transfer contract will always coordinate the supply chain, and the profitability further increases as 1) market size increases, 2) piracy risk cost increases, and 3) marginal cost decreases.

1. Introduction

Advances in the Internet and file compression technologies have transformed the way digital products such as movies and music are created and distributed. In the music industry, online distribution channels have proliferated in recent years. Songs can be transmitted via the Internet in the digitized form so that consumers can conveniently choose to download a single song, an entire album, or a customized bundle from websites such as iTunes and Rhapsody. While current online music sales account for only 15% of total sales [18], online sales are increasing rapidly. A report from the Recording Industry Association of America (RIAA) shows that unit sales of CD albums declined by 27.5% from 2005 to 2007 while digital album unit sales increased by 212.5%. Similarly, unit sales of single song CDs declined by 7.1% while digital single song unit sales increased by 121% [36].

As online distribution channels become more popular, there is an increasing need to re-examine contracts and coordination issues in digital music supply chains. For instance, an important question we should ask is how do existing business models, pricing schemes, and licensing structures need to be adjusted in order to reflect the changes caused by moving from brick-and-mortar retailing to online digital sales. Traditional coordination strategies in physical product supply chains such as buy-back and return policies may not be applicable due to the unique characteristics of digital experience goods [7]. Marginal production cost, packaging cost, and a portion of distribution cost can be eliminated by selling these products through an online digital channel. Furthermore, digital products do not require inventory, which eliminates the risk of obsolescence and perishability [37].

The prevalence of unauthorized copying and dissemination has been a serious threat in the digital experience goods industries. In the music industry, rapid development of compression and file-sharing technologies as well as decreasing cost of copying mediums have provided consumers with greater access to free music than ever before. Although technological preventive controls using software and hardware have been implemented, they have often had limited success, and imposed unfair restrictions on what legitimate consumers can do with the songs they have bought [39]. Also, despite the clear articulation of digital copyright law and legal as well as educational deterrence efforts, piracy still exists due to the high cost of increasing consumers' awareness and of enforcing the law. Thus, it is likely that piracy will remain as a serious problem well into the future.

In this paper, we develop a model to analyze the impact of piracy on digital music supply chain profitability under different contract arrangements between record labels and online retailers and under different consumer piracy risk costs. In dealing with piracy risk cost, prior empirical studies have not focused on the relationship between consumers' piracy risk cost and the amount of content they pirate. Researchers used different measurement terms such as a single unit ("the pirated software") [23,42], multiple units ("pirated music products" or "copies of pirated software") [25], or a general term ("music/software piracy") [10], and implicitly assumed that the piracy risk cost is either fixed or increasing in the amount of content pirated. In a prior study [19], we found that the magnitude of consumers' piracy risk cost may not change with the amount of content pirated in a single session (consumers piracy risk costs are the same in pirating one song

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vs. many songs). This is in spite of the record labels' efforts to penalize individuals who pirate large amounts of content [32,44]. Therefore, to develop effective anti-piracy strategy it is important to understand the implications of fixed vs. increasing consumer piracy risk cost. One contribution of this paper is to explicitly incorporate heterogeneity in consumers' piracy behavior resulting from their piracy risk cost assessment. The rationale for the fixed risk cost is that the largest piracy risk cost occurs in pirating the first song, and the marginal cost of pirating more songs diminishes very quickly after that. Our emphasis is on the importance of understanding how consumers piracy risk assessment affects their piracy behavior and the performance of the record label, retailer, and the total supply chain.

We focus on profit maximization for newly released music albums. A number of studies have examined how perceived risk affects consumer decision and behavior [15,33]. These studies have identified various aspects of risk, such as financial, performance, social, and prosecution risks, involved in ethical decision making [42]. However, it is unclear how consumers assess their piracy risk cost with respect to the amount of content they pirate. For example, if a consumer perceives a high probability of prosecution, she is more likely to perceive higher risk as the number of songs she pirates increases. On the other hand, some consumers may be conscious about their image, or they may have a desire to be identified with certain social group. In such a case, pirating behavior can be perceived as being unethical regardless of how many songs a consumer pirates. To better understand the implications of piracy on digital music sales, we first define two types of consumer piracy risk cost: 1) linear piracy cost and 2) fixed piracy cost. In the linear cost case, we assume that a consumer's piracy risk cost increases linearly as the number of songs pirated increases. In the fixed cost case, the risk cost a consumer attaches to piracy is independent of the number of songs pirated. The piracy act may involve a single song or a full album, but once the consumer violates the law, a fixed risk cost is assigned to the act.

In addition to different types of piracy risk cost, we also examine contractual arrangements between a record label and an online retailer. We consider two contract types: 1) fixed fee contract and 2) per song contract. In the fixed fee contract, the record label charges the retailer a fixed fee for an entire album of songs regardless of the number of times songs are downloaded from the retailer's website. In the per song contract, which is the most common contract type in the music industry, the record label charges the retailer a certain wholesale price for each song downloaded. For each case, we identify an optimal Stackelberg equilibrium and analyze how different piracy risk costs and contract types affect supply chain pricing, record label and retailer's profits, and supply chain coordination. Analytical results show that:

1. The amount of supply chain profit loss due to piracy depends on the type of piracy risk cost of consumers as well as the contract type between the record label and the retailer,
2. Changes in consumers' piracy risk cost not only alter total supply chain profit but also change distribution of the profit between the record label and the online retailer,
3. Piracy has larger negative impact on the profitability of music albums containing a large number of popular songs,
4. The fixed fee full transfer contract will always fully coordinate the supply chain, and
5. The profitability of the fixed fee contract further increases as online market size increases, consumer piracy risk cost increases, and marginal cost decreases.

The rest of this paper is organized as follows. Section 2 presents relevant literature in the area of piracy and supply chain coordination. Section 3 provides an overview of the model in which we describe consumer purchase behavior, consumers' piracy risk costs, and contract types between the record label and the online retailer. Section 4 derives the optimal prices and supply chain profits in the presence of different piracy risk costs as well as under different contract types. Section 5 presents a number of findings. Section 6 contains managerial implications, conclusions, and directions for future research. All proofs are shown in the Appendix A.

2. Literature review

We review relevant literature in two research streams. First, we discuss the impact of piracy on digital experience goods, including approaches to modeling consumer piracy behavior. Then, we briefly review the literature on supply chain coordination strategies.

A large body of research has explored the impact of piracy on digital experience goods industries, especially in the software and music industries. For example, Hong [16] found that Internet growth had a significant negative effect on recorded music sales. However, other studies have shown that the negative impact of piracy on the legitimate demand is considerably smaller than industry estimates [17], and tolerating some piracy might even be beneficial when it creates positive network externality [13,14,27,34,41]. To better understand the impact of digital piracy, a careful analysis of consumer piracy behavior is needed. Previous studies incorporated various economic and behavioral factors such as penalties and ethical propensities that influence consumers' piracy tendency. Chen and Png [29] developed a model that incorporates a penalty for copyright violation set by the government. In the model, consumers are segmented into ethical and unethical groups. While ethical consumers can choose either buying a legitimate product or not using it, unethical consumers maximize their net benefits by choosing among buying the legitimate product, not using it, and pirating. The results show that changes in pricing and monitoring rates have qualitatively different effects on consumers and that from a social welfare perspective, reductions in price are better than increases in monitoring. Similar market segmentation was used by Khouja and Park [21] in a model that considered a heterogeneous consumer market with three segments: ethical, indifferent, and pirating with each having a different affinity to piracy. The results indicate that the incorporation of different consumer segments will cause the retailer to charge lower prices and, therefore, lead to higher legal product diffusion. The authors also show that the royalty system does not solve the double marginalization problem and is suboptimal from a supply chain perspective. Khouja and Wang [22] considered a consumer market which is divided into a retail-captive segment whose consumers are limited to the retail channel and a hybrid segment whose consumers have access to both retail and digital channels. They analyzed the retailer's pricing strategy under an exclusive direct digital channel, exclusive regular retail channel, and dual channels. Khouja et al. [20] analyzed a retailer's pricing decision under piracy using an agent-based modeling simulation. Bhattacharjee et al. [1] analyzed the use of “compilation album” which offers stronger bundling than the classic album bundling. Examples of compilation albums include Christmas and dance music albums. This type of bundling may decrease consumer search costs and reduce the incentive to pirate.

Chellappa and Shivendu [7] developed a model for motion picture DVDs. The model considers two distinct types of piracy: 1) global where consumers obtain illegal copies for a region other than their own and 2) regional where consumers pirate products meant for their own region. Consumers differ among regions with some regions having consumers with higher marginal willingness to pay for the product (Region A) compared to other regions with lower consumer income (Region B). The results indicate that when piracy is prevalent, losses from global piracy can be higher than when there is only regional piracy. Thus, maintaining separate technology standards is critical to minimize the loss. Sundararajan [40] analyzed the optimal pricing and technological protection levels for a monopolist using price discrimination among consumers. In the absence of price discrimination, an optimal protection level is at the technologically