



Analysis of the effectiveness of preventive and deterrent piracy control strategies: Agent-based modeling approach



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ABSTRACT

We use agent-based modeling approach to analyze the impact of various digital piracy control strategies on consumers, retailers, record labels, and artists. We model heterogeneous agent behavior, motives, and interactions to examine the consequences in terms of aggregate system behavior. Using a multi-agent programmable modeling environment (Netlogo), several experiments were conducted to test the simulation model and develop managerial insights. We show that an educational strategy is more effective when consumers are resistant to anti-piracy efforts and budgets for combating piracy are small. Furthermore, value-added service and low-price strategies should be used to encourage legitimate purchases since legal and educational strategies alone deter piracy but do not provide consumers' incentives to purchase legitimate products. Therefore, effectiveness of piracy control strategies can be improved by combining a legal or an educational strategy with a value-added or a low-price strategy. We also find that the profit-maximizing strategies are different for different players in the supply chain. While the record label prefers a low-cost strategy, it is optimal for the whole supply chain to use combined legal or educational strategy with a value-added strategy. Therefore, there is potential for all parties in the supply chain being better off if the record label and the retailer cooperate in combating piracy.

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1. Introduction

The prevalence of unauthorized copying and dissemination has been a serious threat in the music industry. The rapid developments of compression and file-sharing technologies as well as the decreasing cost of copying mediums have provided consumers with greater access to free music than ever before. According to the International Federation of the Phonographic Industry (IFPI), more than 40 billion files were illegally shared in 2008 (IFPI, 2009), and P2P file sharing accounts for approximately 80% of traffic volumes on Internet Service Provider (ISP) networks. The growth of illegal file-sharing is a major factor in the decline of the global music industry revenue by almost 30% from 2004 to 2009 (IFPI, 2009).

To protect intellectual property and increase legitimate sales, record labels, often working with the government, have employed numerous anti-piracy strategies including innovation, education, and enforcement. Despite various piracy control efforts, there is little evidence that these policies have successfully decreased piracy levels (Sinha & Mandel, 2008). Law-suits initiated by the music

industry have resulted in shutting down some of the most well-known file sharing websites such as Napster. However, the traffic volume of P2P sites did not decrease significantly even after the legal threats, and the total number of files shared continue to increase (Bhattacharjee, Gopal, Lertwachara, & Marsden, 2006a). Also, even with the clear articulation of digital copyright law and educational deterrence efforts, piracy is still prevalent due to the high cost of increasing consumer awareness and of enforcing the law.

Understanding the impact of piracy control strategies on consumer behavior and subsequently on profit is a complex problem which is difficult to analyze. The difficulty arises because a model of the problem must capture the following aspects: (1) How piracy control strategies affect consumer behavior? For example, law-suits can change consumers' psychological state and behavior by increasing perceived risks of punishment for a limited time period, unless reinforced by continued litigation. On the other hand, educational campaigns may increase awareness of the damage caused by piracy and may permanently change consumers' attitude toward piracy. Hence, consumers are likely to respond to piracy control strategies in a different ways. (2) How to model consumer piracy behavior?. For a consumer to pirate a product, the value a consumer attaches to the product must exceed the risk of being caught and penalized, and the consumer prefers pirating to

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purchasing a legitimate product (i.e. the expected gain from piracy exceeds the expected gain from purchase). Furthermore, consumers' attitudes toward piracy can be influenced by others such as friends, family, or colleagues. If the relationships in the model are simple enough, it is possible to use analytical models to obtain insights into the problem. However, many real-world problems are often too complex to allow realistic analytical models to be developed (Law & Kelton, 2000).

We utilize agent-based modeling approach to analyze the effectiveness of piracy control strategies used to dissuade consumers from illegal music downloads. Objectives of this paper are to (1) provide an alternative methodology for analyzing and comparing the effectiveness of piracy control strategies, (2) find effective piracy control and pricing strategies in a market where some piracy is unavoidable, and (3) investigate the impact of different piracy control strategies on consumers, retailers, record labels, and artists. The paper is organized as follows. Section 2 presents theoretical background by offering a review of the literature on piracy control strategies. Section 3 introduces agent-based modeling and its use in problem solving. In Section 4, we develop an agent-based model for analyzing the effectiveness of different piracy control strategies. In Section 5, we present the results from simulation experiments and discuss their implications. Section 6 concludes with summary of findings and suggestions for future research.

2. Theoretical background

The literature suggests that piracy may be reduced using preventive or deterrent measures (Gopal & Sanders, 1997). Preventive controls refer to the provision of additional benefits to legitimate consumers, charging low prices, and/or the use of hardware and software technology to prevent piracy. Prior studies suggest that additional benefits offered are important to encouraging consumers to engage in long-term relationships, and satisfied customers are less likely to pirate (Chiu, Hsieh, & Wang, 2008a; Chiu, Lin, Lee, Nieh, & Chen, 2008b). In the context of digital piracy, companies can enhance consumers' use of legal products and turn them into loyal customers through lower-price and value-added product strategy such as personalized recommendation and customization. Additional preventive strategies use technology to prevent unauthorized reproduction of digital music files. Examples of protection methods include Digital Right Management (DRM), encryption, and digital watermarks. However, technological preventive controls have often had limited success (Cicirelli, Furfaro, & Nigro, 2011), and imposed unfair restrictions on what legitimate consumers can do with the songs they have bought. Also, there is little evidence that preventive technology reduces piracy (Sinha & Mandel, 2008; Stone, 2009).

Deterrent controls refer to the use of education and legal campaigns and sanctions to reduce piracy. Legal deterrent controls attempt to dissuade users from copying digital products by disseminating litigious information about piracy to the public (Gopal & Sanders, 1997). In the music industry, the Recording Industry Association of America (RIAA) coordinates anti-piracy efforts such as educational campaigns and lawsuits against pirates and operators of P2P networks (Nandedkar & Midha, 2012). Several studies have been conducted to investigate the impact of deterrent controls on piracy in digital good industries. For example, Gopal, Sanders, Bhattacharjee, Agrawal, and Wagner (2004) demonstrated that the level of music piracy is not significantly affected by a deterrent information message. However, they proposed that the results are due to the difficulty of delivering deterrent information through imaginary scenarios such as the one used in their survey. Another interesting finding by Gopal and Sanders (1997) was that deterrent controls that employ educational and legal campaigns provide

more profits to the publisher than preventive controls that use technology. Also, deterrent controls are shown to be superior with respect to a social welfare.

An empirical study of consumer ethics by Levin, Conway, and Rhee (2004) showed that illegal downloaders are less likely to believe that their behavior harms the publisher or the artist, which is an indication that the record labels have not been successful in educating consumers on the real economic impact of piracy on the music industry. In a follow up to their 1997 study, Gopal and Sanders (1998) studied individuals' ethical behavior toward piracy. The justice construct, which explains ethical predisposition of individuals toward the legal and justice system, is shown to have a significant impact on the level of piracy regardless of ethical and cultural differences. Given these findings, we may argue that piracy prevails unless appropriate piracy control strategies are set up to influence consumer behavior.

In this paper, we consider four generic strategies to combat digital piracy. The first two, legal and educational strategies, are deterrent, the last two, low-price and value-added service, are preventive. In the following, we discuss each strategy in further details.

2.1. Legal strategy

Legal strategy is defined as the actions that music industry takes against pirates and antipiracy regulations or laws by the government. In the past, the RIAA issued threats only to the operators of P2P networks, and have been successful in shutting down some well-known file sharing websites. Recently, the music industry has redirected law-suits and threats toward individual users of P2P networks, and they have filed well-publicized lawsuits in which violators of copyright laws were subject to fines and potential jail time. According to the Wall Street Journal, more than 35,000 people have been sued for illegal music sharing since September 2003 (McBride & Smith, 2008).

Law-suits are likely to influence customer intentions to buy legitimate products. The legal prosecution risk resulting from acquiring pirated products is considered a significant factor in predicting intention to pirate (Chiou, Huang, & Lee, 2005; Tan, 2002; Wang & McClung, 2012). Also, there is an inverse relationship between the perceived severity of punishment and willingness to buy pirated goods (Chiou et al., 2005). However, the impact of law-suits against pirates tends to be limited. Bhattacharjee, Gopal, Lertwacharand, and Marsden (2006b) examined how individuals actually responded to legal threats from the recording industry. The authors tracked the file sharing behavior of 2056 individuals before and after RIAA related law-suits, and found that the majority of substantial sharers as well as non-substantial shares in P2P sites decreased the number of files they shared after the RIAA's law-suits. But, they found an upsurge in the frequency of usage after some time. This suggests that consumers' response to the music industry's legal threats is temporary and sometime after the legal threats, the level of file sharing and the availability of music files quickly bounces back and remains substantial.

2.2. Educational strategy

Educational strategy involves the music industry disseminating information to consumers about the damage piracy causes (Chiu et al., 2008b; Shultz & Saporito, 1996). Record companies have designed and delivered public campaigns that attempt to educate and inform consumers that illegal music downloading activities harm artists, music companies, and society. For example, educational software, Digital File Check (DFC) has been developed to provide advice on how users can download music safely and legally. Also, the music industry has published numerous information brochures

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