



Digital piracy: Price-quality competition between legal firms and P2P network hosts



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ABSTRACT

This paper examines competition between firms that produce legal information goods and host sites that index P2P links. Specifically, we develop a simple model in which a legal firm determines price for its information good and a P2P host site decides on its investment to improve the quality and accessibility of the information goods linked to its site for free download. In the analysis, users choose between goods that are both horizontally and vertically differentiated. We show conditions under which the profitability of legal firms may or may not be negatively affected by the presence of a P2P network. In addition, we demonstrate the resilience of P2P host sites to distribute digital goods. Our approach extends earlier studies in the literature to further allow for price-quality competition between legal firms and P2P network hosts.

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1. Introduction

Piracy of digital goods has become a prevalent topic in both the industrial organization and regulatory literature. The low/zero reproduction cost of digital files allows for easy exchange online, by simply transferring files between computers. More and more goods are being sold in a digital format, thus creating a strong incentive to pirate digital goods. As the internet has become ubiquitous, retailers of physical and digital goods are constantly competing with pirated copies. Anyone with the digital good (legal or illegal) and a computer can easily and costlessly create copies.

A common approach for pirates is to create a specific type of online link¹ to the file which provides access through a Peer-To-Peer (P2P) network. By uploading a digital copy online, obtaining the good becomes as easy as finding the link.

Many websites exist that provide a search engine for links to specific files.² When the user connects via the link, they join a “swarm” which is a network that shares the desired file. It is important to note that without the host site that indexes the links, users would not be able to find anonymous sources for the desired file. Thus, host sites of P2P links provide a necessary service to create robust P2P

¹ The magnet link pertains to a unique file (or good). By creating a magnet link, others looking for a specific good can connect to the user, and obtain pieces of the file (or good).

² The Pirate Bay (TPB) has become an infamous host of P2P links. Basically, they provide an index service to help users identify links to desired files (goods).

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networks both in scope (i.e. size of catalog) and scale (number of suppliers and demanders of a good³). The larger the network, the better it can facilitate timely and anonymous transfers of digital goods. Since P2P host sites act as a central hub to find desired content, they can track access and usage of their links. This allows P2P host sites to act as gatekeepers to files that they themselves do not control. As a result, representing host sites for P2P links is necessary in order to properly identify not only competition in markets with digital goods, but also identify regulatory implications.

This paper is the first attempt to present a simple framework for analyzing the optimizing behavior of host sites of P2P network links. In the face of digital piracy, legal firms have to take into account P2P network hosts that actively manage links to illegally download P2P goods. The framework allows us to characterize explicitly, direct competition between a legal retailer that optimizes profit using price and an illegal source that optimizes profit by improving their indexing quality (in terms of enhancing both the accessibility and characteristics of the information goods linked to the site for free download).

Analyzing the economic effects of counterfeiting has a history that long predates P2P network sharing (Liebowitz, 1985; Ordober and Willig, 1978). With improvement in reproduction technology, additional research has incorporated the properties of digital goods (see, e.g., Takeyama, 1994; Varian, 2000; Chen and Png, 2003; Banerjee, 2003; Peitz and Waelbroeck, 2006a). Still, piracy research has not resulted in a consensus. Even at the firm level, research has shown piracy has an ambiguous effect on the producer's profits. Many of the discrepancies are due to the type of good (software, music, movies, etc.) and its market structure (monopoly, competitive, etc.). Nonetheless, literature has emerged to identify the effects of piracy regulation and protection on profit and welfare (see, e.g., Conner and Rumelt, 1991; Yoon, 2002; Bae and Choi, 2006; Wu and Chen, 2008; Cremer and Pestieau, 2009; Harbaugh and Khemka, 2010). Much of the counterfeit literature has implications for online piracy; however including the nuisances of P2P networks adds additional complexity.

A great deal of the research focuses on the effects piracy has on the legal distributor's market, and excludes piracy networks. More recently, economic literature has emerged discussing and identifying the unique qualities of P2P networks (Gayer and Shy, 2003; Krishna et al., 2003; Cunningham et al., 2004). However, few articles have attempted to model the user response to illegal P2P network goods in the presence of a firm producing the legal version of the good. The contribution by Casadesus-Masanell and Hervas-Drane (2010) presents digital content distribution models to compare the P2P network and client-server distribution, paying special attention to the connection between uploaders and downloaders. Another contribution by Herings et al. (2010) introduces a P2P network into a monopolistic firm's market and employ a two-stage game to capture the firm's

responses. In their analysis, the authors assume that the P2P network could not influence accessibility to the user.

However, the necessary connection and communication that P2P host sites provide is often overlooked in the literature. Our approach differs in that the P2P host site is able to strategically influence the availability and quality of goods for free download, thus affecting both the users' utility from the good and their search cost. In addition, the literature about online piracy omits another critical property of online piracy: advertising. A visit to any P2P host site will require exposing oneself to various amounts of advertising, thus providing a method P2P host sites to monetize visits from users. The financial resources created by advertising allow P2P host sites to optimize their operations, thus enabling them to compete with legal retailers.

It seems that the current literature omits competition between a legal product firm and a P2P network host, one selecting product price and the other selecting access and quality of the good. It is the objective of this paper to fill this gap in the literature. In the analysis, users choose between a legal good and the downloaded P2P version of the good that are both horizontally and vertically differentiated. The key findings in the present paper are as follows. (i) Other things being equal, a P2P network host's investment to increase the accessibility and quality of the P2P network good is higher in the partially served market than in the fully served market. (ii) Under a fully served market, the legal firm is able to make a profit despite competition against a P2P network host. The profitability and hence the viability of the P2P network depends on elements such as legal goods value and downloading costs. (iii) As the degree of horizontal differentiation decreases for digital goods, the P2P websites' optimal level of download file quality will unambiguously increase, while their profits will decrease. In addition, lower horizontal differentiation will cause retail prices to unambiguously decrease.

Our analysis complements the recent contribution by Peitz and Waelbroeck (2006b). In examining whether the music industry necessarily suffers from free downloading, Peitz and Waelbroeck (2006b) develop an interesting model that emphasizes the role of sampling. The authors focus their analysis on the users' lack of knowledge of existing goods. In our model that stresses the role of optimizing behavior by P2P network hosts for digital goods, we consider the situations where users are familiar with the products available, and select a source of the product to maximize their utility. We find that retailers will remain profitable even when P2P network hosts are active in pursuing profit-maximizing behavior by improving the quality of the downloaded P2P goods. But the positive profitability of retailers may decrease due to competition from the P2P source.

The remainder of this paper is organized as follows. In Section 2, we lay out the analytical framework of competition between a firm that produces a legal information product and a host site that indexes P2P links for free download. Section 3 examines the case in which the market is partially served, so only a portion of consumers use the product (legal or illegal). Section 4 focuses on the analysis of competition between the firm and the P2P network host in a fully served market where consumers choose

³ Suppliers or sources of good on a P2P network are referred to as "seeds," demanders are referred to as "nodes."

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