FIGHTING DIGITAL PIRACY: CAN SECONDARY MARKETS FOR DIGITAL GOODS HELP?

by

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ABSTRACT

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The Internet and advanced networking technologies have lead to a rise in the number of pirated digital products. The content industry claims that digital piracy costs several billion dollars per year and is the main reason for declined sales of physical media. Despite the new legislations imposed to address copyright infringements and advanced technological security measures, digital piracy keeps on growing and becomes even a greater threat for copyright owners. Besides deterrent and preventive controls, researchers have also underlined the importance of business models used to distribute and price digital products for the issue of digital piracy. It is believed that an innovative business model that employs a price discrimination technique and an efficient distribution method may help decrease piracy of digital goods.

This study proposes a dual channel model that utilizes both a primary and a secondary market for the transaction of digital products, which allows consumers to sell the products that they have purchased by using a legal platform. Implementing a secondary market and coordinating it with a primary market for the distribution of

digital goods can decrease the level of digital piracy because of mainly two reasons. First, it offers more profitable transactions for consumers, thus results in an increase in the total number of buyers. Second, availability of a secondary market can increase the degree of how consumers perceive the fairness of digital good transactions.

This research first investigates the profitability of the dual channel model for consumers and copyright owners, and the level of piracy in the dual channel model with an economic model. The economic model offers a secondary market within a digital goods retail monopoly framework as a practical alternative to leasing for capturing rents. Model results show that the retailer can increase revenue and market coverage relative to primary market-only sales, which implies a reduction in piracy and an improved relationship with content creators at no cost. Revenue and piracy performance of the proposed model in the presence of piracy is also evaluated by incorporating general model of piracy into the economic model. Additionally, this research uses a behavioral intention model to test the anti-piracy performance of the proposed distribution and pricing mechanism, and compares it with a traditional business model with an experimental survey. Results show that consumers tend to pirate less if there is an available secondary market for the transaction of digital goods. This relation between availability of a secondary market for digital goods and intention to pirate is also mediated by perceived equitable relationship and attitude toward piracy. Finally, it is found that in the presence of a secondary market, consumers perceive legal transactions of digital products more fair.

To my family

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CHAPTER I

Introduction

> "In my view, growing internet piracy is a vote of no-confidence in existing business models and legal solutions. It should be a wake-up call for policy-makers."

Viviane Reding (2009), EU Commissioner for Telecoms and Media Digital Europe

1.1 Electronic Marketplaces

The advent of the Internet and advances in information technologies has opened the gates of an untouched field of new opportunities, strategies and operations for businesses. Information technology has always had a critical influence on business environment as well as on society, governments and human life throughout the history. Nevertheless, organizations and markets have never experienced such a significant revolution as they did over the last 20 years due to the elimination of organizational and geographic boundaries, the true global connection and the ease of access to the information anytime anywhere offered by globally networked information systems, more specifically the Internet.

Rapidly developing information technologies have changed the structures and business practices of organizations as a result of decreasing the time and cost of communicating information and reducing the transaction and search costs for buyers and sellers (Bakos 1997). Most industries have shifted their operations to the online environment and started to serve customers through online vendors. This ability allows manufacturers to provide their products to customers without the need of a retailer, which can shrink the size of supply chains and lead to disintermediation (Clemons et al. 2003). However, the impact of information systems on the business is not one-sided, favoring only manufacturers and sellers. Electronic markets is another important and intriguing outcome of the digital transformation (Malone et al. 1987), which bring buyers and sellers together on an electronic platform to exchange information about prices and product offerings and facilitate transaction among them. Since they simplify the task of comparing quality and price of products offered by different sellers (Bakos 1998) and are believed to reduce prices by lowering transaction costs (Brynjolfsson and Smith 2000), electronic markets could compete with the disintermediation effect and their traditional counterparts.

The online intermediaries Amazon.com, eBay, Priceline.com and Expedia are ranked among the top ten companies operating in Internet services and retailing industry by revenues in 2009 according to Abkowitz and Cendrowski (2009). Moreover, online retail sales were expected to grow from $172 billion in 2005 to $329 billion in 2010 according to a study by Forrester Research (Johnson and Tesch 2005). U.S. Census Bureau (2009) of the Department of Commerce announced that the estimate of U.S. retail e-commerce sales for the third quarter of 2009 was $34 billion (3.7% of total retail sales), which shows an increase of 4.5 percent from the second quarter of 2009 and of 1.8 percent from the third quarter of 2008 while total retail sales decreased 7.5 percent in the same period.

1.2 Digital Products

Electronic markets have always been a hot topic among IS researchers due to their high market shares and popularity. Many previous studies investigate the consequences of online markets such as how they change price levels and influence consumer behaviors, different market designs, structures and pricing strategies to increase efficiency and their employment for the exchange of used goods. The idea of connecting buyers and sellers from all over the globe electronically becomes more interesting with the digitization of information goods. Digital products are represented in bits of ones and zeros and distinguished from other goods by mainly three characteristics: indestructibility, transmutability and reproducibility (Whinston et al. 1997). The trivial reproduction and distribution costs and the durability of digital goods have changed the approach to distributing information goods in electronic markets, such as software, music, videos, and video games. The ability of locating, purchasing, receiving and consuming pure information goods digitally in a few minutes has been very attractive for consumers, leading to opening of numerous online stores for digital content. By being one of the fastest growing businesses on the Internet, the popularity of online content retailing has motivated practitioners and researchers to discover the optimal business models and competitive strategies of distributing and selling these products. Previous reports support this belief that consumer spending for digital content in the U.S. increased to $2 billion in 2005, which shows an increase of 15 percent from the previous year (OPA 2006). iTunes, an online music retailer, was announced to be the number one music store, followed by Wal-Mart, in 2008 according to a market research survey (NPD 2008). It was also reported in January 2009 that 6 billion songs were sold on iTunes store in less than 6 years after its launch, indicating more than 2 million songs downloaded per day (Schonfeld 2009).

Additionally, the characteristics of digital information goods and developments in

networking technologies have led to the emergence of Peer-to-Peer (P2P) networks. P2P networks allow its users to share resources such as information, digital content or storage space without needing a centrally organized server system (Krishnan et al. 2003). This distributed network design can provide better scalability, fault tolerance, lower costs and more efficient utilization of resources at the expense of control over users and the content that is exchanged among users (Kato and Yokoi 2003). On the other hand, no new technology comes without any issues or challenges. P2P networks became widely known among consumers with the Napster file-sharing program in 1999, which was mostly used to share digital songs in MP3 audio-specific format. Napster and similar file sharing networks were later forced to shut down their operations due to copyright infringements. It was estimated that users exchanged over 5 billion music files on P2P networks in 2001 (Dignan 2002), which is more than the number of songs sold on iTunes in 4 years.

1.3 Digital Piracy

No new technology comes without a risk, trade-off or sometimes chaos depending on the potential of the degree of change it may cause. It is no different for the case of the Internet and the content industry. The rapid advancement and dissemination of P2P networks have led to an enormous increase in the number of digital products copied and distributed without the authorization of copyright holders. Physical piracy of information goods, which is ripping the content, duplicating and distributing the copied content on physical media (i.e. CDs or DVDs), has always been a serious issue for producers and distributors since the first created information good. However, digital piracy of information goods has become a far more serious threat for copyright owners than physical piracy and its extent has quickly grown out of control due to the elimination of physical distribution requirement of pirated goods by the Internet.

Previous studies show that estimated revenue losses due to software piracy has jumped to $50.2 billion in 2008 (BSA 2009) from $11.4 billion in 1997 (Clark 1998). The consequences of P2P networks and illegal file sharing for the music industry is not promising either. Unauthorized file sharing has been declared as the major reason of the global drop in audio CD sales by the International Federation of the Phonographic Industry (IFPI 2003). It is estimated that global music piracy causes $12.5 billion of economic losses and 71,060 U.S. jobs lost every year (RIAA 2010). Sharing digital music has almost been a common practice especially among young population because of the shrinking sizes of audio files made possible by the audio file compression formats such as MP3 or MPEG-4. With the growing availability of broadband connections and improvements in the encoding format of digital files, sharing larger files such as movies, video games or software has become less time consuming and troublesome, expanding the scope of digital piracy threat.

Copyright holders have responded to piracy in different ways depending on the industry, but they have concentrated their efforts mainly on two preventive strategies. The first immediate response in fighting digital piracy was taking legal actions against P2P services to eliminate the platforms that facilitate illegal transactions. Although some of the popular P2P services with centralized structures (i.e. Napster) were forced to shut down their operations, legal attempts against decentralized or hybrid P2P systems (i.e. BitTorrent) were not successful. Reports showed a significant increase in the number of P2P applications and P2P traffic volume from 2003 to 2005 (Karagiannis et al. 2004; Madhukar and Williamson 2006). The second popular method of fighting piracy is through technological solutions such as digital rights management (DRM) systems, watermarking, online product registration and "decoy" strategies, which aims either to restrict the undesired use and sharing of files or to pollute the networks with decoy files. However, it is known that technological

preventive efforts are effective only until the first successful hacker. In addition, users are most likely reluctant to purchase a product of which use is limited to certain devices or software. This negative effect on the number of buyers may augment the potential for piracy (Vernik 2009). Another strategy widely used by the content industry is to discourage users from copying copyrighted products by investigative and educational campaigns (Gopal and Sanders 1998). Despite all endeavors to mitigate digital piracy, recent studies report that more than 40 billion files were illegally shared in 2008 (IFPI 2009).

In contrast to these conventional methods of fighting piracy, the academic literature and some practitioners from the industry suggest considering piracy as a competition instead of an enemy to be destroyed. Let us quote the words of Steve Jobs, CEO of Apple Inc. on piracy (Goodell 2003):

> "You'll never stop [piracy]. So what you have to do is compete with it."

To stop illegal downloading, content owners should focus on positive incentives, such as exploring new business models for digital goods by learning from the success of P2P networks that can provide valuable market insight for the content industry (Jordan and Bolton 2004; Hill 2007). For instance, Napster became a hit not only because the content was free to download, but also because it offered easy access to content, convenience, wide selection and customization of products. The first lesson to be learned from this example is that the content industry should provide a legitimate digital distribution channel for information goods to compete with illegal file-sharing. It has been showed that the availability of legal downloading services such as iTunes as an alternative to illegal downloading have resulted in decreased piracy levels (Easley et al. 2003). Consumers are less likely to pirate digital music when there is an alternative legal, pay site that offers features such as extensive music

catalogs, rare recordings and live concert videos (Sinha and Mandel 2008). Danaher et al. (2009) also examined the relationship between legitimate digital distribution and level of piracy, and observed an increase in the piracy rate in the absence of digital sale channels. Hence, development of new online services with more and better product offerings enhancing the product experience is very critical for sellers to encourage legal downloading (Freedman 2003; Bhattacharjee et al. 2009). Recent numbers show that the music industry is on the right track. While the number of licensed online music services was smaller than 50 in 2003, this number increased to almost 400 in 2009 (IFPI 2010). Moreover, music companies' revenues from digital channels reach over $4 billion in 2009, which constitute 27% of the total revenue (IFPI 2010).

Although offering digital products on a legitimate digital channel is a necessary weapon in the battle against piracy, it is obviously not sufficient. Since uniform pricing and traditional client-server distribution structure have not responded well to consumer demands for digital goods (Bhattacharjee et al. 2003; Lang and Vragov 2005), digital content industry needs to develop and adopt innovative contemporary business models to keep up with the changing technological environment and consumer behaviors. Several digital distribution companies (i.e. Altnet-Kazaa alliance) have started to experiment with using P2P networks as a part of their product distribution models (Evangelista 2002). Inviting consumers to participate in the distribution channel by utilizing P2P technologies offers more than operational efficiency (Choi and Perez 2007). Lang and Vragov (2005) developed a pricing strategy for distributing digital goods over P2P networks which reward users actively participating in the distribution process and they found that using a decentralized approach for distributing the content is more profitable than using a centralized structure. A similar model was proposed for the mobile commerce environment, allowing users to market and resell copies of digital content (Cattelan et al. 2006; He et al. 2008).

Grimm and Nutzel (2002) proposed a business model that uses a P2P network to distribute products and allows consumers to redistribute the content and share the profit. Furthermore, Casadesus-Masanell and Hervas-Drane (2007) showed that both a centralized client-server structure and a competing distributed P2P network can benefit from the competitive interaction when they are used to acquire certain products at the same time. However, few studies have examined this interaction with an integrated model that employs both centralized and decentralized structures. A recent study by Feng et al. (2009) examined the feasibility of a dual channel distribution strategy for a digital content seller, which utilizes both centralized and decentralized distribution channels. Users can purchase a product by using the centralized channel (B2C) and also can sell this purchased product to others by using the decentralized channel (C2C).

1.4 The Proposed Research

The Internet and the unique characteristics of digital products have driven researchers and practitioners to seek optimal business models and competitive strategies for distributing and selling these products online. The digital content industry is still experimenting with various business models to meet the consumer demand for digital goods in an efficient and effective way. For instance, there are currently more than 400 legitimate music services worldwide employing diverse models (IFPI 2011). However, existing business models for digital goods in practice still cannot provide clear guidance on how digital information products should be packaged, priced and distributed. Furthermore, the non-decreasing trend of digital piracy can also be interpreted as a vote of no confidence in current business models that fail to respond to consumer demand for digital goods (Reding 2009).

This research aims to address the issue of digital good transactions and piracy

by proposing a dual-channel model that coordinates both a primary market and a secondary market for the distribution of digital goods. While consumers can buy goods directly from the retailer, they can also buy and sell "used" digital goods from each other on a secondary market. The most important requirement for this dual-channel model to work is tight control by the retailer over the users' digital content libraries. Otherwise, consumers could sell numerous copies of the same product (obtained through the primary market or from outside the system) while keeping the original copy, leading to the collapse of the market price. Rapidly growing cloud computing technologies offer a reasonable solution to this problem. Today most hardware used to consume digital media periodically accesses the Internet. Moreover, online services have started to establish connections with each other, and information can be synchronized across different platforms by using cloud technologies. Therefore, control on digital content authorization can be maintained without the use of DRM-like technologies. For instance, Amazon launched a cloud-based streaming service that allows consumers to store music files on the company's servers (Perpetua 2011). When consumers want to play music or video files, they connect to the server and stream the content on their computers or mobile devices. Using such a mechanism enables companies to maintain control over digital content and prevent illegal sharing and copying. In this way, all content that is purchased or sold by consumers can be easily tracked, preventing them from accessing files they are not authorized to use.

Content providers can benefit from the secondary market by increasing their revenue through royalty fees charged for each transaction among consumers, decreasing their distribution costs without losing control over their products, and capturing additional surplus from consumers who choose not to buy products on the primary market (Ghose et al. 2005). Used-good markets can increase the revenue and market coverage of sellers by reaching more consumers who have lower valuations for

offered goods in new-good markets. Copyright holders have argued that secondary markets hurt seller profits by cannibalizing new product sales. However, previous studies show that used good markets are not necessarily harmful for copyright owners since sellers can anticipate the resale value of products and adjust the price of the new good accordingly (Miller 1974; Bulow 1982; Bond and Samuelson 1984). Ghose et al. (2006) examined product cannibalization impact of online secondary markets by observing Amazon.com's used-book market and find that only 16% of used-book purchases cannibalize new-book sales. Shulman and Coughlan (2007) showed that a dual-channel strategy that coordinates a new good market and a retailer-operated secondary market is more profitable for sellers than a single channel strategy.

Implementing a secondary market and coordinating it with a primary market for the distribution of digital goods can decrease the level of digital piracy because of two main reasons. First, such a market structure offers more profitable transactions for consumers and allows them to maximize their utilities. In a primary market, consumers who only have greater valuations for a product than its price will want to purchase this product. The rest of consumers in the market can be viewed as the potential demand for piracy. On the other hand, in the presence of a secondary market, knowing that they will be able to sell products on the secondary market and make extra profits, more consumers will want to buy the product on the primary market. In addition, prices of used products in secondary markets are always lower than those of new products in primary markets. Therefore, consumers will be able to buy a product at a lower price without sacrificing quality when the product appears on the secondary market. In this way, content creators can use the secondary market for digital goods as an indirect tool to utilize a form of second-degree price discrimination, which may increase the total number of buyers and decrease the demand for piracy by converting some of the potential pirates to legal buyers.

Second, availability of secondary markets for digital goods may affect how consumers perceive the fairness of digital good transactions. Due to the copyright arrangements, consumers do not have the right to sell their digital products on a legal platform in the current state of electronic markets. This may drive consumers away from legitimate online sellers of products with limited usage time or number of uses. For instance, people usually watch most movies just once unlike the way they consume music or other software applications. So, certain information products may become totally useless after consuming it. While consumers can sell their purchased movies as DVDs in secondary markets like eBay and make small profits out of them, digital movies purchased and downloaded online (e.g. on iTunes) are not allowed to be resold by consumers by any legal means. Another example is video games. Most video games lose their value after some time due to either introduction of a newer or upgraded version, or over-consumption. Consumers can buy video games either in a physical format from a brick-and-mortar store (e.g. Gamestop) or in a digital format by downloading it from a server (e.g. Sony's Playstation Network Store). Again, while customers are allowed to sell their used games on a physical medium, digitally downloaded games lose all their value after being consumed since they cannot be resold on a secondary market. Because of the aforementioned reasons, consumers may think that the lack of secondary markets creates an unfair advantage for content owners in terms of product pricing and they may perceive the current digital markets as unfair environments to conduct business in.

This research aims to answer the following research questions:

- Is the proposed dual-channel model for the pricing and distribution of digital goods more profitable than existing business models for content creators and providers?
- Can the proposed dual-channel model help mitigate digital piracy?

To address these questions, this research first uses an economic model to compare the revenues of content providers and levels of digital piracy in the proposed dual-channel model and a benchmark model. The model considers two time periods and a monopolist retailer of a digital good. In the benchmark model, the content provider is assumed to utilize a single channel for the distribution of goods with an intertemporal price discrimination strategy by dropping the price of the good in the second time period. Diminishing prices over time is a common practice in the digital content industry today. For instance, iTunes charges $1.29 for newly released songs and $0.99 for older songs. The benchmark case represents today's dominant pricing and distribution model of digital goods. In the proposed dual-channel model, the monopolist offers digital goods in its primary market in the first period as in the benchmark case. However, it opens a secondary market in the second period, in which consumers can sell and buy used goods. The monopolist charges a fee for each transaction executed in the secondary market.

Then, the second study uses a behavioral intention model to test the anti-piracy performance of the proposed distribution and pricing mechanism, and to compare it with a traditional business model using an experiment. The research model is based on expected utility theory (von Neumann and Morgenstern 1944; Bernoulli 1954), equity theory (Adams 1965) and the theory of planned behavior (Ajzen 1985) which has been applied to the context of piracy for various information goods to explain the factors that affect users' decisions whether or not to pirate by numerous studies. I prefer a behavioral intention model because of two main reasons. First, secondary markets for digital goods do not still exist, so there is no actual data that can be collected from any system using such a model. Second, it is very difficult, if not impossible, to capture the perceived fairness of a transaction with an analytical economic model, which is one of the main constructs in our study.

The remainder of this document is laid out as follows. Chapter 2 provides a review of the relevant literature. The proposed dual-channel model is presented in detail in Chapter 3. Chapter 4 presents the analytical economic model of the proposed business model that explores its profitability and if it can help mitigate digital piracy. The behavioral intention research model and the experimental survey which examine consumer behaviors change in the presence of the dual-channel model are given in Chapter 5. Finally, the conclusion and future research directions appear in Chapter 6.

CHAPTER II

Literature Review

This research is at the intersection of three streams of literature: business models, digital products and digital piracy. First, we will review the literature on online business models to understand how a business model is defined, what aspects of business models are important for this study. Second, we will focus on digital products and provide the previous work on the distribution and pricing of digital products. Last, we will summarize the consequences and causes of digital piracy and which lessons should be learned from the literature on digital piracy.

2.1 Business Models in the Information Age

After the migration of various business operations and activities in the offline world to digital channels driven by the Internet technologies, organizations have developed numerous business models to make use of the potential benefits offered by the new online environment. By allowing organizations to serve customers on a medium accessible by anyone from anywhere, the Internet reduces buyer search costs (Bakos 1997), increases product variety available to buyers (Brynjolfsson et al. 2003) and decreases the friction in markets which results in lower price levels, lower price dispersion, lower menu costs and higher transparency (Bailey 1998; Clemons et al. 1998;

Brynjolfsson and Smith 2000).

These benefits have led to the rise of electronic markets (Malone et al. 1987) which are defined as "an inter-organizational information system that allows the participant buyers and sellers to exchange information about prices and product offerings" (Bakos 1997). These systems can be operated by a market participant or an independent firm which is generally called an intermediary. The advantages of electronic markets are threefold (Berryman et al. 1998). Sellers can reach more customers, collect more information about them and target them more effectively. Buyers can decrease their search costs by comparing prices and product offerings of many sellers easily, which may also lead to a reduce in prices and profit margins. Intermediaries can increase their revenues by collecting commission fees for transactions and value-added services such as gathering and analyzing information, facilitating transaction payments and integrating systems of buyers and sellers.

In brief, the Internet provides an unprecedented medium for companies to implement novel strategies and business models. Organizations have always been in the search of new business models and strategies to increase their profits and optimize their operations. However, characteristics of the Internet make innovative business models not only attractive but mandatory for e-businesses to gain competitive advantages or simply to survive. In the information age, how a company uses electronic channels is as important as the quality of the product it offers. Before selecting a strategy, a company must first understand the benefits and challenges of using the Internet as a commercial platform for consumers.

People embrace the Internet as a viable commerce medium because of its accessibility and convenience (Jarvenpaa and Todd 1996), its real-time nature (Franz 2000), time savings (Wigand and Benjamin 1995), availability of comparison shopping (Hoffman et al. 1995; Bakos 1998), anonymity (Parsons 2002), availability of personalized

offerings (Peppers and Rogers 1999) and lower prices (Brynjolfsson and Smith 2000). On the other hand, there are several potential inhibitors to the consumer adoption of electronic commerce, such as the difficulty of evaluating a tangible product's quality on a digital platform and the lack of feel and touch during shopping (Kangis and Rankin 1996), security risks (Rose et al. 1999), lack of trust in online vendors and the fear of fraud (Jarvenpaa and Todd 1996; Furnell and Karweni 1999; Hoffman et al. 1999; Vijayasarathy and Jones 2000), delivery times(Vassos 1996), lack of personal service and enjoyment in shopping (Phau and Poon 2001) and other technology-related issues. Trust is even a bigger issue in consumer-to-consumer (C2C) commerce since sellers are not established business entities. A business model that is planned to be implemented in a company should address one or more barriers listed above.

The popularity of the term "business model" is relatively a young phenomenon and associated to the rise of information technologies. Osterwalder et al. (2005) found that the number of items the term "business model" appeared in business journals are significantly correlated to the NASDAQ market index. It clearly shows the growing importance of business strategies in the digital age. Osterwalder et al. (2005) defines a business model as: "...a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences." It is the description of the logic of a business system for value creation that lies behind the actual processes (Peterovic et al. 2001). So, it can be said that a business model is the conceptual and architectural implementation of a business strategy and the foundation for the implementation of business processes (Osterwalder and Pigneur 2002).

Due to their importance and popularity, scholars from different research disciplines

have attempted to classify business models used in the information age in order to clarify various aspects of business models and to understand their usages, roles and places in firms. Marketing's four P's - product, price, place and promotion- (Strauss and Frost 2001; Shin 2001), value chain of suppliers and buyers (Aufah and Tucci 2001) and value proposition or the mode of revenue generation (Rappa 2001; Mahadevan 2000) are used to build taxonomies for business models. Tapscott et al. (2000) provided a typology of business models identifying five generic b-webs, called agoras, aggregations, value chains, alliances and distribution networks. Timmers (1998) classified business models based on their degree of innovation and their functional integration and identified eleven emerging business models: e-shop, e-procurement, e-auction, e-mall, third-party marketplace, virtual communities, value-chain service provider, value-chain integrators, collaboration platforms and information brokers. Lam and Harrison-Walker (2003) identified six main e-business models by classifying them in a two-dimensional framework according to the objectives of their usages (Table 2.1). Their typology relies on two questions regarding the purpose of an e-business: relational (how it reaches customers) and value-based (how it adds value) objectives. Osterwalder et al. (2005) defined nine building blocks which represent the essential concepts in e-business models by building a rigorous ontology founded on four different main pillars: product, customer interface, infrastructure management and financial aspects (Table 2.2). In addition, there are a number of firms that use hybrid strategies which employ both physical and digital channels for their operations (Gulati and Galino 2000). Mendelsohn et al. (2006) reported that 54% of online consumers had researched a product on the Internet and purchased it from brick-and-mortar stores, and another 37% had researched offline and purchased online in 2005.

A common confusion regarding the concept of a business model is that many

Table 2.1: An objective based typology of e-business models, (adapted from Lam and Harrison-Walker 2003)

		VALUE-BASED OBJECTIVES	
		Financial improvement	Product/channel enrichment
RELATIONAL OBJECTIVES	Direct access	Internet merchants and portals	Virtual product differentiation
	Network development	Brokerage/retail networks	Interactive networks
	Corporate communications	Internet promoters	Image building

studies mention the term business model when they really mean only a part or parts of a business model (Linder and Cantrell 2000). To avoid this confusion, it should be noted that the focus of this research is the product, pricing and distribution strategies for digital information goods in electronic markets, which are considered essential components of a business model in several business model ontology studies.

2.2 Digital Products

2.2.1 Characteristics of Digital Products

The rate of the transformation of commerce from traditional ways to electronic channels depends on the characteristics of the product/services such as cost, tangibility and the degree of differentiation (Peterson et al. 1997). For instance, people search for available apartment listings to rent or purchase over a real estate website, but generally are reluctant to sign a contract using online channels without walking around in the apartment, checking the neighborhood and confirming if the number of rooms, utilities etc. are as promised. Transactions of some product types still require face-to-face contact or a personal experience of the product before purchasing

Table 2.2: Business model building blocks , (adapted from Osterwalder et al. 2005)

PILLAR	MODEL BUILDING BLOCK
Product	Value Proposition
Customer Interface	Target Customer Distribution Channel Relationship
Infrastructure Management	Value Configuration Core Competency Partner Network
Financial Aspects	Cost Structure Revenue Model

(Kangis and Rankin 1996) and can not be finalized in a fully electronic way.

On the other hand, previous studies show that the unique nature of digitized products makes them a good fit for electronic transactions (Phau and Poon 2001; Vijayasarathy 2002). Handling online transactions of digital goods is more complicated than conventional e-commerce methods and demands further developments in IT infrastructure, electronic payment systems and different business models and processes other than the developed ones for the transaction of physical goods (Whinston et al. 1997).

Granados et al. (2006) proposes that the ability to represent a product digitally influences the transparency level in an electronic market. While information goods are purely digital, the ability to represent a physical product digitally is limited. Therefore, the "digitalness" of the product has a significant impact on market structures and business models, as it accelerates the shift toward unbiased electronic markets as stated in the *electronic markets hypothesis* (Malone et al. 1987). Clemons et al. (2003) posited that digitization of pure information goods has led to chaos and uncertainty in most markets for these goods by changing their dynamics and leaving

them vulnerable. So, why do we experience a great electronic transformation and instability in commerce for digital products? To answer that question, we should first understand what digital products are and how they are distinguished from their physical counterparts.

As a broad definition, any goods or services that can be digitized or converted into a sequence of binary digits are called digital products. A number of different expressions appear in the discussion of digital products in the literature, such as "digital content", "electronic information products", "information goods", and "virtual products". Rowley (2002) stated that "an information product is any product (either good or service) whose core or primary product is information and knowledge", and Varian (1998) defined information goods as anything that can be digitized. Koiso-Kanttila (2004) used digital content and digital products interchangeably and defines as "...bit-based objects distributed through electronic channels." Rowley (2008) also proposed that the digital content and digital information products are synonymous terms. Therefore, based on the previous studies, it is safe to say that all terms listed above can be used interchangeably to refer to digital products.

Examples of digital products include software, music, videos, reports, magazines, books etc. Whinston et al. (1997) stated that all three components of a market (product, agent, process) are digital in the transaction of information goods on a digital platform, called fully digital commerce (Figure 2.1). Moreover, Francis and White (2004) identified digital products within their taxonomy of e-commerce as shown in Table 2.3.

All digital products share certain basic attributes which distinguish them from physical products (Whinston et al. 1997): indestructibility, transmutability, reproducibility. Indestructibility indicates no quality depreciation with the number of uses. Therefore, there is no need to replace a digital product once it is obtained.

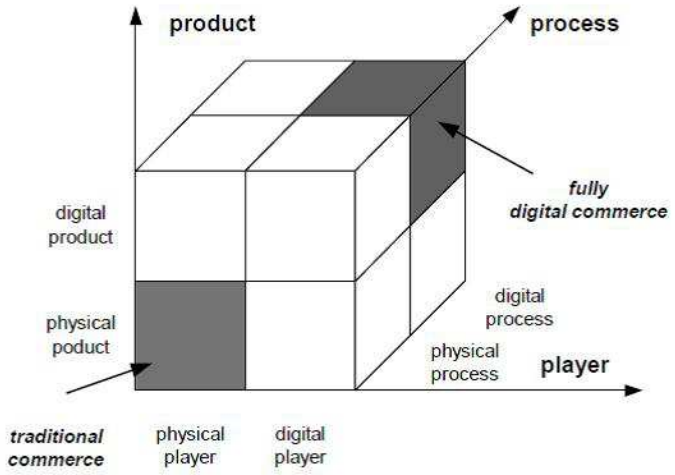


Figure 2.1: Levels of electronic commerce (Whinston et al. 1997)

Transmutability means that the content of digital products can be easily changed. They are extremely customizable and can be personalized easier and faster than physical products. Reproducibility, perhaps the most substantial characteristic of digital products, implies that they can be easily reproduced, transferred and stored. The production of the first copy of digital goods incurs high fixed costs, but the marginal cost of production and the cost of distribution is quasi-zero (Shapiro and Varian 1999; Whinston et al. 1997). Therefore, digital products are considered as liquid since they can easily be reproduced, distributed and customized (Hughes and Lang 2003). The demand for digital goods is more variable and their values are more heterogonous than the other product types. So, product customization and price discrimination is essential for digital products (Whinston et al. 1997). Additionally, each copy of digital content is identical to its original copy. To sum up, a digital product can be produced, reproduced, customized, distributed, experienced and consumed electronically.

Despite sharing these attributes, trading of different types of digital products has its own terms and conditions since their natures are quite different from each other.

Table 2.3: Fulfillment-product classification scheme (Francis and White 2004)

Product	Fulfillment Process	
	Offline	Electronic
Goods	Offline-Goods e.g. books, clothing, CD's, DVD's, groceries	Electronic Goods e.g. Software, MP3's, digital periodicals, electronic art
Services	Offline-Services e.g. Airline tickets, travel, hotels, event tickets	Electronic Services e.g. share trading, chat sites, astrology readings

Hui and Chau (2002) attempted to classify digital products and provides a framework for developing suitable business models and strategies for different digital goods. Their framework uses two dimensions to classify digital products: product category and product characteristics. They identified three product categories which have different product attributes and purposes for buyers: tools and utilities, content-based products and online services. Tools and utilities represent all types of application software. Content-based digital products are electronic newspapers, magazines, journals, music and video. Online services include services that are used to access to server connections and online utilities such as Internet telephony and several online support services. The other dimension is about the intrinsic characteristics of the products: delivery mode (interactive vs. downloadable), trialability and granularity. Both content-based digital products and tools/utilities are downloadable, but content-based goods are more granular and less trialable than software. A song in a digital format can be easily divided into pieces than software and sold in different combinations as in sales of ring tones by iTunes. One can create a ring tone for his/her cell phone by selecting a certain part of a song in a few seconds on iTunes. Also, song or video samples which are limited parts of the full product can be used

to promote content-based digital goods but they do not give a good idea as much as the trial versions of software do for their full versions. Therefore, using same strategies and models for the trading of content-based products and tools/utilities may not be efficient because of their different characteristics. Now let us look at how the emergence of digital products reshapes distribution channels and revenue models in e-commerce.

2.2.2 Distribution Channels for Digital Goods

The ability of distributing a product digitally without needing any physical help significantly alters the supply chain and business models for digital products. For the transaction of physical products on the Internet, electronic markets serve as digital platforms for exchanging information about product prices and offerings, handling order processing and payments. However, they do not have any function related to the product distribution since it should be handled by traditional distribution networks (Figure 2.2). In fully-digital commerce, it can be seen in Figure 2.3 that digital products are delivered to end users with electronic channels and available to consume shortly after the purchase without needing a physical distribution network.

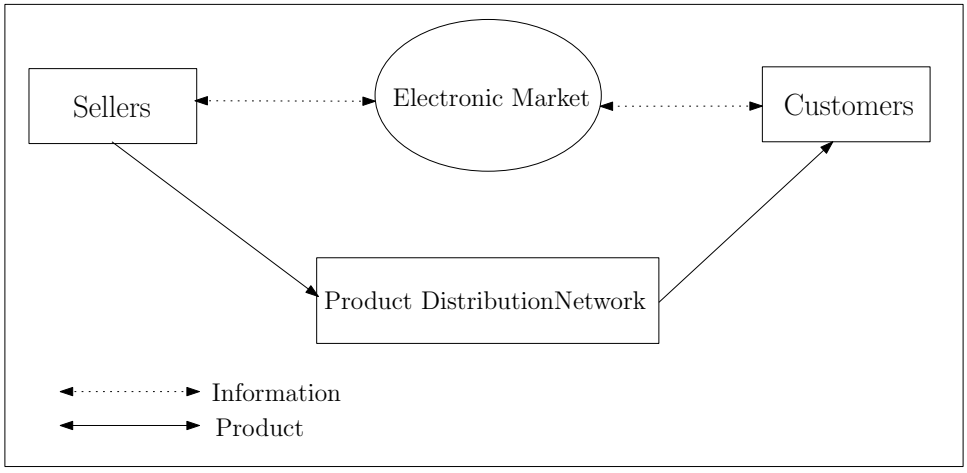


Figure 2.2: Electronic markets for physical products (Strader and Shaw 2000)

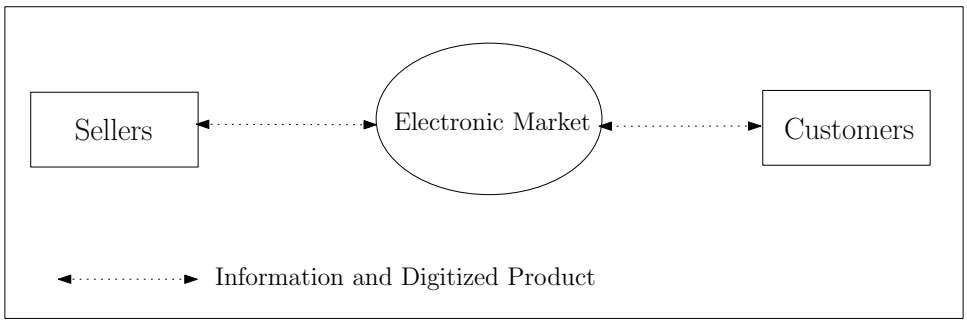


Figure 2.3: Electronic markets for digital products (Strader and Shaw 2000)

The distribution channel for a product is defined as "a group of individuals and organizations that direct the flow of products from producers to customers" (Dibb et al. 2005), in which each group or organization adds value to the final product until it is delivered to end consumers. Various groups involve in the supply chain such as creative, governance, intermediary, technology and end-user stakeholders (Umeh 2007). A typical structure of the value chain for digital products is given in Figure 2.4. Clemons et al. (2003) argued that there is also a selection stage before production which is related to the elimination of unpromising goods to increase the efficiency of product search performed by consumers and improve the supply-demand match, quality control, and product promotions to inform customers better about product offerings. But, since all these activities can be performed at production and distribution stages by intermediaries, this stage is not included in the supply chain diagram. Manufacturing the first original copy of a product occurs at the production stage which is carried out by the producer company. Reproduction is also an essential stage for digital products, where the cost of manufacturing an additional copy of the original product is almost zero. Therefore, duplication process does not require the resources used to create the original product and can be done by other intermediary organizations in the supply chain other than the producer. The distribution stage refers to delivery of goods to the end users. Gosain and Lee (2001) argued that the

emergence of virtual market channels enhances the distribution of digital products in five ways: decoupling of the digital content from the physical distribution networks, allowing unbundling and re-bundling of digital products, enabling dynamic pricing, decreasing the reliance on physical logistics and infrastructure, and increasing role for value-added information and information processing.

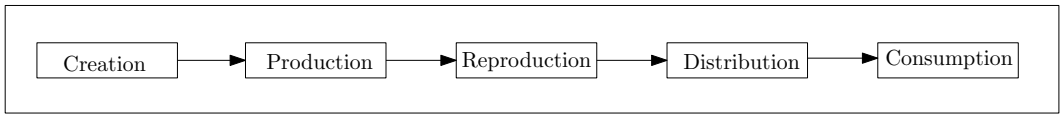


Figure 2.4: A typical distribution chain for physical products (Adapted from Clemons et al. 2003)

While intermediaries such as producers, distributors and markets add value to the final product by facilitating transactions, promoting products, offering a more convenient shopping experience to consumers, providing a large selection of products, making price and quality comparison easier and playing a reassurance role for consumers (Jallat and Capek 2001), there is also a disintermediation effect of information technologies on the structure of distribution channels for digital goods (Davenport 1993), since the Internet enables creators and producers to reach the right group of customers without needing any intermediaries. Therefore content creators (artists, developers), production companies and early-stage companies that are located in the distribution phase can deliver digital products to end consumers bypassing other intermediaries, which creates a variety of combinations for the structure of distribution channels (Figure 2.5). Benjamin and Wigand (1995) pointed out four areas of opportunities and risks for participants of the online distribution chain. First, consumers benefit from more choices due to the easy access to product offerings by various suppliers. Second, e-links between consumers and suppliers reduce the coordination and transaction costs throughout the industry value chain. Third, costless reproducibility of digital product lowers distribution costs. Last, disintermediation effect of digital

channels creates a potential risk for redistribution and reduction in total profits.

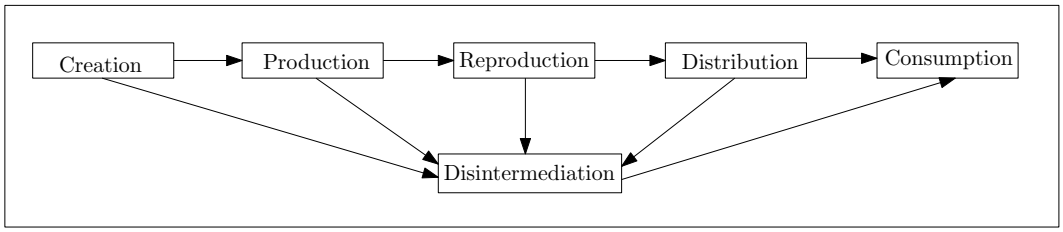


Figure 2.5: Distribution chain for digital products

For instance, the music industry is one of the most affected industries by the digital revolution because of the high demand and the unique characteristics of its main product. After the invent of various audio file compression formats such as MP3, demand for music format has greatly shifted from CDs to digital files, resulting in a rapid move to the use of digital distribution channels from traditional business strategies. Analysts reported that 20 to 33 percent of all music sales would shift from CDs to digital distribution in the next five years (Keegan 2004). While revenues from digital music files increased 6 times from 2004 to 2007, retail sales of recorded music on physical media have declined over 45% (RIAA 2007), emphasizing the strategic importance of digital music for the industry.

Two main reasons of this fast transition are the ability to customize the product and purchase since the digitization of the music business makes purchasing individual songs possible and the instant delivery of the product because of the digitization of distribution channels, which together increase the value of digital audio files. The supply chain has three main participants in music industry: artists (creators), record companies (producers) and retailers (distributors). In the absence of the Internet, there is only a single viable distribution strategy in which the product travels to the consumer through artist, record companies and retailers. However, disintermediation coming with the information technology makes a number of other distribution strategies possible and profitable for all participants in the supply chain. Clemons et al.

(2003) predicted that changes in value creation of different participants in the value chain would address the transformation of supply chain structure caused by digital distribution technologies. The impact of the characteristics of digital music on the participants of the value chain is given in Table 2.4.

Table 2.4: Digital music product characteristics (Bockstedt et al. 2005)

CHARACTERISTIC	PLAYERS AFFECTED	HOW THEY ARE AFFECTED
Easily reproduced	Record label	Low manufacturing cost
	Artist, record label	High cost to make "master", Low break-even
Easily transferred	Record label	Low distribution costs
	Consumer	Cheap, high quality product
Effective electronic format	Digital music retailer	Low inventory costs, Low menu costs
	Consumer	Easy pre-purchase sampling, Likes high portability, Values high compatibility, Demands additional product features
Equivalent quality	Consumer	More product options
	Physical retailer	New entrants can compete
Separability	Artist, label	Song "single" is the product

Premkumar (2003) classified six digital music distribution strategies: record company-retailer-customer (like the traditional model with digital distribution of the product), record company - customer (bypassing the retailer), record company - intermediary - customer (intermediary offers products from multiple artists and record companies such as iTunes), artist - customer (bypassing all intermediaries like Radiohead's distribution model for its "In Rainbows" album[1], artist - intermediary - customer (bypassing the producer), and audio-on-demand (using an online radio which streams the products instead of selling through a retailer). Within the digital music distribution

[1]http://www.time.com/time/arts/article/0,8599,1666973,00.html

paradigm, customers benefit from increased available product selection, lower prices and more convenient shopping. Artist, record companies and retailers can exploit increased visibility of artists, more efficient supply chain structure, reduced inventory costs, possibility of more sales and commissions and increased outsourcing options for the distribution of products to boost the profitability of their operations. Lam and Tan (2001) list a set of possible actions that can be performed to create value by each participant of the supply chain:

Artists: Well-known artists can promote and distribute their products directly to their fans for better financial benefits by bypassing intermediaries. New or less popular artists can use record companies as a support for publicity creation and music distribution or try to find new value-adding partners such as retailers in digital music distribution.

Record labels: Producers of music can distribute their products through retailers, allowing them to allocate more resources to core competency of music creation or restructure themselves as online retailers and reach customers without using any intermediaries. They also need to collaborate with IT companies to develop secure standard of encoding digital audio files.

Retailers: The most visible risk of disintermediation is the elimination of retailers from the supply chain. However, while manufacturing and distribution stages' added-value to the product is decreasing, digital music retailers contribute to the supply chain by adding new values through marketing, promotions, copyrighting and licensing (Bockstedt et al. 2005). Online retailers can attract customers better than the other actors of the supply chain by offering a wide selection of products and employing competitive price strategies. Furthermore, online retailers such as Amazon tend to have extensive information about customers. They can leverage these databases to study shopping behaviors of customers and devise more effective mar-

keting strategies.

The advent of peer-to-peer (P2P) networks further alters the structure of the distribution channel of digital goods. P2P networks enable individuals to share information, digital content, storage space, various computing processes and resources. Shared content does not have to reside on a central server and can be easily distributed from one peer to another. The first popular P2P network widely used to share music files is Napster which was released in May 1999. Napster's network structure was designed to hold the catalog of content on a single central server which allows peers to find which content was available to download from which peer. Later P2P network designs have removed the reliance on a central server for content search by employing a decentralized or hybrid catalog of content which distributes the list of files to various peers called "super nodes" or "ultra peers". This pure distributed design approach eliminates the possibility of controlling the transaction of files among peers for copyright holders. Considering the ease of producing a perfect copy of the original product and distributing it with the lack of control and monitoring on the network, P2P networks has led to a massive digital piracy problem. With increasing bandwidths and broadband Internet connection speeds, large files such as movies in DVD format and full versions of application software have started to being shared over P2P networks besides music files, increasing demand for such file sharing platforms. The number of P2P users has increased to over 9 million in January 2006 from almost 4 million in August 2003[2]. The user ability of copying and distributing digital content adds another channel (consumer-to-consumer) to the supply chain by which end users feed it back with their own resources (Figure 2.6).

[2]http://www.slyck.com

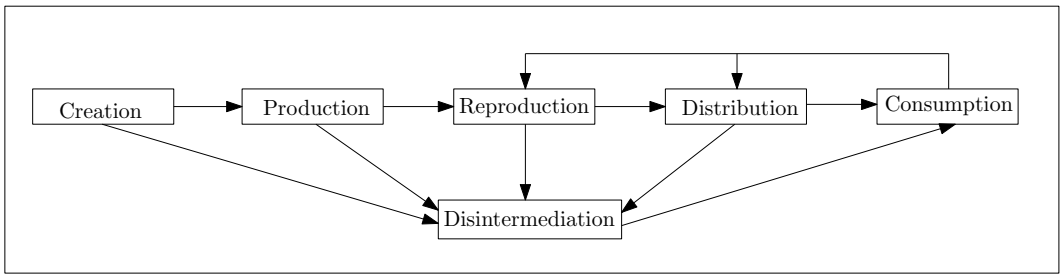


Figure 2.6: Distribution chain for digital products in the presence of P2P networks (Adapted from Hughes and Lang 2003)

2.2.3 Pricing Strategies for Digital Goods

Another important component of a business model is the method of generating revenue. Pricing digital products with a sound revenue model is very essential for digital good sellers. It has been a popular topic in the literature because of its importance and unique cost structure of digital goods: high fixed production costs and almost zero variable (marginal) costs (Shapiro and Varian 1998; Turner 2001). For instance, although developing a video game can cost a couple of million dollars requiring high-tech equipment, a long time and a development team consisting of producers, game designers, artists, story writers, level designers, sound engineers and testers, it can be duplicated in a second without incurring any costs. Therefore, the main objective of a digital good producer must be to recover high-fixed costs while maintaining the price at a profitable level by not being affected by the competitive pricing pressures. Since collecting and analyzing consumer information is much easier and more effective with information technologies, we can predict a shift from cost-based to value-based pricing for digital products, which focuses on customers' willingness to pay rather than the cost structure.

Price discrimination is an efficient pricing strategy which enables sellers to price the product based on the consumer's willingness to pay. Since it has been proved to be more profitable than uniform pricing, a seller should use discriminatory pric-

ing whenever possible (Phlips 1983). Being able to gain detailed information about consumer tastes, preferences and habits raises the possibility of first-degree or perfect price discrimination which is charging a different price to each consumer for the same product or service (Whinston et al. 1997). When perfect price discrimination is not possible in the absence of the information of consumer valuations, sellers can price discriminate by utilizing the product differentiation, which is a type of second-degree price discrimination. The transmutable nature of digital products allows sellers to offer a variety of customized versions of the same product or bundles of products without much added cost, making price discrimination an efficient option for pricing digital goods. Furthermore, sellers can practice discriminatory pricing by charging different prices for the same product to different segments of a market, called third-degree price discrimination. (See Odlyzko (2003) for a detailed discussion of price discrimination in the digital age.)

Although price is one of the most critical value drivers of digital content (Rangan and Adner 2001), pricing should be incorporated with the right product and distribution strategy to address other factors such as timeliness, interactivity, accuracy and appeal. Application of pricing strategies may exhibit variances across different digital products, since their characteristics, user experience and consumption are not identical. For instance, versioning is more suitable and efficient for software than songs because it is possible to obtain a number of different versions of software by simply adding, removing or twisting some features of the program with minimum cost. Although being possible, producing two different versions of a song may either be costly or have no significant difference in value for consumers. On the other hand, streaming content is much more practical to implement for content-based digital products such as music and videos than software. Sellers can develop an optimal pricing strategy for a certain type of product by modifying the usage of the product (the number of

times allowed to use the product after purchasing) or the product offered.

Based on previous studies (Bakos and Brynjolfsson 1999; Gallaugher et al. 2001; Dubosson-Torbay et al. 2004; Sundararajan 2004a; Rowley 2008), we identify five main pricing strategies for digital products: item-based pricing, fixed-fee pricing/subscriptions, rental/usage-based pricing, bundling and versioning.

Item Based Pricing: or the "a la carte" model is widely used for certain digital products such as songs, ringtones or electronic journals. Software or other types of digital content can be increasingly disaggregated into on-demand software applets, individual news stories and songs. Digitization of music allows users to choose individual songs to purchase from a music album. Customers can choose one of the alternative models to consume the product: either they pay just once to download the song (pay-per-download) for unlimited usage or they pay every time they want to play the song (pay-per-play). Pay-per-download models have become widely used in the digital music industry replacing early subscription based models (Burke 2007). For the acquisition of electronic journals, there are also two similar models used: pay-per-view and pay-per-download. While uniform pricing (0.99 cents per song) dominates recent digital music markets, disaggregation of digital content promotes price discrimination by which consumers' immediate needs for a specific item can be exploited.

Fixed-fee Pricing/Subscriptions: Users pay a flat price for unlimited use of the product. In other words, users own the product by paying a fixed price, but this ownership is generally restricted a user or a group of users and/or a platform to use the product. Price can change with the number of users that can use the purchased product (Harmon et al. 2004). Many software offerings are priced by using this manner. Fixed-fee pricing is feasible because of almost zero marginal costs and always improves profits in the presence of non-zero transaction costs (Sundararajan 2004a). However,

it is not flexible enough to customize the prices based on valuations of consumers. Fixed-fee pricing is also used for subscriptions that charge customers periodically with a flat fee for the unlimited usage of a product or a range of products. They are favored in mostly communications media such as telephone services, cable television and magazines. Consumers generally prefer subscriptions with flat-rate pricing over per-use pricing because it acts as an insurance against having unexpected large bills (Cosgrove and Lindhart 1979). Although most of the previous work studying flat-fee vs. per-use pricing based on non-digital products, Fishburn et al. (1997) claimed that subscription or fixed-fee approaches would dominate per-use pricing schemes in selling software and digital entertainment goods. In the music industry, some big record labels have launched services which offered a range of products for a flat rate, such as MusicNet and Pressplay. Some P2P network companies such as Napster and Kazaa legalized their operations by offering music downloads for a flat rate subscription fee.

Rental/Usage Based Pricing: Information goods such as books, video games, computer software and movies are often rented or shared. However, since the previous literature mostly focus on renting physical information products (Varian 2000), it is not possible to apply it to renting digital goods. One of the examples of the rental model is renting software programs or databases remotely hosted by application service providers (ASP) over the Internet (Harrast and Bean 2002; Rajala et al. 2003). This type of model is also known as "pay-as-you-go" pricing and charges customers for outsourced products or services based on time in use, transaction, peak period or some other subscription metrics (Harmon et al. 2004). Streaming content can also be considered as renting the product for a limited time. Some music services and online radios such as Napster, Kazaa, MusicNet, Pressplay, and digital movie rental services such as iTunes and Netflix offer playing the product on the Internet without the option of offline consumption.

Bundling: Bundling is a useful tool for price discrimination method (Adams and Yellen 1976) and offers several benefits, including reduced transaction and production costs, and complementarities among the components of a bundle (Eppen et al. 1991). Bundling can improve profits if the valuations of two goods to be bundled are negatively correlated (Stigler 1963; Adams and Yellen 1976), independent or positively but not perfectly correlated (Schmalensee 1984). There are many studies in the literature discussing profitability, optimal conditions and welfare implications of bundling two or more goods when limited information is known about individual customer preferences (Mcafee et al. 1989; Salinger 1995; Armstrong 1996). Selling small information goods in large bundles is feasible because of their quasi-zero variable costs of production. Bakos and Brynjolfsson (1999) examined the optimal bundling strategies for information goods and found that bundling large numbers of unrelated information goods can increase profits. Geng et al. (2005) showed that bundling is approximately optimal if consumer valuations do not drop too quickly over time, and suboptimal if they do so. For certain categories of information products such as research articles, Chuang and Sirbu (1999) proposed that a mixed bundling strategy could be better when the value of a large bundle is zero for consumers. Mixed bundling strategy is selling products both individually and in bundles. Several studies showed that engaging in a form of mixed bundling of information products outperforms either strategy alone (Fishburn et al. 1997; Chuang and Sirbu 1999). Moreover, Hitt and Chen (2005) analyzed an alternative bundling strategy which allows customers to customize the components of bundles for a fixed price and found that customized bundling strategy is preferred by customers when they are on a constrained budget and their valuations are concentrated on a small number of goods. (See Altinkemer and Bandyopadhay (2000) for a thorough analysis of bundling strategies in digital music industry.)

Versioning: Versioning is a form of second-degree price discrimination based on

offering a series of products with different quality levels at different prices. Multiple versions of the same product separate consumers into segments with different valuations for the product, buying different versions and paying different prices. Different versions of a product can be obtained by the product differentiation by a number of ways including convenience, comprehensiveness, manipulation, community, annoyance, speed, data processing, user interface, image resolution and support (Shapiro and Varian 1998). Jones and Mendelson (1998) reported that versioning might not be optimal for digital information goods with zero marginal costs or concave cost functions. Bhargava and Choudhary (2001) showed that versioning decision depends on the cost-quality ratios of the possible quality levels of different versions and is not related to the nature of consumer distribution. They concluded that the optimal solution is to create a single quality version of a product when the highest quality version has the lowest cost-quality ratio. On the other hand, versioning has been found as a profitable strategy when information goods display network effects (Bhargava and Choudhary 2004; Jing 2006). Wu et al. (2003) suggested that versioning could be an effective strategy when there is substantial piracy of the information good. Chen and Seshadri (2007) stated that success of a versioning strategy depends on the structure of customers' reservation utilities. The authors found that versioning is optimal when customers have convex reservation utilities, or a number of outside options.

Some firms use different combinations of these pricing strategies listed above. For instance, Ministry of Sound adopts a mixed strategy of a la carte and subscription bundle model by offering an access its recording catalogue for a fixed subscription fee and also allowing their subscribers to download a number of tracks for a specified time with an option to pay an additional fee for a permanent access (Dubosson-Torbay et al. 2004). The current model of Napster is another example of a mixed strategy of subscription and a la carte models. Furthermore, many firms seek to generate revenue

from alternative channels by offering the digital content for free or relatively a low price such as through the sale of advertising and additional complementary or non-complementary products/services (Gallaugher et al. 2001). Sundararajan (2004a) demonstrated the profitability of performance-based pricing under uncertainty and asymmetric information about the value of an information product such as Internet-based advertising. Fan et al. (2008) explored the benefits of a mixed strategy of online selling and advertising. They showed that it is profitable to sell products online when content quality is high and cost of online access the content is low. On the other hand, they recommended an advertising strategy when online access cost is relatively high. Dubosson-Torbay et al. (2004) identified some other emerging business models including the tipping, promotion, customer data, preferred placement, statutory levy and space/time-shifting models for the digital music industry. Shapiro and Varian (1998) suggest the use of third-degree price discrimination which is widely used by desktop software manufacturers. Buxmann et al. (2007) focused on the entire supply chain rather than individual sellers and propose a cooperative pricing strategy for the entire music value chain for profit maximization.

2.3 Digital Piracy

No new technology comes without a risk, trade-off or sometimes chaos. The rapid dissemination of networking technologies such as the Internet and peer-to-peer networks (P2P) have led to an enormous increase in the number of digital products copied and distributed without the authorization of copyright holders. Digital piracy is the illegal act of reproduction and distribution of intellectual properties such as computer software, videogames, music and videos over peer-to-peer networks or other networking technologies without a permission from and compensation to legal owners. Physical piracy of digital goods which is ripping the content, duplicating it

and distributing the copied content on physical media (CDs or DVDs) has been a serious issue for digital content producers and distributors. The problem of piracy of digital goods has grown out of hand and become more prevalent because of the elimination of the physical distribution requirement of pirated goods by the Internet. These networks such as Kazaa and BitTorrent are virtual places that enable users to freely share everything that can be digitized, thus making copying and distributing digital goods easier and more difficult to prevent. Previous studies showed that estimated revenue losses of firms due to software piracy has jumped to $50.2 billion in 2008 (BSA 2009) from $11.4 billion in 1997 (Clark 1998). The impact of P2P networks and illegal file sharing on the music industry is not encouraging either. It is estimated that the revenue losses due to music piracy alone are more than $10 billion (Murphy 2003). Sharing digital audio files have almost been a common practice especially among teenagers and young population because of the reduce in the size of music files which has become possible by advanced file compression formats such as MP3 or MPEG-4. The widespread availability of broadband connections and improvements in the encoding format of digital files increase the scope of the piracy problem, making sharing larger files such as movies or other computer software less time consuming and cumbersome.

Digital piracy has been extensively studied in the economic, marketing and information systems literature. We provide a review of the previous literature on digital piracy in three parts. First, positive and negative impacts of digital piracy on various industries are discussed. Contrary to the common belief, copyright holders may benefit from piracy in several ways. We also review the legal actions taken by copyright owners against piracy in the first part. Next, we discuss the reasons of piracy and the influential factors that affect online behaviors of consumers. Last, alternative recommended strategies that can be adopted by copyright holders to deal with piracy

in the existing literature are provided.

2.3.1 Consequences of Digital Piracy

The most obvious impact of digital piracy is the decrease in the number of products sold, thus revenue losses. It is estimated that 35% of software is acquired by illegal means and it results in a loss of more than $31 billion for software producers (Global Software Piracy Report 2005 by Business Software Alliance). Piracy rates are estimated to be 21% in the United States. These rates are more severe globally, 92% in Vietnam and 90% in China. Furthermore, sales of music on physical media have decreased by 28% in the United States 1999 to 2007 (RIAA 2007) (Figure 7). Liebowitz (2004) estimated that the actual sales in the United States have dropped up to 30% after digitalization. Peitz and Waelbroeck (2006) found that illegal file sharing could have caused a 20% drop in music sales worldwide between 1998 and 2002. Zentner (2006) argued that piracy decreases the probability of buying music by 30%, and sales in 2002 would have been around 7.8% higher without illegal downloads. The Recording Industry Association of America (RIAA) reported two main reasons for the decline of sales: the global economic recession and digital piracy since the activity of file sharing indicates a substitution effect. A press release from the International Federation of the Phonographic Industry (IFPI 2003) statesd that "Mass downloading from unauthorized file sharing on the Internet and the massive proliferation of CD burning continues to be a major cause of the fall in CD sales globally." Piracy is claimed to be a key threat to profitability and innovation, and harmful to society as it leads to higher prices, lower profits and reduced new product innovations (BSA 2004).

While copyright holders blame primarily illegal downloads over P2P networks for the recent decline in global record sales, there are some other reasons including the

global economic downturn, the maturing of the CD market, the increased popularity of rival entertainment activities such as DVDs and video games, the industry tendency of less investments in new artists and not enough musical innovations (Freedman 2003). Bhattacharjee et al. (2007) analyzed the effect of digital file sharing on sales of music recordings by observing survival of music albums on the charts. They found that the impact of level of sharing depends on the popularity of albums. While the level of sharing is found to have a significantly negative impact for lower debut ranked albums (low popularity), sales of top debut ranked albums are not affected by sharing. Ahn and Yoon (2009) observed increases in consumer surplus and social welfare with a decline in seller profits. Bhattacharjee et al. (2006) showed that decreasing piracy does not necessarily lead to higher profits. Boorstin (2004) found that the main cause of the recent decline in record sales is not file-sharing. While file-sharing leads to a decrease in the record purchases of younger people, it increases the purchases of older people. So, how does an illegal activity possibly help firms increase their sales and revenues? Several studies in the literature studied conditions under which piracy could increase the profit of a firm and the optimal level of copyright protection (Conner and Rumelt 1991; Givon et al. 1995; Hui and Png 2003).

First, it has been argued that copyright holders could benefit from pirated goods through an exposure or sampling effect (Liebowitz 1985). Sampling can help in the diffusion of a product since it provides the missing information caused by the asymmetric information between producers and consumers of a cultural product (Rogers 1983; Takeyama 2003; Gupta et al. 2004; Duchene and Waelbroeck 2006; Peitz and Waelbroeck 2006). Gopal et al. (2006) found that downloading might make the product more attractive if consumers find out that they would enjoy the product assuming that a single product is sold at a fixed price. Since digital products are experienced goods, it is difficult to assess the value of products before trying them. Consumers

can use illegal copies as samples in order to value the product and make their decision on purchasing a legal copy of the product. Janis Ian, a recording artist whose last hit album was in 1975, states that CDs bought by people who downloaded her music illegally via P2P networks made her an extra $2,700 a year (Ian 2002).

Second, piracy may be socially beneficial in the presence of strong network effects (Conner and Rumelt 1991). When positive network externalities are operating in a market, the value of the product rises with the installed base of users. Network effects can be partly direct or indirect for software. The value of a product directly increases with the number of users since more files generated with that software become available for exchange. Product value and usefulness also indirectly increase with the size of the network as more complementary products or services are offered for a larger base of users. Therefore, it may be profitable for a seller to accommodate a certain level of piracy in order to increase the willingness to pay for originals (Takeyama 1994). Givon et al. (1995) speculated that the success of Microsoft Excel over other spreadsheet software is due to a high tolerance of piracy. Jain (2008) found that firms might choose weak copyright protection in the absence of network externalities and piracy could sometimes lead to innovation and an increase in social welfare. They also show that when there are strong network effects, it is profitable to choose strict copyright protection.

Last, if sellers can identify users who use an original product to generate copies and who do not, it is possible to price discriminate. Indirect appropriation suggests that price discrimination can be applied as a function of the potential number of copies that will be made. Therefore, sellers can charge higher prices to users who are expected to copy (Liebowitz 1985; Besen and Kirby 1989).

There are two measures identified in the literature of criminology to fight crime: preventives and deterrents (Blumstein et al. 1978). Preventives aim to increase the

costs of committing crimes and deterrents try to hinder individuals from engaging in criminal activity through the threat of legal sanctions. Straub (1990) identified various preventive and deterrent controls for fighting computer hardware use and software piracy. Preventive controls for software piracy focus on technology-based solutions to make copying software more difficult for users, including hardware-based controls such as disks, coders, cards and locks; and software-based controls such as passwords, encryption, activation and registration codes (Malhotra 1994). A common preventive control used in the music industry is digital rights management (DRM) technologies. DRM technologies attempt to control how consumers can access, copy, or convert digital goods. In online music industry, DRM involves specifying and associating rights with digital music, placing control measures on music files to enforce rights, enabling access checks and tracking permission usage and payment. Therefore, number of uses, means of usage and platforms to use the product are determined by DRM. (See Kwok (2002) for a detailed discussion of DRM technologies.) Napster uses digital fingerprinting technology to prevent sharing of digital audio files by identifying the sound patterns in such files. Preventive controls may also include innovative pricing mechanisms that can make legal purchases more attractive for consumers.

Copyright holders also discourage users from copying copyrighted products through deterrent controls such as legal, investigative, and educational campaigns (Schneider 1987; Mason 1990). The Software Publishers Association and the Business Software Alliance devise investigative campaigns by operating piracy hotlines, filing lawsuits, and engaging in educational campaigns which aim to disseminate information on the legal aspects of piracy (Gopal and Sanders 1998). The RIAA has filed several lawsuits against a range of P2P network companies such as MusicCity.com, Kazaa, Grokster and Audiogalaxy, starting with Napster in December 1999. In May 2000, the court ruled that Napster violated the Digital Millennium Copyright Act of 1998 and shut

down its operations. The RIAA redirected legal threats toward individual internet users from P2P networks in June 2003 and these recent legal developments have considerably changed the previously perceived notion of immunity from legal liability when violating copyright law (Graham 2003). Bhattacharjee et al. (2006) explored the impact of legal threats on file sharing activity and found that reactions of individuals who share a large number of files to legal threats are different than those who share a lesser number of files. Their study further indicated that after legal threats and reduced level of file sharing, there is still a substantial number of music files available on P2P networks.

While there is substantial amount of piracy observed in music industry in spite of the extensive use of preventive and deterrent controls, sale trends in movie industry do not indicate a decline as expected due to spreading broadband connections and enhancements in P2P network structures (Figure 2.7 and 2.8). Although sharing certain characteristics like high fixed costs of production, almost zero marginal costs and almost perfect quality of unauthorized copies, the scale of piracy may vary depending on market characteristics and the nature of products.

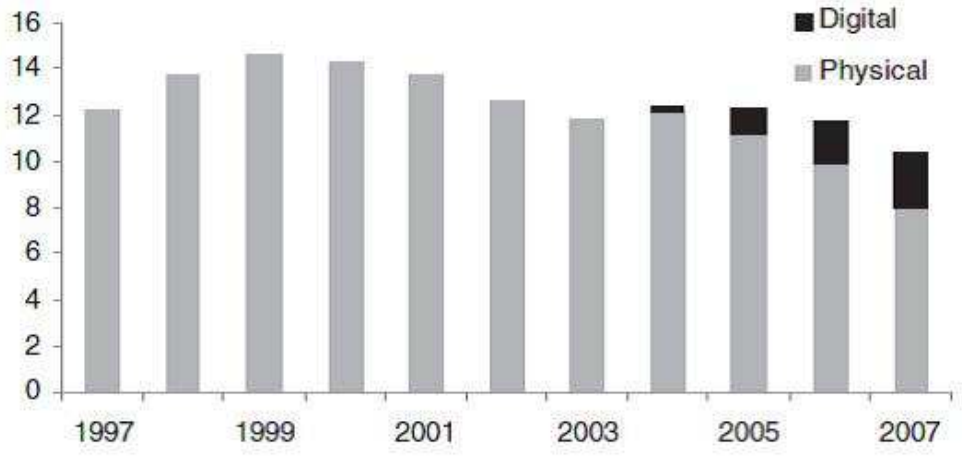


Figure 2.7: Total value of US manufacturer's unit shipments in the record industry (in billions $, net of returns) (Source: RIAA, from Dejean 2009)

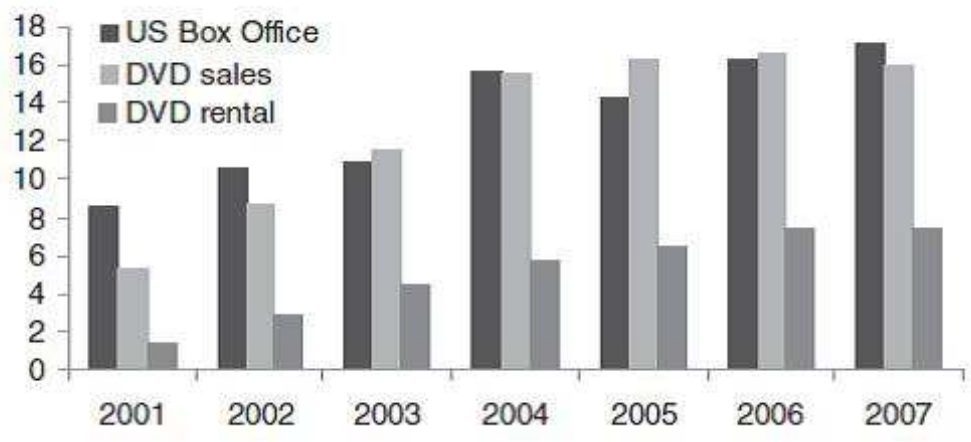


Figure 2.8: Total revenues in the movie industry (in billions $) (Source: MPAA, from Dejean 2009)

Peitz and Waelbroeck (2006) pointed out the complexity of software and its online support features which might decrease the attractiveness of copying such products for end-users. They added that direct network effects for software have been reduced with the standardization of file formats, weakening the argument of using copies to increase seller profits. Video games industry is not affected by piracy as much as other industries because of proprietary formats including online components of video games that are not available in copied products. Moreover, piracy in the music industry is more widespread than in the movie industry since the size of audio files are much smaller than movies and consumers tends to consume music repeatedly unlike movies. Additionally, value and quality of a movie file can significantly decrease when copied if the copied version does not have any choices of format, language, subtitles and extra material, making piracy less of a threat for the movie industry. Ghosemajumder (2002) discussed the factors that affect the desire to share a product and identified three primary factors: interest, risk and network. By assessing the intensity of all factors for each industry, he concluded that willingness to share with third parties is high in music and video game industries, medium in movie and newspaper/magazine

industries, and low in business software and book industries.

2.3.2 Causes of Digital Piracy

In order to take the right actions to prevent people from engaging in digital piracy, one should first understand why people pirate and what are the influential factors that drive people to share digital goods illegally. Hill (2007) explained the reasons why people pirate with three theoretical perspectives: moral development, equity theory, and moral intensity. Behavioral studies concentrating on the demographics and personality characteristics such as moral development (Solomon and O'Brian 1990; Glass and Wood 1996; Sims et al. 1996; Gopal and Sanders 1998; Bhattacharjee et al. 2003; Hinduja 2003; Gopal et al. 2004; Liebowitz 2004; D'Astous et al. 2005; Sinha and Mandel 2008) suggested that males and young people engage in piracy more. Liebowitz (2004) reported that 41% of a sample group of Internet users between the ages of 18 and 29 admitted to download audio files illegally compared to 21% of those between ages of 30 and 44. It has also been found that social norms do not hinder piracy activity and piracy is viewed as acceptable and normative behavior (Cohen and Cornwell 1989; Oz 1990; Solomon and O'Brian 1990; Glass and Wood 1996). Moreover, certain cultural norms have an influence on consumers' online behavior (Kini et al. 2004). Piracy is more prevalent in societies where intellectual property rights are poorly enforced. Ki et al. (2006) found that the rate of music piracy is lower in individualistic countries such as the United States. They also show that music piracy rate is lower in more educated societies.

Several software piracy models are based on deontological aspect of ethical evaluation (Hunt and Vitell 1986; Gopal and Sanders 1997; Thong and Yap 1998) which can be used to determine the effectiveness of deterrence controls such imposing copyright laws and devising educational campaigns. While Gopal and Sanders (1997) found that

deterrent policies have a significant influence on software piracy, Gopal et al. (2004) could not find the same influence for digital music piracy. Thong and Yap (1998) explored softlifting using Hunt and Vitell (1986)'s ethical decision-making theory which suggest that individuals are influenced by deontological (rules define what is ethical or not) and teleological (consequences of the behavior) evaluations. Banerjee et al. (2008) found that individual and situational characteristics influence ethical behavior intentions. Eining and Christensen (1991) identified five factors that influence software piracy behavior: computer attitudes, material consequences, norms, social-legal attitudes and effective factors. Limayem et al. (1999) found that social factors and perceived consequences influence the piracy behavior. Cronan and Al-Rafee (2008) used the Theory of Planned Behavior (TPB) to determine factors that affect digital piracy and showed that attitude toward piracy, perceived behavioral control, moral obligation and past piracy behavior influence the intention to pirate digital content. Other explanations of software piracy are listed as moral judgment, risk, codes of ethics, self efficacy, and organizational policies (Wagner and Sanders 2001; Kuo and Hsu 2001; Tan 2002).

Price is identified as a key motivational factor to explain why people download illegal music (Molteni and Ordanini 2003; Bhattacharjee et al. 2003; Plowman and Goode 2009). Some people perceive the prices for digital goods to be high and unfair given the economic success of copyright owners. People who download digital goods use this perception to justify their illegal actions (Harrington 1989; Hinduja 2003; Gupta et al. 2004). Gopal et al. (2002) found empirical evidence on the relation between the price of music CDs and the level of music files downloaded illegally. Other studies support this argument without saying anything about the direction of the relation between price and piracy levels, showing that the average price of music CDs (Lesk 2003) and level of online music files shared (Bhattacharjee et al. 2003)

have steadily raised since 1990s. Ang et al. (2001) recommended new pricing policies to target digital pirates. Software piracy studies also state that increasing software prices increases piracy (Conner and Rumelt 1991; Glass and Wood 1996; Cheng et al. 1997; Gopal and Sanders 1997, 2000; Moores and Dhillon 2003).

Besides price, valuations of products have a considerable role in digital piracy behavior of consumers. Customers with a high value for a product tend to purchase the product rather than acquire it by illegal means (Conner and Rumelt 1991; Cheng et al. 1997; Gopal and Sanders 1998). In other words, as the perceived quality of the product increases in a society, less piracy is observed for that product. This statement is accompanied by Bhattacharjee et al. (2007)'s findings on music industry that album sales of well-known artists are not affected by P2P sharing. Rob and Waldfogel (2006) also confirmed that legitimately purchased music is valued much more than illegally downloaded music. On the other hand, Plowman and Goode (2009) did not find significant support for the effect of the quality of the song on music downloading behavior for light downloaders. Wang et al. (2009) analyzed the moderating effects of idolatry (worship to someone or the desire to act like someone) on the relationship between the intention to illegally download music and the intention to purchase music. Furthermore, annual income has been found to be negatively correlated with downloading behavior (Madden and Lenhart 2003), with pirating computer software (Gopal and Sanders 1998) and with pirating unknown songs (Bhattacharjee et al. 2003).

Technology that facilitates the piracy also has a critical impact on piracy behavior (Conner and Rumelt 1991; Bhattacharjee et al. 2003). The main objective of the usage of preventive controls such as protection techniques and encryption is to increase the cost of pirating software and prevent easy access to pirated goods. Effective ways of increasing protection with preventive controls are discussed in several

studies (Liu et al. 2003). However, Gopal and Sanders (1997) argued that increasing preventive controls lead individuals who do not have an intention to acquire a product legitimately to simply do without it, which may imply a drain on software producer profits. Furthermore, DRM technologies constraint the usage of the content for legitimate users, and such restrictions on the usage decrease the utility of legitimate users (Yoon 2002). Vernik (2009) found that the level of piracy might decline when DRM protection is removed.

Last, Glass and Wood (1996) used Equity Theory to explain the act of software piracy among individuals. Also, some studies applied this idea to the online music context and found that a perceived equitable relationship between an individual and the music copyright holder affect the attitude of an individual and his/her intention to illegally download online music. If an individual perceives an inequity or an unfairness in the exchange with the copyright owner, this inequitable relationship will lead to more positive attitudes towards music piracy (Kwong and Lee 2002; Plowman and Goode 2009). Both studies found that the lack of a perceived equitable relationship between consumers and copyright owners positively affect consumers' attitudes toward music piracy. Furthermore, Coyle et al. (2009) used the same idea in their study with a different term "consumer equity and feeling ripped-off."

2.3.3 Lessons Learned

Although it may not be possible to completely eliminate piracy since there will always be a demand for pirated music (Lam and Tan 2001), copyright holders can find an optimal combination of appropriate measures and an effective strategy to alleviate the issue of piracy by examining causes and consequences of digital piracy studied by many scholars. Sellers can protect the legal rights of products/services by using preventive and deterrent controls (Gopal and Sanders 1997). Preventive controls

employ technology-based solutions to make copying and distributing digital content more difficult. Deterrent controls aim to discourage users from pirating through legal, investigative and educational campaigns. These controls include copyright laws, anti-piracy and educational campaigns, preventive technological solutions such as DRM technologies, product offerings, distribution strategies and pricing.

Previous studies showed that ethical dispositions have a significant influence on the intention of customers to download content illegally (Gopal and Sanders 1998). Individuals do not consider illegally downloading content as a crime or unethical issue because of several reasons like that they believe artists and record companies already make enough money and downloading a song would not hurt copyright holders. Therefore, devising educational campaigns which aim to build a negative attitude to illegal music downloading and strengthen the understanding towards copyrights is one of the methods of preventing digital piracy (Freedman 2003; Ki et al. 2006; Wang et al. 2009). Another way to inform the society about the gravity of piracy issues is applying better defined copyright laws and protection of intellectual property rights by governments. There are a number of studies focusing on the government's role in piracy problem. For instance, Chen and Png (2003) discussed how the government should respond to digital piracy using fines, taxes and subsidies. Regarding to imposing copyright laws, Gopal and Sanders (1998) found that government's incentive for copyright enforcement depends on the size and maturity of the domestic software industry. They also claim that software producers do not benefit from preventive control methods. So, firms should find the optimal timing and intensity of deterrent controls such as copyright laws, anti-piracy and educational campaigns to prevent piracy. However, Gopal et al. (2004) did not find any significant effect of deterrent controls on digital music piracy and suggested that firms should focus on preventive controls in the music industry, contradicting with Kwong and Lee (2002)'s

findings which stated that deterrents significantly affect the downloading behavior of individuals.

Moreover, perceived risk of punishment can be increased through litigation. Bhattacharjee et al. (2006) argued that RIAA's legal actions against individuals have been effective, but not enough. Accordingly, increasing legal threats might also be another option for copyright holders to prevent piracy by eliminating no fear of getting caught when pirating among consumers. Sinha and Mandel (2008) demonstrated that a consumer's perceived risk of getting caught downloading illegally decreases her tendency to pirate. However, these legal actions against individual consumers were criticized since they could create a backlash on the music industry (Graham 2003; Ahrens 2003). Gayer and Shy (2006) posited that massive anti-piracy campaigns and the large number of ongoing and pending lawsuits may eventually hurt copyright owners. Considering the positive effects of piracy such as sampling and network effect, firms should choose an optimum intensity of copyright enforcements. Ben-Shahar and Jacob (2001) examined how digital content producers could engage in selective copyright enforcement.

Danaher et al. (2009) studied the relationship between legitimate digital distribution and the level of piracy. They observed an increase in the piracy rate in the absence of any digital sale channels. This finding underlines the importance of offering digital channels for legitimate purchases in the battle against piracy. Sinha and Mandel (2008) found that consumers are less likely to pirate digital music when there is an alternative pay site that offers features such as extensive music catalogs and the availability of extras such as rare recordings, live concerts and videos. Therefore, development of new online services with more and better product offerings which can also enhance the product experience is very critical for sellers to encourage legal downloading with creative and engaging features (Freedman 2003; Bhattacharjee

et al. 2009).

Since price is one of the determinant factors in piracy behavior, many studies recommend innovative pricing options to fight against piracy, mostly focusing on various price discrimination techniques (Bhattacharjee et al. 2003; Clemons et al. 2003; Wu et al. 2003; Sundararajan 2004a; Chellappa and Shivendu 2005; Bhattacharjee et al. 2006; Khouja and Park 2007; Bhattacharjee et al. 2009; Khouja and Rajagopalan 2009; Li and Lin 2009). Differential pricing could be a useful strategy since young people who constitute the primary group of consumers in the music industry have very high price elasticity of demand for music. Most research on pricing digital goods prior to the rise of P2P networks did not consider piracy as a factor which in fact significantly influences consumer demands. However, Khouja and Park (2007) posited that explicitly considering the presence of piracy causes the monopolist to lower the price to capture more demand from indifferent and pirating consumers. On the other hand, Khouja and Rajagopalan (2009) showed that monopolist could charge higher prices to optimize profits under piracy when there are no positive network externalities.

Second-degree price discrimination, such as bundling and versioning, is an efficient strategy by which a monopolist can increase profit under piracy (Varian 2000; Bhattacharjee et al. 2003). Smith and Telang (2009) analyzed piracy in the movie industry and suggested that product differentiation and market segmentation strategies could be effective to compete with freely available copies. While price discrimination by quality may not work in music industry, differential pricing for different music categories (Bhattacharjee et al. 2003) or for different market segments (Gopal and Sanders 2000) may be successful since there are significant piracy differences based on consumer demographics. A study among Spanish P2P users demonstrated the effectiveness of value-based strategies on influencing the piracy behavior of consumers (Sandulli and Martin-Barbero 2007). King and Lampe (2003) showed that

allowing piracy is always inferior to price discrimination for a monopoly to maximize profit. Sundararajan (2004a) studied optimal pricing and technological protection for a monopolist that uses price discrimination among consumers willing to buy different quantities of a product. Chellappa and Shivendu (2005) suggested product sampling as a source of revenue and recommend distinct pricing and sampling strategies for underestimated and overestimated products to mitigate piracy. Bockstedt et al. (2005) also proposed that product differentiation by offering new services, product versions, extensions and unique bundles is a lucrative strategy for digital music retailers in the presence of digital piracy. Jordan and Bolton (2004)'s recommendations on the piracy problem are not different. They suggest exploring new business models by examining the offerings of peer-to-peer networks and consumer behaviors using such networks.

Our findings from the review of previous literature overlap with Hill (2007)'s summary of strategic responses by copyright holders to accommodate piracy. He listed seven strategies that copyright holders could pursue: adopting a permissive stance to piracy to increase revenue by employing sampling strategy and strong network effects, increasing the perceived moral intensity associated with the decision to participate in the market for pirated products, counter piracy by providing free samples, lowering the price of the legal good, offering something extra to consumers who purchase the legal good, switching to a business model which is less vulnerable to piracy, and embracing the technology used by pirates such as peer-to-peer networks and offering a legal alternative to illegal digital distribution.

CHAPTER III

The Proposed Model for Distributing and Pricing Digital Goods

This chapter focuses on the proposed dual-channel model which utilizes both a primary and a secondary market for the distribution of digital goods. In the model, copyright holders (retailers, content creators etc.) can sell their products on a centralized distribution platform like iTunes. Consumers can resell their previously purchased goods on a secondary market. In this way, copyright holders can distribute their products through a centralized or a decentralized distribution channel by implementing a secondary market. Unique characteristics of digital products allow an efficient environment for a double-auction pricing mechanism for the resale of used goods in the secondary market. Alternatively, a fixed price for all copies of a certain good set by the retailer (similar to the Amazon.com's Trade-in service) can be used for the digital good resales in the secondary market.

3.1 Benefits of a Secondary Market for Digital Goods

It is evident that digital media industries need to modify existing business models or develop entirely new strategies to address digital piracy. This research proposes

that implementing a secondary market for the transaction of digital goods not only increases the revenues of content providers but also mitigates digital piracy. Resale of products through secondary markets has an important effect on their distribution, production and pricing. Secondary markets have always been perceived as a threat by manufacturers, producers and copyright owners because of their substitution effects and potential detrimental effects on market power of monopolies (Bulow 1982). Reducing the durability of the good (Bulow 1982) or restricting the second-hand market (Liebowitz 1982) has been suggested to avoid competition from secondary markets. Miller (1974) argued that a monopolist should increase prices for new-goods in order to maximize its profits due to the availability of second-hand markets. However, a number of previous studies have demonstrated that producers may benefit from secondary markets. First, Liang (1999) showed that the presence of a secondary market makes firms commit to a production sequence because of the available substitutes in the secondary market. Second, there is a sorting benefit of the use of secondary markets (Anderson and Ginsburgh 1994). Secondary markets increase the efficiency of the allocation of new and used products among consumers with heterogenous product values. The possibility of reselling past purchases raises the willingness of consumers to pay since they are able to make profits by selling the products to other consumers with lower willingness to pay. In this way, firms can charge higher prices and earn more profits by employing indirect price discrimination (Chen et al. 2008).

A retailer can benefit from secondary markets (used-good markets) by capturing additional surplus from consumers who were unable to buy in the new-good market (Ghose et al. 2005). So, used-good markets can increase the revenue of sellers by reaching more consumers who have lower valuations for the goods offered in the new-good markets. Copyright holders have argued that secondary markets hurt seller profits by cannibalizing new product sales. However, previous studies show that used good

markets are not necessarily harmful for copyright owners since sellers can anticipate the resale value of products and adjust the price of the new good accordingly (Miller 1974; Bulow 1982; Bond and Samuelson 1984). Ghose et al. (2006) examine product cannibalization impact of online secondary markets by observing Amazon.com's used-book market and find that only 16% of used-book purchases cannibalize new-book sales. The authors also conduct the same study for products with digital characteristics such as CDs and DVDs. They find higher cross-price elasticities of new product demand with respect to used product prices for CDs and DVDs than books (Telang and Smith 2008). Moreover, Shulman and Coughlan (2007) show that a dual-channel strategy that coordinates a new good market and a retailer-operated secondary market is more profitable for sellers than a single channel strategy.

Utilizing a secondary market and coordinating it with a primary market for the distribution of digital goods can decrease the level of digital piracy because of two main reasons. First, it offers more profitable transactions and allows consumers to maximize their utilities. In a primary market, consumers who only have greater valuations for a product than its price will want to purchase this product. The rest of consumers in the market can be viewed as the potential demand for piracy. On the other hand, in the presence of a secondary market, knowing that they will be able to sell products on the secondary market and make extra profits, more consumers will want to buy the product on the primary market. In addition, prices of used products in secondary markets are always lower than those of new products in primary markets. Therefore, a customer will be able to buy a product at a lower price without sacrificing quality when the product appears on the secondary market. This decrease in prices and increase in expected utilities make buying products more attractive than pirating them for some consumers, which may increase the total number of buyers and decrease the demand for piracy by converting some of the potential pirates to legal buyers.

Price is identified as a key factor in explaining why people download illegal music (Molteni and Ordanini 2003; Bhattacharjee et al. 2003; Plowman and Goode 2009). Some consumers may perceive the prices of digital goods to be high and unfair given the economic success of copyright owners, and use this perception to justify their illegal actions (Harrington 1989; Hinduja 2003; Gupta et al. 2004). Furthermore, uniform pricing for music in both physical and digital form is believed to be suboptimal and inadequate in response to the changing environment of the music industry in the presence of digital distribution and consumption of products (Bhattacharjee et al. 2003; Gopal et al. 2004). Previous research in economic theory shows that price discrimination and product differentiation strategies are more effective than uniform pricing if a company serves in a market with heterogeneous consumers (Tirole 1988). Since consumer valuations of various information products are far from being homogeneous, numerous studies agreed that price discrimination and market segmentation with quality differentiation can reduce piracy and increase social welfare (Clemons et al. 2003; Wu et al. 2003; Bhattacharjee et al. 2006). Several price discrimination techniques such as bundling strategies (Bakos and Brynjolfsson 1999; Geng et al. 2005), nonlinear usage-based pricing mechanisms (Sundararajan 2004b; Khouja and Park 2007) and versioning (Bhargava and Choudhary 2004; Cremer and Pestieau 2009) are proposed to be optimal for markets that suffer from piracy losses. Smith and Telang (2009) analyzed piracy in movie industry and suggested that product differentiation and market segmentation strategies can be effective to compete with freely available unauthorized copies. Chellappa and Shivendu (2005) recommended product sampling strategies and distinct pricing as a way of benefiting from piracy.

It has been shown in economic literature that a monopolist can use a secondary market as an indirect tool to utilize a form of second-degree price discrimination (Anderson and Ginsburgh 1994). However, digital products have different characteristics

than physical products, like their indestructible nature (Whinston et al. 1997). Since digital goods do not wear or tear after being consumed, usage has no effect on the quality of digital goods. Therefore, it is almost impossible to use secondary markets to achieve quality-based price discrimination for digital products. On the other hand, the same indestructibility characteristic allows an efficient environment for a double-auction pricing mechanism in second-hand markets for digital goods. Let us consider a certain movie in a given digital format. Since none of its authorized used copies is different from each other in terms of quality, a secondary market can bring multiple buyers and sellers together for the transaction of used copies of this digital movie. By using auctioning, the secondary market structure of the model that we propose in this study serves as a first-degree price discrimination mechanism, which is often suggested as a remedy for digital piracy in the literature (Clemons et al. 2003; Wu et al. 2003; Bhattacharjee et al. 2006).

Auctioning a digital product is different from the traditional idea of physical product auctions in a number of ways. Physical products lose value as they are being used and the depreciation rate depends on how they are used. Therefore, a consumer can have different values for two used items although having the same value for them when they are new. But values of digital products do not depreciate with usage or consumption. A digital product which has been used a million times is as good as a brand new one. So, value of a product for a consumer does not decrease as it is consumed. This characteristic of digital products allows an efficient environment for a double-auction pricing mechanism in which there are multiple buyers and sellers for a certain product such as various securities. Moreover, trust among buyers and sellers is a major issue in consumer-to-consumer commerce and considered as a critical factor that could hinder online activity in C2C auctions (Sutanonpaiboon and Abuhamdieh 2008). However, since all transactions among consumers in the proposed

model are monitored and guaranteed, trust in the community is maintained by the central authority. Also, delivery of the product after the purchase is almost instantaneous depending on the size of the file, which can be considered as an advantage of auctions of digital products over traditional online auctions.

Second, availability of secondary markets for digital goods may affect how consumers perceive the fairness of digital good transactions. Due to the copyright arrangements, consumers do not have the right to sell their digital products on a legal platform in the current state of electronic markets. This may drive consumers away from legitimate online sellers of products with limited usage time or number of uses. For instance, people usually watch most movies just once unlike the way they consume music or software applications. So, certain information products may become totally useless after consuming it. While consumers can sell their purchased movies as DVDs in secondary markets like eBay and make small profits out of them, digital movies purchased and downloaded online (e.g. on iTunes) are not allowed to be resold by consumers by any legal means. Another example is video games. Most video games lose their value after some time due to either introduction of a newer or upgraded version, or over-consumption. Consumers can buy video games either in a physical format from a brick-and-mortar store (e.g. Gamestop) or in a digital format by downloading it from a server (e.g. Sony's Playstation Network Store). Again, while consumers are allowed to sell their used games on a physical medium, digitally downloaded games lose all their value after being consumed since they cannot be resold on a secondary market. Because of the aforementioned reasons, consumers may think that the lack of secondary markets creates an unfair advantage for content owners in terms of product pricing and they may perceive the current digital markets as unfair environments in which to conduct business.

3.2 Facilitating the Secondary Market for Digital Goods

Reselling digital content is a new idea and there are currently no services available that provide a secondary market for consumers to resell their previously purchased digital goods. While there is plenty of room for abusing such a resale model for digital goods such as selling a product with keeping an unauthorized copy, there are plenty of technologies that offer a solution to this problem. The two key technologies to facilitate a secondary market for the resale of digital goods and prevent possible exploits in such a system are cloud computing and streaming technologies.

Cloud computing refers to computational resources (such as applications, databases, file services) delivered as services over the Internet and hardware and systems software in the data centers that provide these services (Armbrust et al. 2010). Cloud application services that are referred to as "Software As A Service" (SaaS) eliminate the need to install and run on the client's computer. Cloud computing offers numerous benefits for consuming digital content. First, consumers using cloud technologies do not need large hard-drives to store their digital content. Since all content is stored on the server side, when a consumer wants to consume a product, he can easily connect to the server and access the file. Second, it enables content creators to maintain control over their products and prevent unauthorized sharing and use. For instance, Amazon.com launched a cloud-based streaming service that allows consumers to store music files on the company's servers (Perpetua 2011). When consumers want to play music or video files, they connect to the server and stream the content on their computers or mobile devices. Using such a mechanism enables companies to maintain control over digital content and prevent illegal sharing and copying. In this way, all content that is purchased or sold by consumers can be easily tracked, preventing them from accessing files they are not authorized to use. Therefore, control on digital content authorization can be maintained without needing the use of DRM-like

technologies.

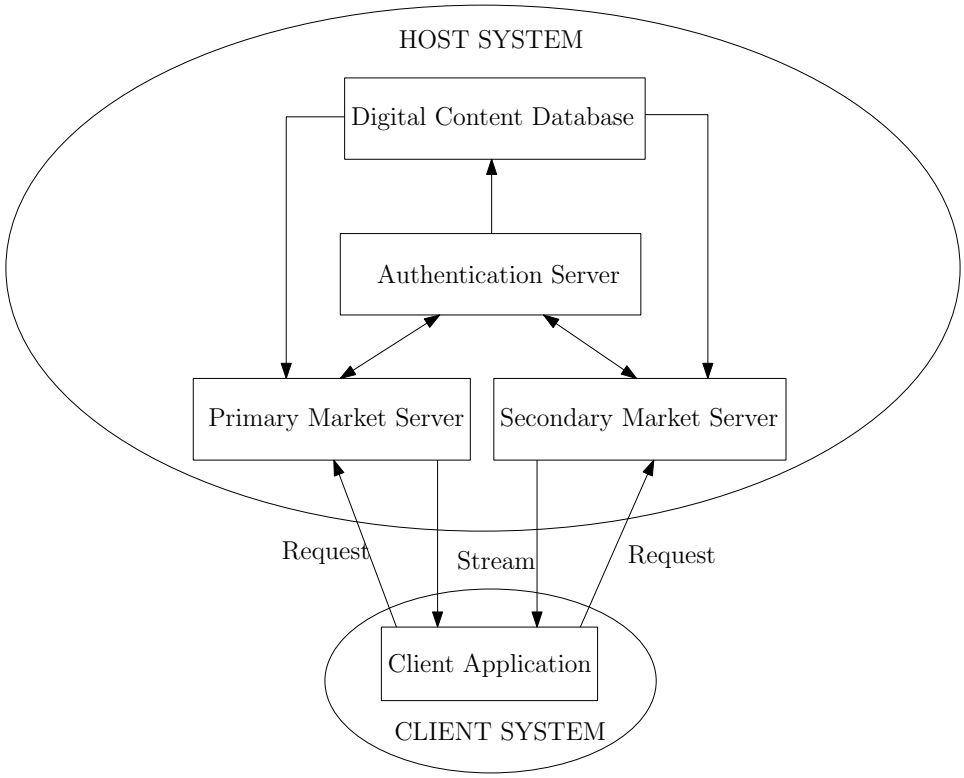


Figure 3.1: System Infrastructure for Streaming Files

Figure 3.1 shows a simple infrastructure that coordinates a primary and a secondary market for the transaction of digital goods. When a user desires to purchase a new digital file, s/he sends a request to the host system by using the client application interface. This request is processes in the primary market server and the related transaction information is sent to the authentication server. The transaction information is processes and the new file is added to the user's content library. When the user desires to access the file, it is retrieved from the content database and streamed to the user via the client application interface. When the user desires to sell a digital file that s/he has previously purchased, the request is sent to the secondary market server. This request is held in the server until another user sends a request to the secondary market server to purchase the file. When a user desires to purchase a used

file, the transaction is processed in the secondary market server and the related transaction information is sent to the authentication server. The digital file is added to the buyer's content library and removed from the seller's content library. Therefore, the digital file is only accessible by the buyer after the resale. It should be noted that there are no file downloads in such a system. When users desire to access the files that they are authorized to, they have to stream the file using host system. Considering that every new technology/device that is used for consuming digital products has an easy access to the Internet in the information age, storing files in a local hard drive is not required to access digital content. All users store their content in the host's server and easily access them whenever they need to.

If content creators and retailers do not find streaming a viable solution for the distribution of their goods, a similar system that uses a DRM-like technology for the protection of files can be adopted for the resale of digital goods. There is also a filed patent which proposes a similar infrastructure for facilitating resale of digital content over a computer network (Wolf 2006). The only difference in such a system is that users download the files from the server that they purchase and these files are stored at the client side rater than at the server side. A simple infrastructure that facilitates the resale of digital goods by downloading can be seen in Figure 3.2. When a user desires to sell a file, the request is sent to the secondary market server. If the files is purchased by another user, requests are processed and sent to the authentication server. The authentication server removes the product ownership of the seller and gives it to the buyer. This information is sent to the seller's application and the file is deleted from the user's content library at the client side. The buyer downloads the file from the server and adds it to his/her content library. Also, it can be seen in Figure 3.2 that after a transaction between two users is processed at the server side, the file can be directly transferred from the seller to the buyer using a peer-

to-peer network structure, if the two users are online at that time. If the seller is not available for uploading, a copy of the content is downloaded by the user from the server. When the seller logs onto the system, server sends a notice to the client side informing that the transaction is complete and the file is deleted from the user's content library. Spotify and Napster are two examples of legal online music stores that use P2P network structures to distribute digital content.

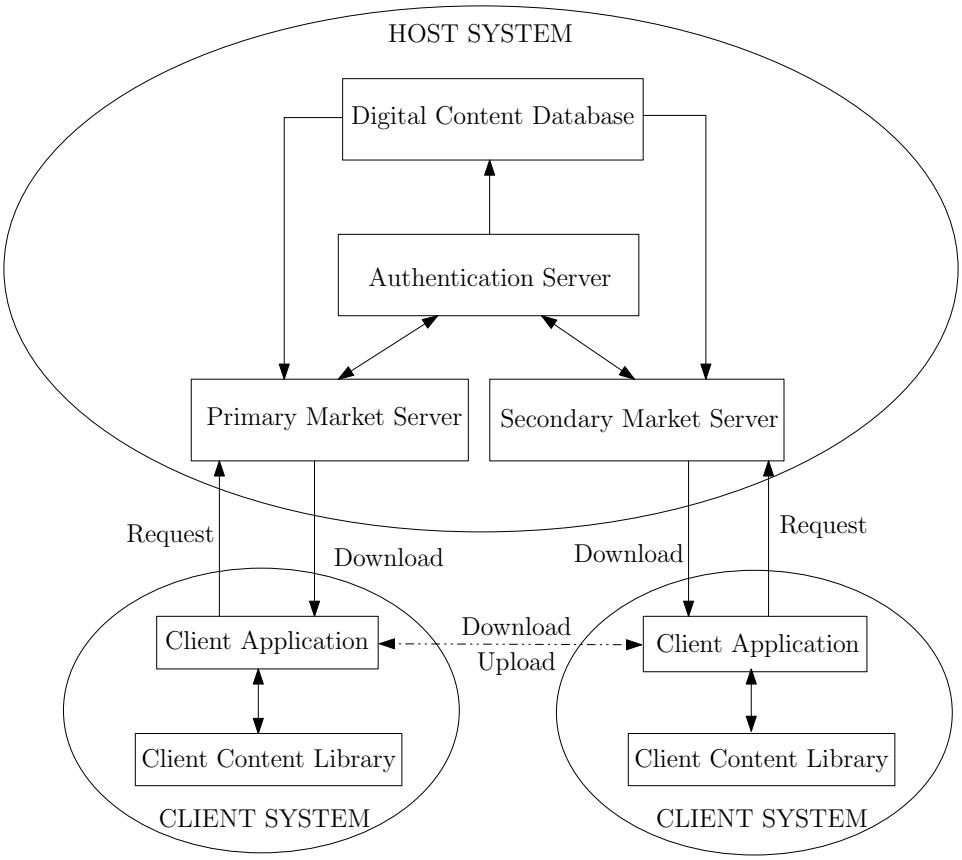


Figure 3.2: System Infrastructure for Downloading Files

Krishnan et al. (2007) suggest that peer-to-peer networks will play an important role in the digital strategy of firms that distribute digital content in a number of industries in the near future. While being considered as the primary reason of the spread of digital piracy, peer-to-peer network structure offers a more effective and efficient way to distribute content since each user of the network actively involves in

the distribution of the product (Parameswaran et al. 2001). It is discussed in the previous section that P2P networks help copyright holders promote their content as consumers use shared files as samples for their future purchases. Their marketing function is not limited to the sampling effect and they can further serve as marketing platforms by establishing virtual communities in which consumers can communicate directly to each other, exchange information, promoting products through word of mouth and trading content (Hughes and Lang 2003). Because of the numerous advantages of distributed and decentralized structure of P2P networks over client-server type architectures such as better scalability, reliability, lower costs and more efficient utilization of resources (Ahmad 2003), over 200 companies have invested in P2P network structures because of the offered operational efficiency (Kato and Yokoi 2003) and have started to incorporate such networks into a variety of business applications, including collaborative computing (SETI@Home), instant messaging, enterprise information sharing (Bad Blue), and distributed data storage (PeerioData).

Centralized client-server structure is still the most prevalent distribution model for digital products. Companies are generally reluctant to adopt P2P networks for distributing digital content because of their lack of control mechanisms over content supply and distribution channels (Kwok et al. 2003). Most of legitimate P2P companies which previously allowed illegal downloads, such as Napster, were forced to adopt a centralized client-server delivery mechanism instead of a distributed model. However, due to increased distribution efficiencies and service levels offered by P2P networks, several companies have started to test the utilization of such distributed networks as part of their promotion and distribution strategy. For instance, Steve Winwood, a well-known British singer-songwriter, has distributed free copies of his songs over P2P networks in order to promote recently released albums (Reuters 2004). Furthermore, digital content intermediaries such as Peer Imact, INTENT Mediaworks

(Young et al. 2005), Altnet (Associated Press 2003), SnoCap (Healey 2004) and weedfiles.com (Dean 2004) provide copyright holders with secure distribution channels by using P2P networks, allowing consumers to sample and purchase desired products (See Krishnan et al. (2007) for more examples).

Researchers have also started to study the possible efficient implementation methods of P2P networks for the legitimate distribution of digital products. Allowing consumers to actively participate in the distribution chain is considered as an innovative distribution strategy of digital goods (Slater et al. 2005). The difficulty of employing a distributed channel for the product distribution is not only related to piracy. There are other issues observed in P2P network environments that impede the operation efficiency, such as free-riding and trust (Krishnan et al. 2003). Many studies present various incentive mechanisms mad payment schemes to encourage users to contribute the network (Golle et al. 2001; Vishnumurthy et al. 2003; Yu and Singh 2003). Others examine the design of digital commerce architectures under P2P contexts, focusing on transaction procedures and information exchange (Iwao et al. 2001; Gang and Li 2003; Androutsellis-Theotokis and Spinellis 2004). Hughes et al. (2008) argue that the success of a P2P implementation for the distribution of digital goods should be analyzed by addressing technical, economic, structural, legal, political, socio-cultural and cognitive factors. Courcoubetis and Antoniadis (2002) identify reputation, cost, utility and degree of competition as key parameters for P2P business models.

Casadesus-Masanell and Hervas-Drane (2007) show that both a centralized client-server structure and a competing distributed P2P network can benefit from the competitive interaction when they are used to acquire certain products at the same time. However, few studies have examined this interaction with an integrated model which employs both centralized and decentralized structures. For example, Grimm and Nutzel (2002) propose a business model that uses a P2P network to distribute prod-

ucts and allows consumers to redistribute the content and share the profit. Consumers using this model are given two options for acquiring the product: paying for the product or downloading it for free. Customers who choose to pay for the product get the right to redistribute the product and receive a commission fee for redistribution of the product copies. Additionally, Lang and Vragov (2005) develop a pricing strategy for distributing digital goods over P2P networks which reward users actively participating in the distribution process. They find that using a decentralized approach for distributing the content is more profitable than using a centralized structure. A similar model is proposed for the mobile commerce environment, which allows users to market and resell copies of digital content (Cattelan et al. 2006; He et al. 2008). Users perform transactions among each other without needing a central server in an offline manner. Each transaction is recorded and required modifications in the accounts of parties involved in the transactions are applied such as rewards, when they connect to the Internet. These aforementioned proposed models do not allow consumers to price the content that they redistribute as content providers set the prices and royalty fees for redistributing the product. A recent study by Feng et al. (2009) examines the feasibility of a dual channel distribution strategy for a digital content seller, which utilizes centralized and distributed distributing structures. Users can purchase the product by using the centralized channel (B2C) and also can sell the purchased content at their own prices by using the distributed channel (C2C). They find the dual-channel strategy more profitable than single channel strategy when the portion of innovators in the consumer population is higher than certain threshold values. Innovators are defined as loyal consumers who always prefer the B2C channel to buy the product in the paper. They also show that monopolist always prefers to set a higher price when the dual channel distribution strategy is optimal.

By utilizing both centralized and decentralized channels, copyright owners can en-

joy the benefits of a decentralized structure through a decrease of distribution costs without losing control over their content since the products sold on the secondary market will be transferred by the direct connection between two consumers. Therefore, a retailer's servers or other sources will not be used for the exchange of used digital goods. Besides the operational efficiency, decentralized distribution channels provide an interactive environment for consumers and allow them to build a virtual community in which promotions of products by consumers are significantly more effective than traditional marketing techniques (Feng et al. 2009). Moreover, the proposed hybrid model allows consumers to resell purchased digital goods with double auctions. Another advantage of implementing a secondary market and connecting consumers to each other for the distribution of products is using a technology that has already been widely accepted by users. So, yesterday's pirates can contribute to the creation of a future market for the business model proposed in this study. For instance, some former pirates who had used the illegal version of Napster before its shutdown have migrated to iTunes and the current legitimate version of Napster as paying customers (Choi and Perez 2007).

A hybrid distribution strategy that coordinates a centralized channel for distributing new digital products and a decentralized channel for pricing and distributing used digital products with an auction mechanism will not only generate a higher total surplus including seller and consumer surpluses but also can mitigate digital piracy. The secondary markets should always offer lower prices for products when the primary markets are open. Auction-based pricing is a first-degree price discrimination technique which has been recommended by many researchers to decrease the levels of digital piracy. It is previously mentioned in the previous chapter that "one price for all" pricing model (i.e. uniform prices for all songs or albums) decreases the demand and interest for content products and may lead people to find "illegal" ways to ac-

quire the products. Furthermore, due to the copyright arrangements, consumers do not have the right to sell their digital products on a legal platform in the current format of electronic markets, which may drive consumers away from legitimate online sellers for products with a limited usage time or number of uses. For instance, people usually watch most of the movies once unlike the consumption of music. So, the product becomes totally useless after consuming it. While consumers can sell their purchased movies as DVDs in secondary markets like eBay and make a small profit out of them, digital movies that are purchased and downloaded online (e.g. on iTunes) are not allowed to be sold by consumers by any legal means. Another example is video games. Most videogames lose their value after some time due to either introduction of a newer or better version, or over-consumption. Consumers can buy video games either in a physical format from a brick-and-mortar store (e.g. Gamestop) or in a digital format by downloading it from a server (e.g. Sony's Playstation Network Store). Again while customers are allowed to sell their used games on a physical medium, digitally downloaded games lose all their value after being consumed since they cannot be sold on a secondary market.

CHAPTER IV

The Economic Model

This chapter develops a model with two periods, a monopolist retailer of a digital good, and a continuum of consumers who vary continuously in their intrinsic values for the good. In the first period the retailer sells the product through a primary market, in the second period the firm facilitates a secondary market. A rational expectations framework is assumed for the model. We first show that under a fairly general distribution of values and a "reasonable" primary market price, a unique price exists which clears the secondary market in the second period. We then adopt a linear value function specification and show that the retailer typically earns greater profits by facilitating a secondary market than by operating a primary market in both periods (henceforth called the 2-price model, from Tirole (1988)). We also show that for an intuitive range of model parameter values, the secondary market model can actually generate greater total demand and profit for the retailer than the 2-price model, which suggests the firm may be able to increase profit and potentially reduce piracy by switching from a purely primary market model to a dual channel primary/secondary market model. For convenience, we will use the term "secondary market model" for the proposed dual-channel model throughout this chapter.

While the relationship between the retailer and the content creator is not modeled

in this chapter, the increased demand for licensed copies and presumably the decrease in demand for pirated copies will enhance the retailer's bargaining position relative to the content creator. Finally, we incorporate a model of piracy into the secondary market and the 2-price models, and evaluate the revenues and piracy levels in these models in the presence of piracy.

4.1 A Competitive Secondary Price

There are two periods and a monopolist retailer of a good. For convenience we assume the good can be produced at zero marginal cost, or alternatively that the content creator who supplies the good to the monopolist receives a constant share of total revenue. In either case the monopolist maximizes profit by maximizing total revenue.

There exists a continuum of potential consumers $i \in [0,1]$. Consumer i has value $v_1(i) \geq 0$ of consuming the good in period 1. We assume $v_1(i)$ is continuously differentiable and $v_1'(i) < 0$ on $i \in [0,1]$. We further assume that $v_1(0)$ is finite, and for simplicity that $v_1(0) = 1$ (the latter assumption is not necessary for the results in this section, merely convenient). We let $v_2(i)$ be the present discounted value to i of consuming the good in period 2 alone, and $v_0(i)$ be the present discounted value of consuming the good in periods 1 and 2. We assume

$$v_0(i) = [1 + \beta(1 - \alpha)]\, v_1(i) \tag{4.1}$$

$$v_2(i) = \beta v_1(i) \tag{4.2}$$

where $\beta \in (0,1)$ reflects the rate of time preference and $\alpha \in (0,1)$ is a common depreciation factor. Depreciation in this case is psychological rather than physical. It can be interpreted as becoming tired or bored with the good, and only applies in

period 2 to an individual who bought it in period 1. Movies and video games, for example, are frequently associated with this sort of depreciation. Usage depreciation is necessary for the existence of a secondary market; without it, all individuals who buy the good in the first period necessarily value it more in the second period than all of those who did not.

We assume that the firm sets a uniform price for the good in the first period, while the price in the second period is set competitively in a secondary market. The firm imposes transaction fee $\tau \in [0, 1)$ on secondary market sellers, where τ is a fraction of the sale price. Thus if p_t is the price of the good in period t, the firm's revenue per transaction in the second period secondary market is τp_2, while the seller keeps $(1 - \tau)p_2$.

We next begin to establish necessary and sufficient conditions for the existence of a secondary market. These conditions culminate in Result 1, where we show that a secondary market exists in the second period if and only if the monopolist charges a first period price within a particular interval, and further the price which clears the secondary market is unique (for a first period price in the appropriate interval).

Lemma 1 *For all $i < j$ such that $i, j \in [0, 1]$, it must be the case that $v_0(i) - v_1(i) > v_0(j) - v_1(j)$, $v_1(i) - v_2(i) > v_1(j) - v_2(j)$, and $v_0(i) - v_2(i) > v_0(j) - v_2(j)$.*

Lemma 1 follows directly from the assumption that $v_1'(i) < 0$. We assume i's utility is quasilinear in money, so that we have the following net utility functions:

$$u_0(i, p_1) = v_0(i) - p_1 \tag{4.3}$$

$$u_1(i, p_1, p_2, \tau) = v_1(i) - p_1 + \beta(1 - \tau)p_2 \tag{4.4}$$

$$u_2(i, p_2) = v_2(i) - \beta p_2 \tag{4.5}$$

Thus $u_0(i, p_1)$ is i's present discounted net utility of purchasing the good in the

primary market and keeping it, $u_1(i, p_1, p_2)$ is i's present discounted net utility of purchasing the good in the first period and reselling it on the secondary market, and $u_2(i, p_2)$ is i's present discounted net utility of purchasing the good in the secondary market.

We define:

$$\begin{aligned} i^*(p_2, \tau) \equiv i \in [0,1] :\ & u_0(i, p_1) = u_1(i, p_1, p_2, \tau) \\ \Rightarrow\ & (1-\alpha)\, v_1(i^*) = (1-\tau)p_2 \\ j^*(p_1, p_2) \equiv i \in [0,1] :\ & u_0(i, p_1) = u_2(i, p_2) \\ \Rightarrow\ & (1-\alpha\beta)\, v_1(j^*) = p_1 - \beta p_2 \\ k^*(p_1, p_2, \tau) \equiv i \in [0,1] :\ & u_1(i, p_1, p_2, \tau) = u_2(i, p_2) \\ \Rightarrow\ & (1-\beta)\, v_1(k^*) = p_1 - (2-\tau)\beta p_2 \end{aligned}$$

For notational convenience we will not explicitly write the dependence of these critical values on prices and the transfer fee when the context is clear. Each of these critical values represents a consumer who is indifferent between taking two actions (e.g., i^* represents a consumer who, having purchased the good in the first period, is indifferent in period 2 between keeping it and re-selling it in the secondary market). Note that these critical values do not necessarily exist for given p_1 and p_2.

Lemma 2 *If $i^* = j^*$, $j^* = k^*$, or $i^* = k^*$, then $i^* = j^* = k^*$ and there does not exist a secondary market.*

Proof. Suppose $j^* = k^*$. Adding $-\beta p_2 + \tau\beta p_2$ to both sides of the definition of j^*, then by the definition of k^* we obtain

$$(1-\alpha\beta)v_1(j^*) - \beta p_2 + \tau\beta p_2 = (1-\beta)v_1(k^*).$$

Since $j^* = k^*$ by assumption, we have $(1-\alpha)v_1(j^*) = (1-\tau)p_2$. Thus $i^* = j^* = k^*$.

Suppose $i^* = j^*$. Multiplying both sides of the definition of i^* by β and rearranging terms, we obtain $\alpha\beta v_1(i^*) - (1-\tau)\beta p_2$. Since $i^* = j^*$ by assumption, by the definition of j^* we have

$$\beta v_1(i^*) - (1-\tau)\beta p_2 = v_1(i^*) - p_1 + \beta p_2.$$

Therefore $(1-\beta)v_1(i^*) = p_1 - (2-\tau)\beta p_2$, and thus $i^* = j^* = k^*$.

Finally, suppose $i^* = k^*$. We first multiply both sides of the definition of i^* by β. Since $i^* = k^*$ by assumption, we set $\beta v_1(i^*) = \beta v_1(k^*)$ to obtain

$$\beta(1-\tau)p_2 + \alpha\beta v_1(i^*) = v_1(i^*) - p_1 + (2-\tau)\beta p_2$$

Therefore $(1-\alpha\beta)v_1(i^*) = p_1 - \beta p_2$, and thus $i^* = j^* = k^*$.

Now suppose conditions are such that $i^* = j^* = k^*$. By Lemma 1 it must be the case that $u_0(i) > u_1(i) > u_2(i)$ for all $i < i^*$, and $u_2(i) > u_1(i) > u_0(i)$ for all $i > i^*$. Thus there does not exist a positive measure of agents willing to re-sell the good in the secondary market. If $u_2(j^*, p_2) \leq 0$ there are no buyers in the secondary market, as well, so p_2 is a no-trade competitive equilibrium price. If $u_2(j^*, p_2) > 0$ then there are buyers in the secondary market, so excess demand is positive and p_2 is not a competitive equilibrium price. ■

We next derive a condition on p_2 given fixed p_1 necessary to sustain a secondary market. Fix p_1 and suppose that at $p_2 = \widetilde{p_2}$ we have $i^* = j^*$. Then from the definitions of i^* and j^* we know that

$$\widetilde{p_2} = \frac{1-\alpha}{(1-\alpha\beta)(1-\tau) + \beta(1-\alpha)} p_1. \tag{4.6}$$

Denote this critical consumer as $\widetilde{i^*}$. We continue to use i^*, j^*, and k^* to denote

indifferent consumers for arbitrary p_2. We show $p_2 > \widetilde{p}_2$ is necessary for the existence of an active secondary market.

Lemma 3 *Fix p_1 and suppose $p_2 < \widetilde{p}_2$. Then $k^* < j^* < i^*$ for any of these critical values that exist. Further, $p_2 \leq \widetilde{p}_2$ is not a competitive equilibrium price in the secondary market unless $u_2(j^*, p_2) \leq 0$, in which case the secondary market is empty.*

Proof. First suppose i^*, j^*, and k^* exist. Then $\widetilde{i}^*$ necessarily exists since $j^* < \widetilde{i}^*$ and $k^* < \widetilde{i}^*$ (which follows directly from the fact that $p_2 < \widetilde{p}_2$). Clearly $i^* > \widetilde{i}^*$. Substituting for p_1 in the definition of j^* and k^*, we find $p_2 = \frac{1-\alpha\beta}{\beta} v_1(j^*) - \frac{1-\beta}{\beta} v_1(k^*)$. Let $\varepsilon = v_1(k^*) - v_1(j^*)$. Then

$$p_2 = (1-\alpha)\, v_1(j^*) - \frac{1-\beta}{\beta}\varepsilon \tag{4.7}$$

Because $j^* < \widetilde{i}^*$, then $v_1(j^*) > v_1\left(\widetilde{i}^*\right)$. By definition $\widetilde{p}_2 = (1-\alpha)\, v_1\left(\widetilde{i}^*\right) = (1-\alpha)\, v_1\left(\widetilde{i}^*\right)$. Thus $\varepsilon > 0$, which implies $k^* < j^* < i^*$ for $p_2 < \widetilde{p}_2$.

If $\widetilde{i}^*$ does not exist then j^* and k^* do not exist trivially. If $\widetilde{i}^*$ exists then i^* necessarily exists, and j^* and k^* may or may not exist (if they do, obviously they are each less than i^*). Consider the continuous linear path of prices from $\widetilde{p}_2$ to p_2. From the paragraph above we know that for the values of these prices at which j^* and k^* both exist, $k^* < j^*$. Thus since k^* recedes from $\widetilde{i}^*$ more quickly than j^*, if only one of these critical values disappears along the path it must be k^*. This establishes the first statement in the lemma.

For $i < i^*$, i prefers to buy the good in the first period to keep it rather than buy it in the second. For $i < j^*$, i prefers to buy the good in the first period to keep it rather than buy it to later re-sell it in the second. Since $j^* < i^*$, then for all $i < j^*$, i prefers to buy the good in the first period and keep it relative to other purchasing options (of course, for him to actually buy the product it must also be true that

$u_0(i) > 0$). By similar logic, for $i > j^*$, i prefers to buy the good in the second period relative to other purchasing options.

Thus there are no re-sellers of the good (this is also obvious true if some subset of the critical consumers do not exist). If $u_2(j^*, p_2) > 0$, then a positive measure of agents prefer to buy the good in the secondary market in period 2, so p_2 is not a competitive equilibrium. If $u_2(j^*, p_2) \leq 0$, then the secondary market is empty. ■

Lemma 4 *Fix p_1 and suppose $p_2 > \widetilde{p_2}(p_1)$. Then $i^* < j^* < k^*$. Relative to other purchasing options, for $i < i^*$, i strictly prefers to buy the product in period 1 and keep it in period 2. For $i \in (i^*, k^*)$, i strictly prefers to buy the product in period 1 and re-sell the product in the secondary market in period 2. For $i > k^*$, i strictly prefers to buy the product in period 2 on the secondary market.*

Proof. From the proof of Lemma 3 it is clear that Equation 4.7 still applies, but since $p_2 > \widetilde{p_2}$ it must be the case that $\varepsilon < 0$. Thus $i^* < j^* < k^*$.

By Lemma 1, for $i < j^*$, i strictly prefers to buy the product in period 1 and keep it rather than buy the product in period 2. For $i < i^*$, if i buys the product in period 1 he strictly prefers keep it in period 2 rather than sell it in the secondary market. Since $i^* < j^*$, then for $i < i^*$, i strictly prefers to buy the product in period 1 and keep it rather than his other purchasing options (of course, for i to actually buy the product it must also be true that $u_0(i) > 0$).

By Lemma 1, for $i > i^*$, if i buys the product in period 1 then he strictly prefers to re-sell the product in period 2 rather than keep it. For $i < k^*$, i strictly prefers to buy the product in period 1 and re-sell it in period 2 rather than buy the product in period 2. Since $k^* > i^*$, if $i \in (j^*, k^*)$, then i strictly prefers to buy the product in period 1 and re-sell it in period 2 rather than his other purchasing options.

By Lemma 1, for $i > j^*$, i strictly prefers to buy the product in period 2 than to

buy the product in period 1 and keep it in period 2. For $i > k^*$, i strictly prefers to buy the product in period 2 than to buy the product in period 1 and re-sell it in the secondary market. Since $k^* > j^*$, if $i > k^*$, then i strictly prefers to buy the product in period 2 rather than his other purchasing options. ■

We next establish conditions on first and second period prices necessary to support a secondary market.

Lemma 5 *If $p_2 \geq v_1(0)$ or $p_1 \geq [1 + \beta(1-\tau)]\, v_1(0)$, there does not exist a secondary market.*

Proof. If $p_2 \geq v_1(0)$, by Equation 4.5 the utility of $i = 0$ of purchasing the good in the second period is weakly negative. Since for all $i > 0$, $v_1(i) < v_1(0)$, the measure of secondary market buyers is 0.

Suppose $p_1 = [1+\beta(1-\tau)]v_1(0)$, and consider the utility of a potential re-seller. By Equation 4.4 we have $u_1\left(i, p_1, p_2, \tau\right) = \beta(1-\tau)\left(p_2 - v_1(0)\right)$. We've already established that if $p_2 \geq v_1(0)$, the measure of secondary market buyers is 0. But we now see that if $p_2 \leq v_1(0)$ and $p_1 \geq [1 + \beta(1-\tau)]\, v_1(0)$, then $u_1\left(i, p_1, p_2, \tau\right) \leq 0$ and the measure of secondary market re-sellers is 0 as well. Thus for $p_1 \geq [1 + \beta(1-\tau)]v_1(0)$, there are no sales of any kind for any p_2. ■

We next establish that when $i^* = j^* = k^*$ in the $[0, 1]$ interval, the utility of buying the good in the first period and keeping it is strictly positive for the critical consumer. This is a useful fact when proving the existence of a secondary market.

Lemma 6 *Given p_1 and $\widetilde{p_2}(p_1)$, it must be the case that $u_0\left(i^*, p_1\right) > 0$ provided $\alpha > \tau$.*

Proof. Substituting $v_1(i^*)$ from the definition of i^* into the definition of $u_0\left(i^*, p_1\right)$,

we find

$$u_0\left(i^*, p_1\right) = \frac{[1+\beta(1-\alpha)](1-\tau)p_2}{1-\alpha} - p_1$$

Substituting p_1 from the definition of $\widetilde{p_2}$ into this equation, we obtain

$$u_0\left(i^*, p_1\right) = \left[\frac{[1+\beta(1-\alpha)](1-\tau)}{1-\alpha} - \frac{(1-\alpha\beta)(1-\tau)+\beta(1-\alpha)}{1-\alpha}\right] p_2$$

Simplifying this expression, we obtain

$$u_0\left(i^*, p_1\right) = \frac{\beta(\alpha-\tau)}{1-\alpha} p_2$$

Clearly this expression is strictly positive for $\alpha > \tau$. ■

The condition that $\alpha > \tau$ is intuitive. We know that $\alpha > 0$ is a necessary condition for the existence of a secondary market, α drives a wedge between the period 2 value of re-sellers and the period 2 value of secondary market buyers. If the transaction fee is greater than the deterioration factor, the wedge disappears.

Result 1 *Suppose $\alpha > \tau$ and $p_1 \in (0, [1+\beta(1-\tau)]\, v_1(0))$. Then there exists a unique competitive equilibrium price p_2 that clears the secondary market.*

Proof. First suppose $i^* = j^* = k^* \in (0, 1]$ given p_1 and $\widetilde{p_2}(p_1)$. By Lemma 6, $i < j^{ast}$ prefers to buy the product in the first period and keep it, and $i > j^*$ prefers to buy the product on the secondary market relative to other purchasing options. Thus the measure of sellers in the secondary market is zero. By Lemma 6, the measure of buyers in the secondary market is positive.

Let the measure of secondary market sellers as a function of p_2 (given p_1) be denoted $s(p_2)$ and the measure of secondary market buyers be denoted $b(p_2)$. Let $\rho(\alpha) = \widetilde{p_2}(p_1) + \alpha\left(v_1(0) - \widetilde{p_2}(p_1)\right)$. By Lemma 4, $b(p_2)$ is strictly decreasing in p_2 until

is reaches zero, and it must equal zero when $p_2 = v_1(0)$. Similarly, $s(p_2)$ is strictly increasing in p_2. Because these measures are continuous and strictly monotonic in p_2, by the intermediate value theorem there exists $\alpha \in (0,1)$ such that $s(\rho(\alpha)) = b(\rho(\alpha))$. Thus $\rho(\alpha))$ is the unique competitive equilibrium price given p_1.

Now suppose the critical consumer does not exist at $\widetilde{p_2}(p_1)$. Since $p_1 < [1+\beta(1-\tau)]\, v_1(0)$, then $\widetilde{p_2}(p_1) < v_1(0)$, so $b(\widetilde{p_2}(p_1)) > 0$ and $s(\widetilde{p_2}(p_1)) = 0$. Clearly $b(\widetilde{p_2}(p_1))$ is strictly decreasing in p_2 until it reaches zero, and this measure equals zero at $p_2 = v_1(0)$. For some $\widehat{\alpha} \in (0,1)$, it must be the case that $k^* = 0$, and $b(\rho(\widehat{\alpha}))) > 0$. For $\alpha > \widehat{\alpha}$, $b(\rho(\alpha))$ continues to decrease while $s(\rho(\alpha))$ is strictly increasing. Since these measures are continuous and strictly monotonic in p_2, by the intermediate value theorem there exists a unique competitive equilibrium price as in the preceding paragraph. ■

4.2 Linear Value Functions in a Digital Goods Monopoly

Coase (1972) first developed the insight that the combination of time and rational expectations can be detrimental to a monopoly. Suppose a monopolist for a particular good faces a fixed continuum of consumers for a finite number of periods, each of whom buys at most one unit of the good. In the final period, since the firm sold goods to the highest value consumers in preceding periods, its price must be reduced in order to sell anything. In a rational expectations framework consumers correctly anticipate this price drop, and some of the higher-value consumers who would have bought the good in an earlier period will wait until the final period. This unraveling takes place all the way back to the first period. Thus profits for the firm are decreasing in the number of periods the good is available for sale.

Tirole (1988) formalized this intuition in a simple 2-period model with a linear

value function representing the distribution of consumer preferences. In this section we first extend Tirole's model to include "use depreciation" for consumers. That is, a consumer's intrinsic value for the product diminishes with his use of it, a common characteristic associated with media such as movies and video games. We then introduce an alternative rational expectations model, where the firm exogenously commits to facilitating a secondary market for its product in the second period. We demonstrate that secondary market model increases the firm's profit relative to Tirole's 2-period model for nearly all possible parameter values.

However, this increase in profits comes at a cost in sales due to higher prices, which intuitively may lead to greater piracy of digital goods. We do not model the relationship between the monopoly retailer and the content creator in this paper, but it is plausible that the content creator would prefer greater to lesser sales to mitigate the extent of piracy, and would be willing to provide incentives to the retailer to increase the volume of sales. Therefore we also calculate constrained-optimal prices for the secondary market model, where sales are constrained to be equal to sales in Tirole's 2-period model, and compare revenue between the two. For a reasonably large and plausible range of parameters, the secondary market model can achieve equal sales and greater revenue than the alternative model.

4.2.1 The Two-Price Model

Our benchmark model is a monopolist retailer of a digital good. We extend Tirole's (1988, pg. 80-82) durable goods monopoly model by including usage depreciation factor α. We assume consumers derive utility from the product during each of two periods owned, and after the second period no one derives value from the good. The firm can charge a different price for the good in each period. We maintain a rational expectations framework, so that consumers in the first period correctly anticipate the

monopolist's price in the second period. Thus no consumer will buy the product in the second period if its price is not strictly less than the price in the first period. Diminishing prices over time is a common practice in the digital content industry today. For instance, iTunes charges $1.29 for newly released songs and $0.99 for older songs. We let p_1 and p_2 denote prices in the first and second period, respectively. (See Table 4.1 for modeling notation used throughout this chapter.)

Table 4.1: Modeling Notation

Variable	Definition
u_1	Utility of consuming a product in the first period
u_2	Utility of consuming a product in the second period
u_0	Utility of consuming a product in the first and second period
v_1	Consumer value of a product in the first period
v_2	Consumer value of a product in the second period
v_0	Consumer value of a product in the first and second period
q_1	Number of buyers in the first period
q_2	Number of buyers in the second period
q_0	Number of buyers who do not sell the product in the second period
Q	Total number of buyers
r	Number of pirates
p_1	Product price in the first period
p_2	Product price in the second period
τ	Rate of commission charged by the monopolist for secondary market transactions
α	Psychological depreciation factor for a product
β	Rate of time preference (patience discount factor) for a product
δ	Rate of quality degradation for the unauthorized copy of a product
c	Constant cost of piracy (reproduction and search costs)
R_1	Revenue in the first period
R_2	Revenue in the second period
R	Total revenue

The monopolist faces a continuum of consumers $i \in [0, 1]$ with heterogeneous

values for the product. For simplicity we assume that values of consuming the good in one period are linear, so that

$$v_1(i) = 1 - i \tag{4.8}$$

The value functions v_0 and v_2 associated with purchasing the good in the first and second periods, respectively, introduced in equations 4.1 and 4.2, are represented in Figure 4.1. The associated quasilinear net utility functions are u_0 and u_2, as in equations 4.3 and 4.5.

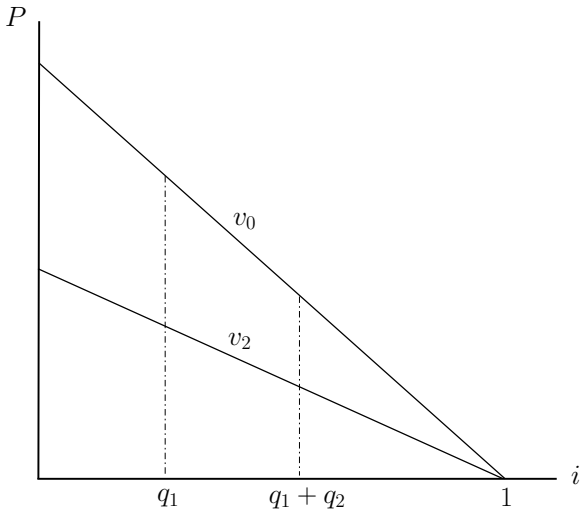


Figure 4.1: Value Functions for the Two-Price Model

We now turn our attention to the firm. We assume that the firm pays a constant share of its revenue to the copyright holder of the good, or alternatively that the marginal cost of producing the good is zero. In either case the monopolist maximizes profit by maximizing total revenue. We define

$$q_1(p_1, p_2) \equiv \ i : u_0(i, p_1) = u_2(i, p_2) \tag{4.9}$$

$$q_2(p_1, p_2) \equiv \ j : u_2(q_1 + j, p_2) = 0 \tag{4.10}$$

We may treat q_1 and q_2 as first and second period demand, respectively, under the following restrictions on prices: $p_1 \in (0, v_0(0)]$ and $p_2 \in [p_1 + v_2(0) - 1, p_1]$. We now show that a revenue-maximizing pair of prices exists in this range. If $p_1 \leq 0$, all consumers buy the good in the first period and total revenue is less than or equal to zero. If $p_1 > v_0(0)$, all demand is in period 2, so demand in both periods will be unaffected if p_1 is decreased to equal $v_0(0)$. If $p_2 \geq p_1$, there is no demand in period 2, so demand in both periods is unaffected by setting $p_2 = p_1$. And finally, if $p_2 < p_1 + v_2(0) - 1$, then there is no demand in period 1 (q_1 is negative). But then there is no effect on demand in either period of decreasing the first period price to the point that $p_1 = 1 + p_2 - v_2(0)$, where $q_1 = 0$.

We now find prices which maximize total revenue for the firm. Given q_1, the firm chooses to sell quantity q_2 which maximizes second period revenue. From equations 4.10, 4.2, and 4.8, the price in the second period can be written as

$$p_2 = \frac{1}{\beta} v_2(q_1 + q_2) = v_1(q_1 + q_2) = 1 - q_1 - q_2$$

The firm chooses q_2 to maximize revenue in the second period for a given quantity q_1, given by:

$$R_2(p_2, q_2) = q_2 p_2$$
$$\Rightarrow R_2(q_2) = q_2(1 - q_1 - q_2)$$

Second period revenue is strictly concave for $q_2 > 0$, so from the first order condition

we obtain

$$q_2^* = \frac{1 - q_1}{2} \tag{4.11}$$

$$p_2^* = \frac{1 - q_1}{2} \tag{4.12}$$

Thus revenue in period 2 is

$$R_2^* = \left(\frac{1 - q_1}{2}\right)^2 \tag{4.13}$$

Now let us consider revenue in the first period. Using the indifference equation 4.9 and substituting equation 4.8 into the value functions v_0 and v_2, we can write p_1 as:

$$p_1 = (1 - q_1)(1 - \beta\alpha) + \beta p_2$$

Under the rational expectations assumption we can replace p_2 with p_2^* so that

$$p_1 = \frac{2 - 2\beta\alpha + \beta}{2}(1 - q_1) \tag{4.14}$$

Therefore to maximize the present value of total revenue the firm solves: $\max_{q_1} R_1(q_1) + \beta R_2(q_1)$, which can be rewritten as:

$$\max_{q_1} \left[\frac{2 - 2\beta\alpha + \beta}{2}\left(q_1 - q_1^2\right) + \frac{\beta}{4}\left(1 - 2q_1 + q_1^2\right)\right]$$

Since α and β are restricted to the interval $(0, 1)$ this function is strictly concave in q_1. Taking the first-order condition and solving the problem, we find that

$$q_1^* = \frac{2\left(1 - \beta\alpha\right)}{4\left(1 - \beta\alpha\right) + \beta} \tag{4.15}$$

4.2.2 The Secondary Market

Rational expectations adversely affects our digital goods retailer. The firm would increase its profit by credibly committing to charge the same (high) price in both periods, but consumers correctly anticipate that the firm will lower its price to maximize profit in the second period.

How might the firm commit to not lowering its price? If the firm maintains a sufficient degree of control over access to its digital content after sale (e.g., digital audio files through iTunes), it could manage a secondary market for consumers in the second period, thereby increasing the value of the good in the first period to future re-sellers, and earning a transaction fee on secondary market sales in the second (companies operating secondary markets such as Amazon and eBay charge sellers a fraction of the selling price or a fixed fee). When the owner of a digital file sells it to another consumer in the secondary market, the file would be deleted from the seller's library and added to the buyer's.

Of course, a rational firm without regard for reputation would undercut the secondary market price in the second period. Correctly anticipating this price cut, consumers would not take seriously the possibility of re-selling the good, putting us back in the 2-price model. For the moment we simply assume the firm can credibly commit to maintaining a viable secondary market for its product in the second period without specifying the mechanism which makes this possible. Thus the firm sets a fixed price and commission rate to maximize revenue. We then demonstrate that for a range of the utility parameters α and β, the firm can set the commission so as to increase both total revenue and total demand for its product relative to the two-price model. We then introduce a model of piracy and show that increased demand for licensed copies of the product diminishes the incidence of piracy. This is an attractive outcome for the creator of the digital content, who in turn may be willing to negotiate

more attractive rates for the distributor, potentially rationalizing its commitment to the secondary market.

4.2.2.1 Revenue-Optimal Fees in the Secondary Market

We continue to assume there are two periods with costs proportional to revenue. The good is available only in the primary market in period 1. The firm manages a secondary market in period 2, in which customers buy and sell used goods. Due to the indestructible nature of digital goods (Whinston et al. 1997), usage has no effect on the good's intrinsic quality. Since by assumption the firm will not lower its price, in the second period all market activity takes place in the secondary market.

Although this means no sales of new products for the monopolist in the second period, the monopolist can maximize its revenue by imposing a commission fee on the transactions among consumers on the secondary market. Whenever a consumer sells a used good to another consumer on the secondary market, the retailer gets a commission per used good sold. If we let τ denote the tax rate for selling a good on the secondary market and p be the selling price of the good, the retailer collects a commission τp per used good sold, while the sellers gain is $(1 - \tau)p$. Companies operating second-hand markets such as Amazon or eBay charge commissions to sellers by collecting a fraction of the selling price or a fixed fee.

Consumers have four available sets of actions. They may buy the good in the first period and keep it in the second period. They may buy the good in the first period and re-sell it in the second period. They may buy the good in the second period on the secondary market. Or they may choose to buy nothing at all. These decisions are a function of the consumer's value of consuming the good and the price of the good in periods 1 and 2. We maintain the same value and net utility functions presented in equations 4.1-4.5 and 4.8. The three value functions are displayed in Figure 4.2.

In Section 1 we proved there is a unique competitive market clearing price in the secondary market in period 2.

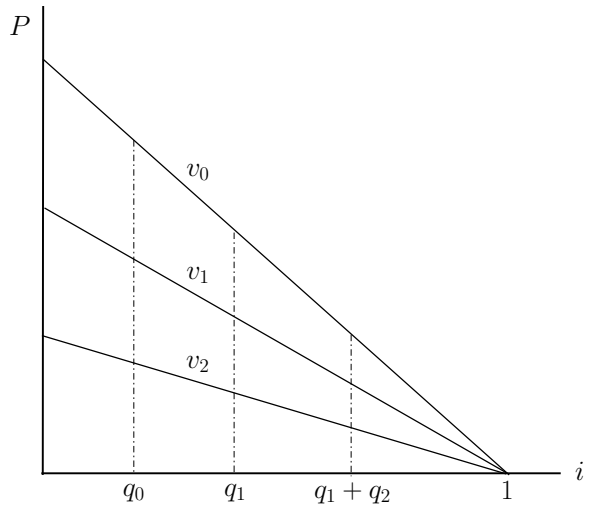


Figure 4.2: Value Functions for the Secondary Market Model

We begin by deriving a condition for each of three marginal consumers. First consider the consumer who is indifferent between buying a used good in period 2 and buying nothing at all, located at $q_1 + q_2$ in Figure 4.2. For this consumer $u_2(q_1 + q_2, p_2) = 0$, so that

$$p_2 = \frac{v_2(q_1 + q_2)}{\beta} = v_1(q_1 + q_2) = (1 - q_1 - q_2) \tag{4.16}$$

The second marginal consumer q_1 (denoted j^* in Section 1.) is indifferent between being a buyer or seller in the secondary market (see Figure 4.2). For this consumer

$$\begin{aligned} u_1(q_1, p_1, p_2) &= u_2(q_1, p_2) \\ v_1(q_1) - p_1 + \beta p_2(1 - \tau) &= v_2(q_1) - \beta p_2 \\ 1 - q_1 - p_1 + \beta p_2(1 - \tau) &= \beta(1 - q_1) - \beta p_2 \end{aligned}$$

Solving for p_1:

$$p_1 = (1 - q_1)(1 - \beta) + \beta p_2(2 - \tau) \tag{4.17}$$

It is necessarily the case that $q_1 \in (0, 1)$ since the secondary market exists for allowable p_1.

Third, we potentially have the consumer located at q_0 (denoted i^* in Section 1) in Figure 4.2 who buys the good in the first period and is indifferent between keeping and selling the good in the secondary market. For this marginal consumer we have

$$\begin{aligned} u_0(q_0, p_1) &= u_1(q_0, p_1, p_2) \\ v_0(q_0) - p_1 &= v_1(q_0) - p_1 + \beta p_2(1 - \tau) \\ (1 + \beta(1 - \alpha))(1 - q_0) - p_1 &= 1 - q_0 - p_1 + \beta p_2(1 - \tau) \end{aligned}$$

Solving for τ gives us:

$$\tau = 1 - \frac{(1 - \alpha)(1 - q_0)}{p_2} \tag{4.18}$$

If $q_0 < 0$, then there is no consumer who buys the good in the first period and keeps it in the second; all primary market buyers re-sell the good in the secondary market.

We must also add a market clearing condition on the secondary market, which will equate the mass of buyers and sellers in period 2:

$$q_2 = q_1 - \max(0, q_0) \tag{4.19}$$

The present value of firm revenue is thus equal to:

$$R = R_1 + \beta R_2 = p_1 q_1 + \beta p_2 q_2 \tau \tag{4.20}$$

Due to the max operator in the market clearing equation, we must consider two cases

in the maximization of total revenue, $q_0 > 0$ and $q_0 \leq 0$. We begin with the first case and impose the constraint $q_0 > 0$ on the firm's maximization problem. We also solve for the set of parameter values such that q_0 is optimal less than or equal to zero (it is a small set with very high β and α). We then solve the second case.

Case 1: $q_0 > 0$. Substituting equations 4.16 and 4.19 into equation 4.18, we obtain the transaction fee as a function of first and second period demand

$$\tau = \frac{(\alpha - 2)q_2 + \alpha(1 - q_1)}{1 - q_1 - q_2}$$

Then second period revenue for exogenous q_1 is given by

$$R_2(q_2) = p_2 q_2 \tau = (\alpha - 2) q_2^2 + \alpha (1 - q_1) q_2$$

This function is strictly concave for $q_2 \in [0, 1]$. The firm maximizes this function subject to the following inequality constraints: (1) $q_0 > 0 \Rightarrow q_2 < q_1$; (2) $q_2 \geq 0$; (3) $p_2 \geq 0 \Rightarrow q_2 \leq 1 - q_1$. Solving the firm's constrained maximization problem in the second period gives us

$$q_2^* = \frac{\alpha(1 - q_1)}{4 - 2\alpha} \tag{4.21}$$

provided $q_1 > \frac{\alpha}{4-\alpha}$; if not the assumption $q_0 > 0$ is violated and we are in Case 2.

Substituting 4.21 into 4.20 and simplifying the expression, we obtain total revenue as a function of q_1:

$$R(q_1) = \frac{\beta\alpha^2}{4(2-\alpha)} + \left(\frac{2 - \alpha + 2\beta - 3\beta\alpha}{2 - \alpha}\right) q_1 + \left(\frac{-8 + 4\alpha - 8\beta + 12\beta\alpha - \beta\alpha^2}{4(2-\alpha)}\right) q_1^2$$

Thus revenue is of the form $R(q_1) = a + bq_1 + cq_1^2$. It is straightforward to show that for $\alpha, \beta \in (0, 1)$, $b > 0$ and $c < 0$, so revenue is strictly concave in q_1 in the relevant

range of parameter values. Solving for optimal q_1 gives us:

$$q_1^* = \frac{2(2-\alpha+2\beta-3\beta\alpha)}{4(2-\alpha+2\beta-3\beta\alpha)+\beta\alpha^2} \tag{4.22}$$

This solution is only valid for $q_1^* > \frac{\alpha}{4-\alpha}$. Let $x = -16+20\alpha-6\alpha^2 < 0$ for all α, and $y = 16-36\alpha+18\alpha^2-\alpha^3$ which changes sign at $\hat{\alpha} \approx 0.6434$. Then we have the following restriction on parameters to be in Case 1:

$$\beta < \frac{x}{y} \quad for \quad \alpha \geq \hat{\alpha}, \quad \beta > \frac{x}{y} \quad for \quad \alpha < \hat{\alpha}$$

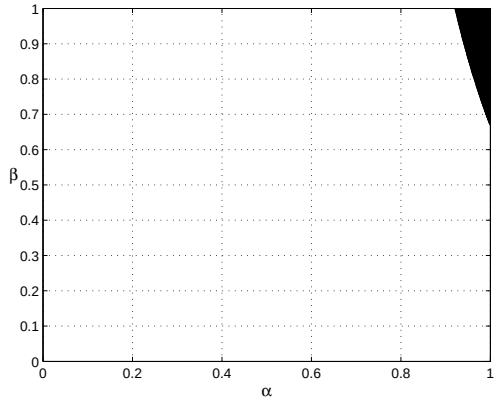


Figure 4.3: Region where $q_1^* \leq \frac{a}{4-a}$

The shaded region in Figure 4.3 represents the set of parameters for which $q_0 \leq 0$ and we must apply Case 2.

Case 2: $q_0 \leq 0$. In this case we continue to maintain equations 4.16, 4.17, and 4.19, where 4.19 simply reduces to $q_1 = q_2$. Rather than an indifferent consumer at q_0, we instead have the inequality constraint $v_0(0) - p_1 \leq v_1(0) - p_1 + \beta p_2(1-\tau)$, which can be re-written as

$$q_2 \leq \frac{\alpha-\tau}{2(1-\tau)}. \tag{4.23}$$

Revenue in period 2 can be written as $R_2 = q_2 p_2 \tau = q_2 (1-2q_2)\tau$. By substitu-

tion, we can re-write equation 4.17 as

$$\tau = \frac{1 + \beta - p_1 - (3\beta + 1)q_2}{\beta\,(1 - 2q_2)},$$

so that second period revenue can now be written as

$$R_2\,(q_2) = \frac{1}{\beta}\,(1 + \beta - p_1)\,q_2 - \frac{1}{\beta}(3\beta + 1)q_2^2$$

for fixed p_1. Clearly this function is strictly concave in q_2 in the appropriate space of parameters. Thus we can take the first order condition of R_2 subject to the constraint in 4.23, which returns $q_2^* = \frac{1+\beta-p_1}{3\beta+1}$ provided the constraint is not violated. However, plugging in this value for q_2 and solving for total revenue as a function of price gives us $R\,(p_1) = \frac{(1+\beta)^2}{4(1+3\beta)} - \frac{1}{4(1+3\beta)}p_1^2$, which is clearly maximized at $p_1 = 0$. Thus it must be the case that

$$q_2^* = \frac{\alpha - \tau}{2(1 - \tau)}. \tag{4.24}$$

We can re-write 4.24 to make τ^* a function of q_2. Taking the total discounted revenue equation 4.20 and substituting 4.16, 4.17, and 4.19, we obtain total discounted revenue as a function of q_2 and τ. However, after applying some algebra the variable τ falls out of the equation, and we are left with

$$R\,(q_2) = (1 + \beta)q_2 - (1 + 3\beta)q_2^2$$

The first order condition gives us

$$q_1^* = q_2^* = \frac{1 + \beta}{2(1 + 3\beta)}. \tag{4.25}$$

In Figure 4.4 we present an optimal revenue comparison of the secondary market

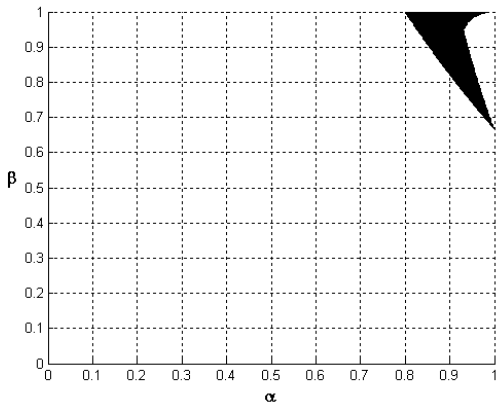


Figure 4.4: Region where revenue in 2-price model dominates secondary market model

model and the 2-price model. The region where revenue in the 2-price model is greater than revenue in the secondary market model is shaded. Clearly the secondary market model generates more revenue for most possible parameters. However, total demand for the product also tends to be lower in the secondary market model, which intuitively may lead to more piracy of the digital good.

Before moving to a model of piracy, we first show the set of parameters such that both revenue and total demand can be greater in the secondary market. That is, if the firm is willing to sacrifice some revenue in order to increase demand for its licensed product (and presumably reduce piracy, which may potentially improve its relationship with the digital content creator, a relationship which will remain exogenous in this paper), there are a set of parameters where it is possible for the secondary market to dominate the 2-price model on both revenue and demand.

This region is displayed in Figure 4.5. For the secondary market to dominate the 2-price model in both demand and revenue there must be at least a moderate degree of enjoyment deterioration of the product. And a moderate degree of deterioration requires very patient consumers. As deterioration becomes large less patience is required. Products which intuitively may fit in this category (products for which

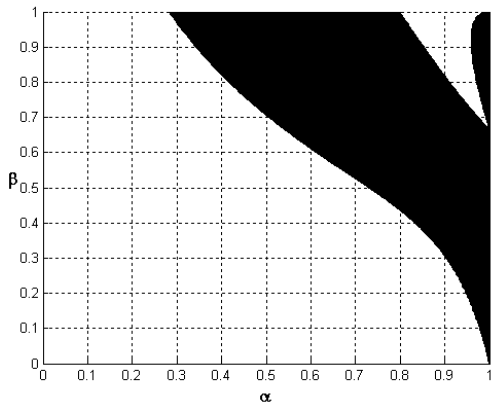


Figure 4.5: Region where revenue in secondary market model dominates for equal demand

consumers may be fairly patient but who quickly tire of the product after purchase) are digitally distributed movies and video games.

4.3 Piracy

In this section, we extend our two-period market equilibrium model by introducing the possibility of acquiring goods through piracy without purchasing a legal copy. We aim to compare revenues, market coverages and piracy rates in the traditional two-price model and the secondary market model in the presence of piracy.

Although piracy does not entail a monetary cost and saves the price of the good for consumers, according to the previous studies, they are known to suffer two main types of costs when engaged in piracy. First, the pirated copy is not an perfect substitute of the legal copy and incurs some degree of quality degradation (Takeyama 1997; Holm 2003; Sundararajan 2004a; Bae and Choi 2006). Pirated copies of digital goods typically lack several functions, features or components which are available in legal copies. For instance, unauthorized copies of software do not come with user manuals or online support. Pirated digital movies do not include extra material such

as commentaries, deleted scenes or subtitles. Similarly, consumers cannot enjoy online multiplayer components of video games if the copy is pirated.

We assume that this cost is proportional to the valuation of the consumer for the legal copy. If consumer i has value $v_1(i)$ of consuming a legal copy of the good in period 1, the value of consuming a pirated copy of the good in period 1 can be defined as:

$$v_{1p}(i) = (1 - \delta)\, v_1(i) \tag{4.26}$$

where $\delta \in (0, 1)$ reflects the rate of quality degradation. The parameter δ can also be interpreted as the level of protection or enforcement efforts controlled by the monopolist (Takeyama 1997; Bae and Choi 2006; Banerjee et al. 2008; Jain 2008). People consider expected consequences of being caught when engaged in an illegal activity. Therefore, if δ represents the probability of being caught and punished after pirating a good, the value of consuming an unauthorized copy for consumers would be proportional to $(1 - \delta)$. In addition to the risk of punishment, consumers also incur an internal cost of committing an illegal activity (Solomon and O'Brian 1990), which is called the moral cost of pirating (Takeyama 1997; Chellappa and Shivendu 2005; Khouja and Park 2007). Cremer and Pestieau (2009) defines the cost of piracy as a function of the quality of the illegal copy and the effort to enforce copyrights. We aim to capture all these different types of costs which degrade the value of the good for the consumer by the parameter δ.

Second, we assume that there is a constant cost c of piracy which includes reproduction and search costs associated to illegal copying (Takeyama 1997; Holm 2003; Wu et al. 2003; Bae and Choi 2006; Khouja and Rajagopalan 2009). Since this repro-

duction and search cost is assumed to be the same for all consumers and not related to the valuation of consumers for products, it can be considered as the price of using an unauthorized copy. Hence, the utility of consuming a pirated good in period 1 for the consumer i can be given as:

$$u_{1p}(i,c) = (1-\delta)\, v_1(i) - c \tag{4.27}$$

Since consumers need only one copy of the good (legal or illegal), they will pirate the good either in period 1 or in period 2 if they find optimal to pirate. When a consumer copies a good in period 1, his utility from pirating can be defined as:

$$u_{0p}(i,c) = [1+\beta\,(1-\alpha)]\, v_{1p}(i) - c = [1+\beta\,(1-\alpha)]\,(1-\delta)\, v_1(i) - c \tag{4.28}$$

Alternatively, consumers may have to pirate the good in the second period because of the lack of supply of unauthorized copies in the first period. In our model, period 1 represents a time interval which starts with the release of a new product and continues until the monopolist drops the price of the good (2-price model) or the monopolist opens the secondary market for the transaction of used goods (secondary market model). So, there may not be enough unauthorized goods to satisfy the demand for piracy during the first period and consumers wait until the second period to pirate the good. Piracy depends on the total number of legal copies and is facilitated by the diffusion of these legitimate copies of product in the market (Khouja and Smith 2007). Furthermore, Boldrin and Levine (2002) assumed that copying takes one period in their multi-period model of a market for information goods. Therefore, it may be the case that unauthorized copies are only available in the second period in our model.

We define the utility of pirating the good in period 2 as:

$$u_{2p}(i,c) = \beta v_{1p}(i) - \beta c = \beta\left(1-\delta\right)v_1(i) - \beta c \tag{4.29}$$

We first assume that consumers can only consume unauthorized copies in the second period and compare the revenues and piracy rates in the two-price and secondary market models. We then present a more general piracy model in which consumers can consume unauthorized copies in either period 1 or 2 and discuss piracy for the 2-price and the secondary market model.

4.3.1 Piracy in Period 2

The only difference between the case in which consumers can acquire an authorized copy of a product only in the second period and the case without piracy that has been already solved in the previous section is that consumers have three possible actions to take in period 2 instead of two: buy the good, do without the good and pirate the good.

Let Δu denote the difference between the utilities of buying the good and pirating the good in period 2. It can be seen in Equation 4.30 that Δu decreases as i approaches to 1, given $p_2 \geq c$. Therefore, we can conclude that pirates should be located at the right hand side of buyers in period 2 along the continuum of consumers in both two-price and secondary market models (See Figures 4.6 and 4.7).

$$\Delta u = u_2 - u_{2p} = \beta[\delta(1-i) - (p_2 - c)] \tag{4.30}$$

For both models, in order to have a meaningful analysis of piracy, we restrict

our attention to the parameter regions given below, where the piracy constraint is binding:

$$\frac{c}{1-\delta} < p_2^* \tag{4.31}$$

where p_2^* denotes the optimal price in period 2 for both models without piracy discussed in the previous section. When δ and/or c are not too high, this condition is satisfied. Otherwise, piracy would be redundant and not decrease the demand for legal copies in period 2.

4.3.1.1 Two-Price Model with Piracy in Period 2

The value functions v_0, v_2 and v_{2p} associated with purchasing the good in periods 1 and 2 and pirating the good in period 2, respectively, are represented in Figure 4.6. q_1, q_2 and r denote the demands for buying the good in periods 1 and 2 and pirating the product in period 2, respectively.

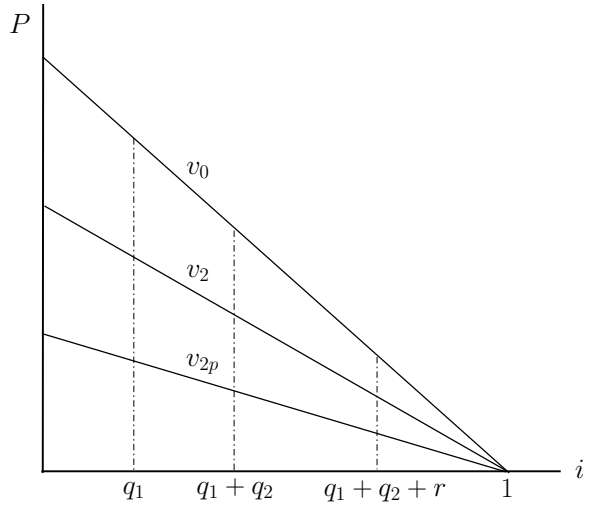


Figure 4.6: Value Functions for Two-Price Model When Consumers can Pirate in Period 2

In the second period, we have three groups of consumers: buyers, pirates and those who choose to do without the product. According to Figure 4.6, there is a consumer who is indifferent between pirating the good and doing nothing (located at $q_1 + q_2 + r$), and another who is indifferent between purchasing the good and pirating it (located at $q_1 + q_2$). Let us look at the conditions derived from these marginal consumers.

For the marginal consumer $q_1 + q_2 + r$, $u_{2p} = 0$. Therefore, the demand for piracy can be given as:

$$r = (1 - q_1 - q_2) - \frac{c}{1 - \delta} \tag{4.32}$$

For the marginal consumer $q_1 + q_2$, the utility of buying the good, u_2 is equal to the utility of pirating the good, u_{2p}. This equality gives us

$$p_2 = \delta v_1(q_1 + q_2) + c = \delta(1 - q_1 - q_2) + c \tag{4.33}$$

The firm chooses to sell quantity q_2 which maximizes the revenue in period 2, for a given q_1. We can write the revenue in period 2 by substituting p_2 given in Equation 4.33 as:

$$R_2(p_2, q_2) = q_2 p_2$$
$$\Rightarrow R_2(q_2) = q_2[\delta(1 - q_1 - q_2) + c]$$

Second period revenue is strictly concave for $q_2 > 0$, so from the first order condition

we obtain

$$q_2^* = \frac{1-q_1}{2} + \frac{c}{2\delta} \tag{4.34}$$

$$p_2^* = \frac{\delta(1-q_1)+c}{2} \tag{4.35}$$

Thus revenue in period 2 is

$$R_2^* = \frac{1}{\delta}\left(\frac{\delta(1-q_1)+c}{2}\right)^2 \tag{4.36}$$

Now we turn our attention to the first period. Consumers have two possible actions to perform in the first period. They can either buy the product or do nothing at all and wait until the second period. This implies that there is a third marginal consumer located at q_1 in Figure 4.6, who is indifferent between buying the good in the first and second period. The condition derived from this marginal consumer is the same with the one in the case without piracy.

$$p_1 = (1-q_1)(1-\beta\alpha) + \beta p_2$$

Under the rational expectations assumption we can replace p_2 with p_2^* so that

$$p_1 = (1-q_1)(1-\beta\alpha) + \beta\left(\frac{\delta(1-q_1)+c}{2}\right) \tag{4.37}$$

Therefore to maximize the present value of total revenue the firm solves: $\max_{q_1} R_1(q_1) + \beta R_2(q_1)$, which can be rewritten as:

$$\max_{q_1}\left[(1-\beta\alpha)q_1 - \left(1-\beta\alpha+\frac{\beta\delta}{4}\right)q_1^2 + \frac{\beta(\delta^2+c^2+2\delta c)}{4\delta}\right]$$

Since α and β are restricted to the interval $(0, 1)$ this function is strictly concave in q_1. Taking the first-order condition and solving the problem, we find that

$$q_1^* = \frac{2(1-\beta\alpha)}{4(1-\beta\alpha)+\beta\delta} \tag{4.38}$$

4.3.1.2 Secondary Market Model with Piracy in Period 2

All of the assumptions used in the solution of secondary market model without piracy still hold for the corresponding piracy case. Consumers have five available sets of actions: buying the good in period 1 and keeping it in period 2, buying the good in period 1 and selling it in period 2, buying the good in period 2, pirating the good in period 2, and doing without the product. The four value functions and marginal consumers are displayed in Figure 4.7.

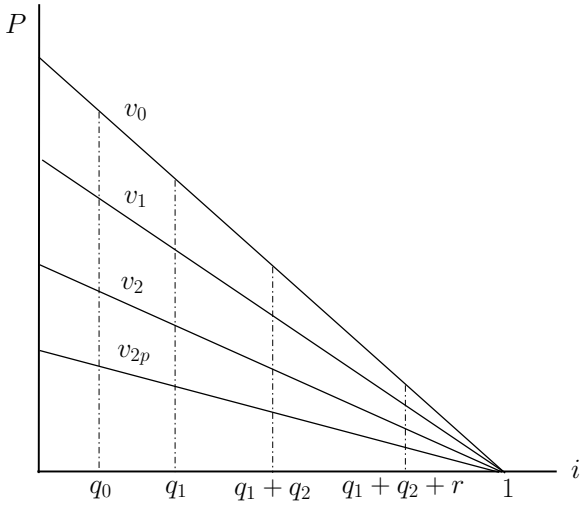


Figure 4.7: Value Functions for Secondary Market Model When Consumers can Pirate in Period 2

The conditions derived from the marginal consumers located at q_1+q_2 and q_1+q_2+r

are the same as we found for the two-price model in the previous section.

$$\begin{aligned} r &= (1 - q_1 - q_2) - \tfrac{c}{1-\delta} \\ p_2 &= \delta(1 - q_1 - q_2) + c \end{aligned}$$

When the monopolist offers a secondary market, we previously showed that the consumer located at q_0 in Figure 4.7 who buys the good in period 1 is indifferent between keeping and selling it in period 2. Using the equality derived from this marginal consumer, we have

$$\tau = 1 - \frac{(1-\alpha)(1-q_0)}{p_2}$$

We also proved in Section 1 that there should be a market clearing condition which levels the mass of buyers and sellers in period 2:

$$q_2 = q_1 - \max(0, q_0)$$

We again consider two different cases of in the total revenue maximization depending on the value of q_0.

Case 1: $q_0 > 0$. Using the equations for p_2 and τ derived above, we can write the second period revenue for a given q_1 as

$$R_2(q_2) = [(1 - q_1)(\delta + \alpha - 1) + c]q_2 - (\delta - \alpha + 1)q_2^2$$

This function is strictly concave for $q_2 \in [0, 1]$. The firm maximizes this function subject to the following inequality constraints: (1) $q_0 > 0 \Rightarrow q_2 < q_1$; (2) $q_2 \geq 0$; (3) $p_2 \geq 0 \Rightarrow q_2 \leq 1 - q_1$. Solving the firm's constrained maximization problem in the

second period gives us

$$q_2^* = \frac{(1-q_1)(\delta+\alpha-1)+c}{2(\delta-\alpha+1)} \tag{4.39}$$

provided $q_1 > \frac{\delta+\alpha+c-1}{3\delta-\alpha+1}$; if not the assumption $q_0 > 0$ is violated and we are in the $q_0 \leq 0$ case.

It should also be noted that if $\delta + \alpha < 1$ and c is not high enough, we end up with a negative quantity q_2*. Therefore, we should have the following restriction on the degree of quality degradation δ:

$$\delta > 1 - \alpha - \frac{c}{1-q_1}$$

Otherwise, there will be no consumers who want to buy a legitimate copy in the secondary market in period 2. We will discuss this case later at the end of this section.

We derived in the secondary market model section that:

$$p_1 = (1-q_1)(1-\beta) + \beta p_2(2-\tau)$$

The present value of firm revenue is equal to:

$$R = R_1 + \beta R_2 = p_1 q_1 + \beta p_2 q_2 \tau$$

Substituting Equation 4.39 into the revenue function above and simplifying the expression, we obtain total revenue as a function of q_1:

$$\begin{aligned} R(q_1) = \; & \tfrac{\beta(\delta+\alpha-1)^2}{4(1+\delta-\alpha)} + \left(\tfrac{4(\delta-\beta-\alpha+\alpha\beta+2\beta c+3\beta\delta-2\alpha\beta c-4\alpha\beta\delta+1)}{4(1+\delta-\alpha)}\right) q_1 \\ & - \left(\tfrac{4\delta-3\beta-4\alpha+2\alpha\beta+10\beta\delta-14\alpha\beta\delta+\beta\alpha^2+\beta\delta^2+4}{4(1+\delta-\alpha)}\right) q_1^2 \end{aligned}$$

Thus revenue is of the form $R(q_1) = x + yq_1 - zq_1^2$. It is straightforward to show that

for $\alpha, \beta, \delta, c \in (0,1)$, $y > 0$ and $z < 0$, so revenue is strictly concave in q_1 when q_0 is greater than zero. Solving for optimal q_1 gives us:

$$q_1^* = \frac{2\delta - 2\beta - 2\alpha + 2\alpha\beta + 6\beta\delta - 8\alpha\beta\delta + 4\beta c - 4\alpha\beta c + 2}{4\delta - 3\beta - 4\alpha + 2\alpha\beta + 10\beta\delta - 14\alpha\beta\delta + \beta\alpha^2 + \beta\delta^2 + 4} \tag{4.40}$$

Case 2: $q_0 \leq 0$. Fig 4.8 shows the parameter space (upper-right side of the borders) where q_0 is zero or negative. It can be seen in the figure that the area of the region where $q_0 \leq 0$ increases with the rate of quality degradation for the pirated copy, δ.

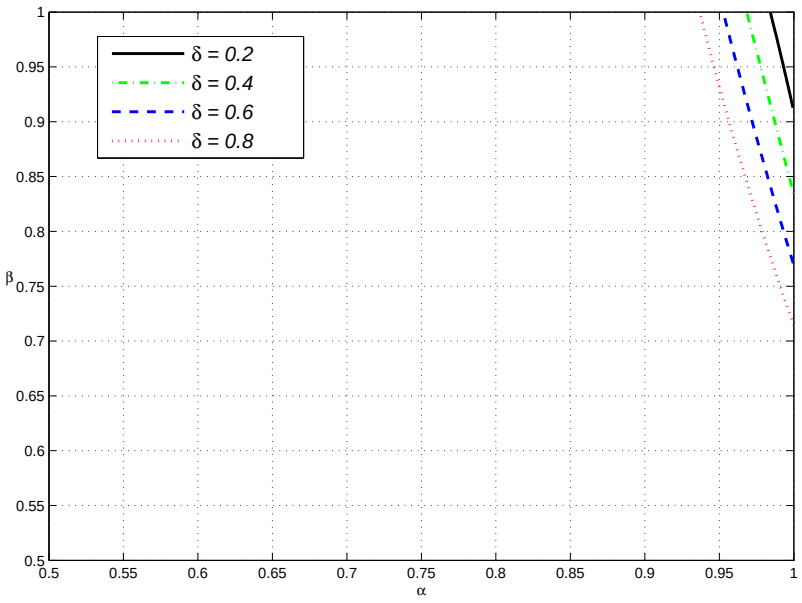


Figure 4.8: Region where $q_0 \leq 0$ when c = 0

We previously showed in the secondary market model without piracy that the optimal quantity sold in period 2 should satisfy the following equality if there are no consumers willing to buy the good in period 1 and keep it in period 2:

$$q_2^* = \frac{\alpha - \tau}{2(1 - \tau)}$$

Therefore, we can rewrite the equation above as:

$$\tau^* = \frac{\alpha - 2q_2}{1 - 2q_2}$$

Since we know that $q_1 = q_2$ when $q_0 \leq 0$, prices in period 1 and 2 can be given by:

$$p_2 = \delta_2(1 - 2q_2) + c$$
$$p_1 = (1 - q_2)(1 - \beta) + \beta(\delta + c - 2\delta q_2)\left(\frac{2 - \alpha - 2q_2}{1 - 2q_2}\right)$$

Now we can write the total discounted revenue as a function of only q_2:

$$R\left(q_2\right) = (2\beta\delta - \beta + 1 + 2\beta c)q_2 - (4\beta\delta - \beta + 1)q_2^2$$

The first order condition gives us

$$q_1^* = q_2^* = \frac{2\beta\delta - \beta + 1 + 2\beta c}{2(4\beta\delta - \beta + 1)} \tag{4.41}$$

This solution is only valid for $q_1^* \leq \frac{\delta+\alpha+c-1}{3\delta-\alpha+1}$

Case 3: $q_2 \leq 0$. As we mentioned before, if $\delta \leq 1 - \alpha - \frac{c}{1-q_1}$, there will be no demand for used legal copies in the secondary market in period 2. This also affects the demand (q_1) for legal copies in period 1. Since there will be no buyers in the secondary market, consumers will not consider buying the good in period 1 and selling it in period 2, implying that low δ values may possibly destroy the secondary market and convert the model into a single-price model in which consumers perform only two actions: buying the good in period 1 and keeping it in period 2 or pirating the good in period 2. In this case, we should have a consumer who is indifferent

between taking these two actions. Therefore, we define:

$$\begin{aligned} u_0(i, p_1) &= u_{2p}(i, c) \\ (1 + \beta(1 - \alpha)v_1(i) - p_1 &= \beta(1 - \delta)v_1(i) - \beta c \end{aligned}$$

From the equality above, we can derive that:

$$p_1 = (1 + \beta(\delta - \alpha))(1 - q_0) + \beta c$$

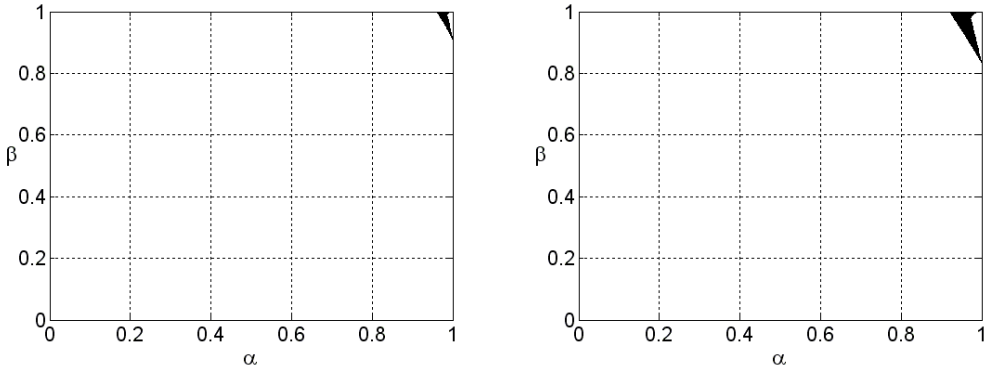
Then, the monopolist should maximize the following revenue:

$$R(q_0) = q_0[(1 + \beta(\delta - \alpha))(1 - q_0) + \beta c]$$

The first order condition gives us that

$$q_0* = \frac{\beta\delta - \beta\alpha - \beta c + 1}{2\beta\delta - 2\beta\alpha + 2}$$

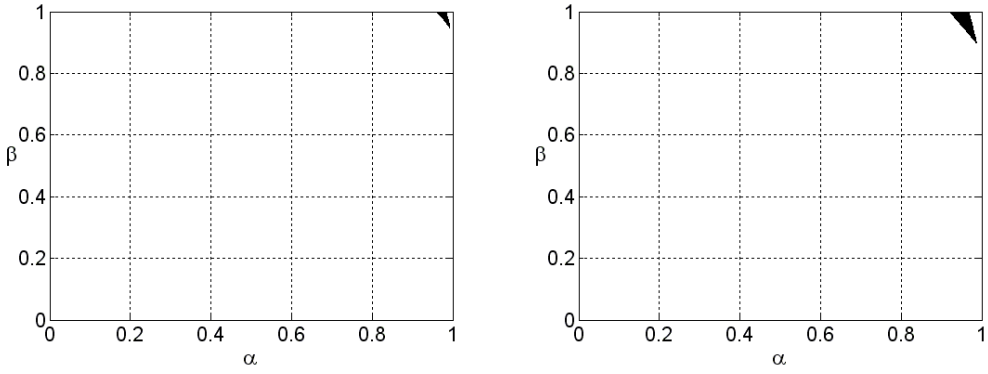
Figure 4.9 compares optimal revenues in the 2-price model and the secondary market model for various δ values when c is zero. Shaded regions show α and β values where revenue in the 2-price model is greater than revenue in the secondary market model. Clearly, the secondary market model generates more revenue than the 2-price model in the presence of piracy in period 2 for most of the α-β parameter space (except for very high α and β). It can be further seen that revenue of the secondary market model dominates revenue of the 2-price model for more α and β values as δ decreases. This implies that the secondary market model is more profitable when consumers perceive that the unauthorized copy of a good is almost a perfect substitute of the legal copy.



(a) $\delta = 0.2$ (b) $\delta = 0.4$

(c) $\delta = 0.6$ (d) $\delta = 0.8$

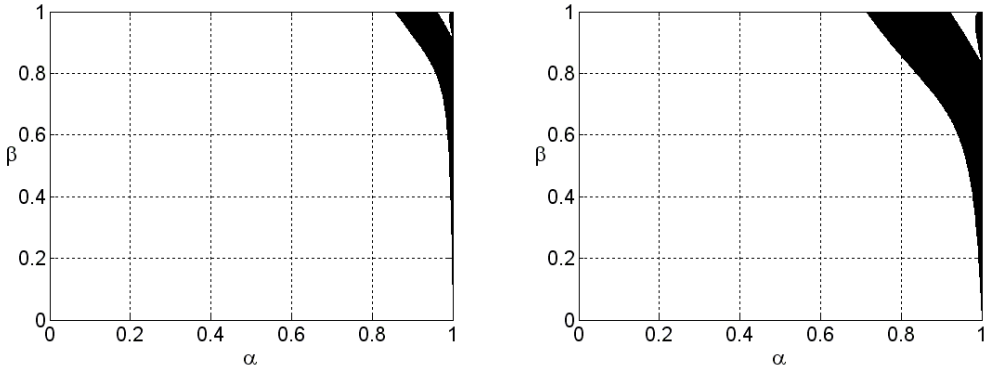
Figure 4.9: Revenue comparison when c = 0 (Shaded regions denote where the 2-price model dominates in revenue)



(a) $\delta = 0.2$ (b) $\delta = 0.4$

(c) $\delta = 0.6$ (d) $\delta = 0.8$

Figure 4.10: Piracy comparison when c = 0 (Shaded regions denote where the secondary market model dominates in piracy)



(a) $\delta = 0.2$ (b) $\delta = 0.4$

(c) $\delta = 0.6$ (d) $\delta = 0.8$

Figure 4.11: Revenue comparison for equal piracy when c = 0 (Shaded regions denote where the secondary market model dominate in revenue for equal piracy)

Figure 4.10 compares piracy levels in the 2-price model and the secondary market model for various δ values when c is zero. The level of piracy in the secondary market model is lower than the level of piracy in the 2-price model in the shaded region. The piracy performance of the 2-price model is superior to that of the secondary market model for most possible parameters. Additionally, the secondary market model starts to perform better in terms of piracy with the increasing δ.

To sum up, for low δ values, the secondary market model generates higher revenues but allows more consumers to pirate the product than the 2-price model for almost all α and β values. As the value of δ increases, the region where the secondary market model dominates in piracy expands but the region where it dominates in revenue shrinks. To normalize the revenue performances of both models, let us look at how they perform if the levels of piracy allowed in both models are the same.

Figure 4.11 compares revenues in the 2-price model and the secondary market model for different δ values when c is zero and when the number of pirates are the same in both models. In the shaded region, revenue in the secondary market model is greater than revenue in the 2-price model if the total number of quantities sold are the same in both models, which also means that piracy levels are equal to each other in both models. It can be said that for the corresponding α and β values (in the shaded region), a monopolist using the secondary market model can decrease piracy by sacrificing some of its revenue but still make a higher revenue than the 2-price model.

4.3.2 Piracy in Period 1

In this section, we present a general model of piracy without any restrictions on consumers' piracy behaviors. Consumers may choose to consume unauthorized copies either in period 1 or in period 2, depending on their utilities. The utility of consuming

an unauthorized copy in the first and second period is given in Equation 4.28 and only in the second period is given in Equation 4.29.

$$u_{0p}(i,c) > u_{2p}(i,c)$$
$$[1+\beta\,(1-\alpha)]\,(1-\delta)\,v_1(i) - c > \beta\,(1-\delta)\,v_1(i) - \beta c$$

Considering these utility functions, we can say that a consumer will always choose to pirate a product in the first period rather than in the second period if he finds it optimal to pirate the product, since the utility of consuming the unauthorized copy in the first period is always greater than the second period utility. Therefore, we generalize the utility of pirating a product as:

$$u_p(i,c) = [1+\beta\,(1-\alpha)]\,(1-\delta)\,v_1(i) - c \tag{4.42}$$

Let us examine how piracy changes the market equilibrium in the 2-price model and the secondary market models if piracy is observed in the first period.

4.3.2.1 Two-Price Model with Piracy in Period 1

To identify which consumers will possibly choose to consume unauthorized copies, we first have to know the slope of the value curve of consuming an unauthorized copy. We know that the value curve of pirating a product should be always below the value curve of buying the product in period 1 and keeping it in period 2 (v_0), since $[1+\beta(1-\alpha)]v_1(i) > [1+\beta(1-\alpha)]1-\delta)v_1(i)$. Therefore, there are three possible positions where the value curve of piracy can be located: It can be between v_0 and v_1, between v_1 and v_2, and below v_2. However, cases are exactly the same for the 2-price

model if the value curve of piracy is below the value curve of buying the product in period 1 (v_1) or above it. So, this leaves us with two possible cases: The piracy value curve may be between the value curve of buying in period 1 and the value curve of buying in period 2, or below the value curve of buying period 2. Figure 4.12 shows these two possible cases where the value curve of piracy may be located relative to the other value curves.

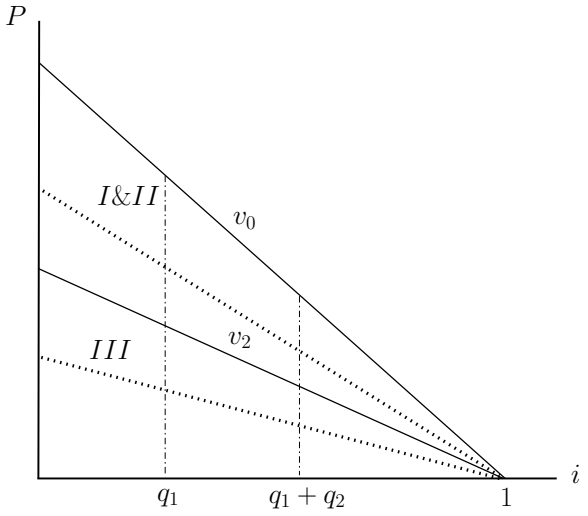


Figure 4.12: Value Functions for the 2-Price Model

Assuming that the position I denotes the region between v_0 and v_1, and the position II denotes the region between v_1 and v_2, when the slope of the piracy value curve (v_p) is greater than the value curve of consuming the product in the second period (v_2), the piracy value curve is located at either in position I or II. Since the piracy value curve being in position I or II does not change anything for the 2-price model, we combine these cases and call this position and case $I\&II$. For the position $I\&II$, we must have the inequality, $(1 + \beta(1 - \alpha))(1 - \delta) > \beta$, which gives us:

$$\delta < \frac{1 - \beta\alpha}{1 + \beta(1 - \alpha)}$$

If the constant cost of piracy (c) is zero or very small, the utility of consuming the product in period 2 will never be greater than the utility of pirating the product for all $i \in [0, 1]$. In this case, there will be only three types of consumers in the market: consumers who buy in the first period and keep in the second period, consumers who pirate, and consumers who do nothing. If c is high enough to push the utility of pirating below the utility of buying in period 2 for some consumers, we will have four groups of consumers in the market: consumers who buy in the first period and keep in the second period, consumers who pirate, consumers who buy in the second period, and consumers who do nothing. Figure 4.13 shows the utilities of three possible actions and the market segmentation. In this case, consumers should be located along the consumer continuum i in the following order: buyers in period 1, pirates, buyers in period 2, and those who do nothing.

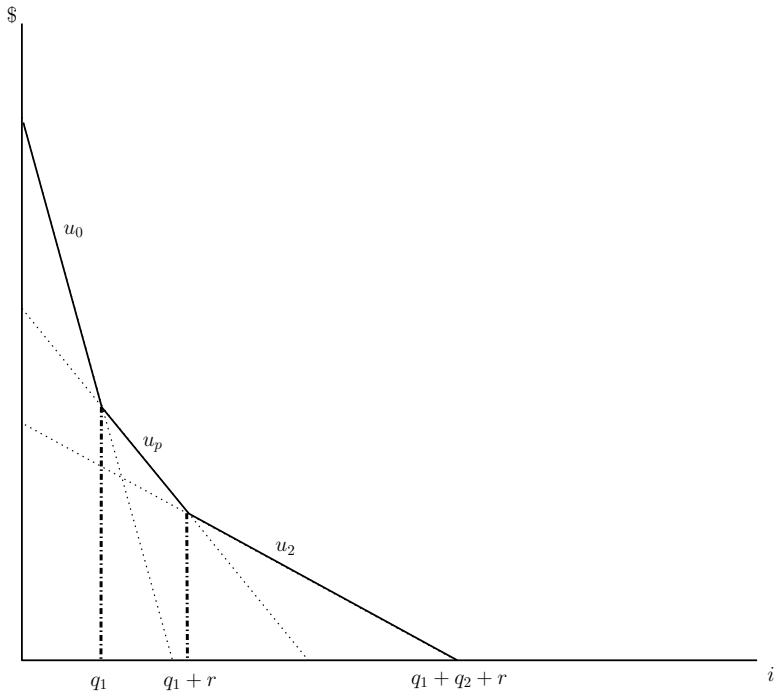


Figure 4.13: Utility Functions and Market Segmentation in the 2-Price Model (Case I & II)

When the value curve of piracy is at position III, δ is greater than $\frac{1-\beta\alpha}{1+\beta(1-\alpha)}$. In this case, pirates should be located between $q_1 + q_2$ and 1 (right hand side of the buyers in period 2) on the consumer axis i, which is similar to the case of piracy in period 2 discussed in the previous section. Figure 4.14 shows the consumer segments depending on their optimal actions.

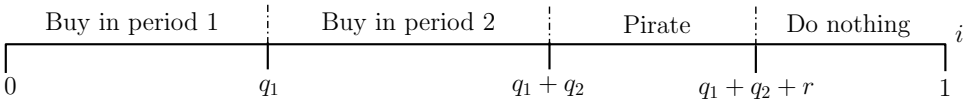


Figure 4.14: Market Segmentation in the 2-Price Model (Case III)

4.3.2.2 Secondary Market Model with Piracy in Period 1

In the secondary market model, the value curve of pirating a product should be again below the value curve of buying the product in period 1 and keeping it in period 2 (u_0). Hence, there are three possible piracy scenarios for the secondary market model if consumers can acquire unauthorized copies in the first period. Depending on the value of δ, the value curve of piracy will be at positions I (between v_0 and v_1), II (between v_1 and v_2) or III (below v_2) in Figure 4.15. It also should be noted that in the presence of piracy in period 1, there is still an equilibrium price which clears the secondary market. Therefore, our market equilibrium condition ($q_0 = q_1 - q_2$) should be true for all possible cases. Piracy offers the most value when the piracy

value curve is located at position I in Figure 4.15. When v_p is at position I, the slope of piracy value curve ($(1 + \beta(1 - \alpha))(1 - \delta)$) should be greater than the slope of the value curve of consuming the product in period 1 (the slope of v_1 is 1). Then, we obtain:

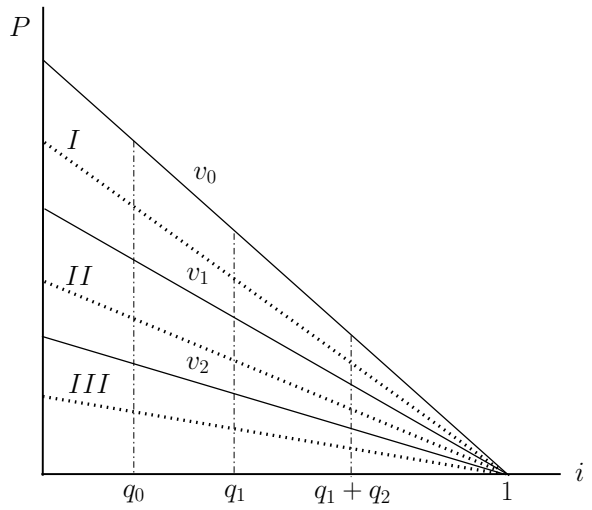


Figure 4.15: Value Functions for the Secondary Market Model

$$\delta < \frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}$$

In this case, if c is zero or very small, the utility curve of piracy is always above the utility curves u_1 (buying in period 1 and selling in period 2) and u_2 (buying in period 2). Therefore, there will be no consumer activity in the secondary market. If c is high enough to push the utility curve of piracy below to u_1 and u_2 for an interval along i, there will be some consumers who find optimal to buy and sell in the secondary market. Then, there is a certain range of δ and c values which will create five different consumer segments in the following order along the consumer continuum i: consumers who choose to buy the product in period 1 and keep it in period 2, consumers who choose to pirate the product, consumers who choose to buy the product in period 1 and sell it in period 2, consumers who choose to buy the product in period 2, and consumers who choose to do without the product. If there are five consumer segments along the consumer axis, we should have four marginal consumers which will separate these segments (See Figure 4.16).

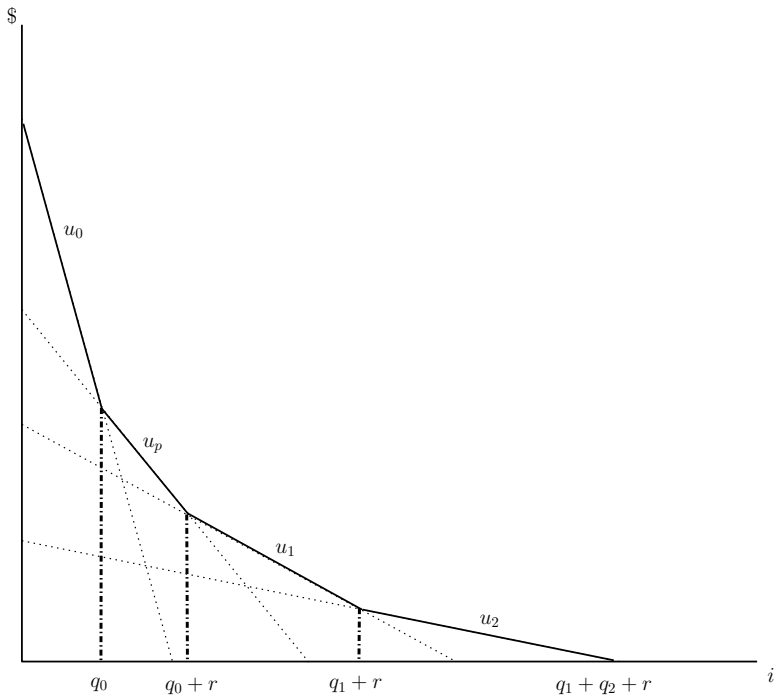


Figure 4.16: Utility Functions and Market Segmentation in the Secondary Market Model (Case I)

If δ is greater than $\frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}$ but smaller than $\frac{1-\beta\alpha}{1+\beta(1-\alpha)}$, v_p is located at position II, between v_1 and v_2. For zero or very small c, the piracy value curve is always above the value curve of buying in period 2. So, there will be no buyers in the secondary market. This also negatively affects the consumers who find optimal to buy in period 1 and sell in period 2. Since there will be no buyers in the secondary market, none of the consumers will consider selling the product in the secondary market. If c is high enough to push the piracy value curve below to v_2, some consumers would find it optimal to buy in period 2 using the secondary market. Figure 4.17 shows the market segmentation for this case in which different consumer segments will be located along the consumer axis in the following order: consumers who choose to buy the product in period 1 and keep it in period 2, consumers who choose to buy the product in period 1 and sell it in period 2, consumers who choose to pirate the product, consumers who choose to buy the product in period 2, and consumers who choose to do without the

product.

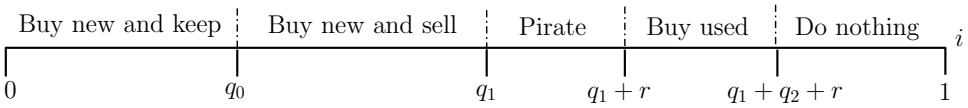


Figure 4.17: Market Segmentation in the Secondary Market Model (Case II)

If δ is greater than $\frac{1-\beta\alpha}{1+\beta(1-\alpha)}$, piracy offers the least value among all options for consumers and the value curve of piracy is at position III in Figure 4.15. In this case, consumers who will choose to pirate the product are located after the buyers in period 2. The order of five consumer segments and four marginal consumers along the consumer continuum i are shown in Figure 4.18: consumers who choose to buy the product in period 1 and keep it in period 2, consumers who choose to buy the product in period 1 and sell it in period 2, consumers who choose to buy the product in period 2, consumers who choose to pirate the product, and consumers who choose to do without the product.

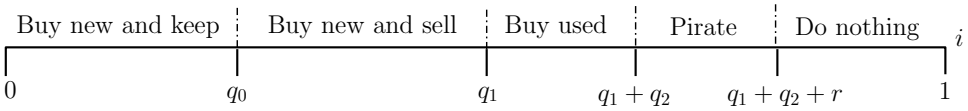


Figure 4.18: Market Segmentation in the Secondary Market Model (Case III)

Table 4.3 summarizes the required δ values for different cases of piracy in period 1 in the 2-price and the secondary market models. We next compare the performances of both models in the presence of piracy in period 1. Solutions for optimal quantities and prices for all cases in both models are provided in Appendix A. Model results for piracy in period 1 for various δ and c values are given in Figures 4.19-4.23. Revenues, piracy levels and revenues for equal piracy levels in the 2-price model and in the

secondary market model are compared for 3 different c values (low, moderate and high) for each given δ.

Figures on the left-hand side (subfigures a, c and e) demonstrate the comparison of revenues and piracy levels in the 2-price and the secondary market model for a given δ and c. Let R denote the revenue in the 2-price model and R_s denote the revenue in the secondary market model. Similarly, let r denote the piracy level in the 2-price model and r_s denote the piracy level in the secondary market model. In subfigures a, c and e of Figures 4.19-4.23, revenue is higher and piracy is lower in the secondary market model than in the 2-price model in red regions ($R_s > R$ and $r_s < r$). So, the red zone represents the values of α and β parameters where the secondary market model performs better in revenue and piracy than the 2-price model. In green regions, both revenue and piracy are higher in the secondary market model than in the 2-price model ($R_s > R$ and $r_s > r$). It means that the secondary market model outperforms the 2-price model for only revenue. Finally, both revenue and piracy are lower in the secondary market model than in the 2-price model in blue regions ($R_s < R$ and $r_s < r$). So, the secondary market model performs better only in piracy in blue regions. Color coding of the figures is given in Table 4.2.

Table 4.2: Color Coding

	$R_s > R$	$R_s < R$
$r_s < r$	Red	Blue
$r_s > r$	Green	White

Additionally, each figure is divided into two or three zones by black colored borders. These zones represent the corresponding cases for each model. For instance, in the top-left zone of Figure 4.19, both models are in Case I. In the bottom-left

zone, both models are in Case II. It should be noted that Cases I and II are the same for the 2-price model (labeled as Case I&II). The small zone in the top-right corner indicates that Case III should be applied for the optimal solution of the secondary market model. However, the 2-price model is still in Case II since there is not a third case for the optimal solution of the 2-price model. It should also be noted that as δ increases, the area of Case III expands and the area of Case I shrinks. When δ is 0.5 or higher, there are only two possible cases (Case II and III) left, since Case I is no longer possible for both models. When Case I disappears, the top zone represents Case III and the bottom zone represents Case I (See Appendix A for the optimal solutions for both models in each case).

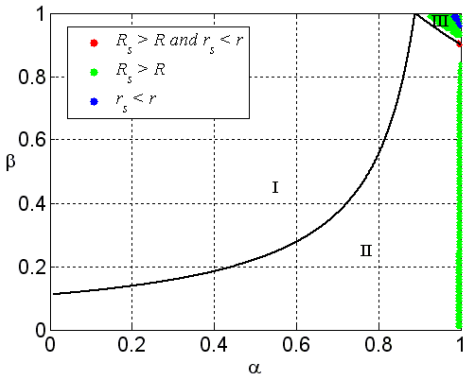
Figures on the right-hand side (subfigures b, d and f) compare revenues in the 2-price model and in the secondary market model for various δ and c values when piracy levels are equal to each other in both models. Regions shaded in gray denote where the secondary market model generates more revenue than the 2-price model when the piracy level is the same in both models ($R_s > R$ and $r_s = r$). In the shaded regions, a monopolist can decrease the piracy level by decreasing its prices in the secondary market model but still can keep its revenue above the 2-price model. Since the functions are not as well-behaved as in the case without piracy or in the case with piracy in period 2, it is difficult to observe a precise behavior of the secondary market model performance for different parameters (α, β, δ and c).

However, it can be roughly said that secondary market model generates more revenue and decreases the level of piracy for low c values ($c = 0.01$) when both models are in Case III (top-right zone in the figures). This region increases with δ, which means that when Case III is applied to the secondary market model, its performance is better for high δ values. For moderate c values ($c = 0.05$), the secondary market model performs better in revenue and piracy than the 2-price model for high α values.

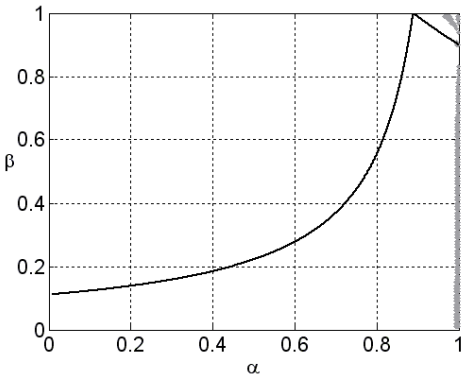
This region also expands with δ. For high c values ($c = 0.1$), we again observe a better performance for the secondary market model for high α. When models are in Case II and α is high, the secondary market model performs better only in revenue for low β. As β increases, the secondary market model starts to perform better in both revenue and piracy. Regions where the secondary market model dominates for high c values also expand with δ. In result, the secondary market model is superior to the 2-price model when the cost of piracy is high. For instance, when δ is 0.1 and c is 0.01, the 2-price model dominates almost everywhere in the α-β parameter space. On the other hand, when δ is 0.9 and c is 0.1, the secondary market model completely dominates the 2-price model in revenue and piracy performance.

Table 4.3: Required δ Ranges for Possible Cases of Piracy in Period 1

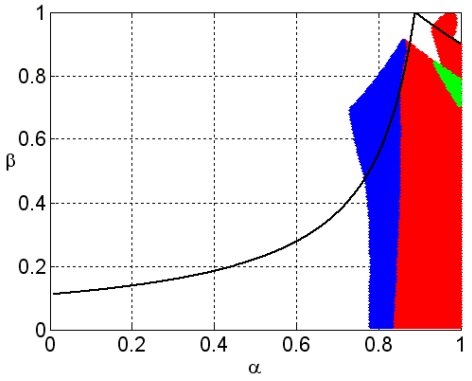
	Case I	Case II	Case III
Two-Price Model	$\delta < \frac{1-\beta\alpha}{1+\beta(1-\alpha)}$	$\delta < \frac{1-\beta\alpha}{1+\beta(1-\alpha)}$	$\delta > \frac{1-\beta\alpha}{1+\beta(1-\alpha)}$
Secondary Market Model	$\delta < \frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}$	$\frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}\delta < \frac{1-\beta\alpha}{1+\beta(1-\alpha)}$	$\delta > \frac{1-\beta\alpha}{1+\beta(1-\alpha)}$



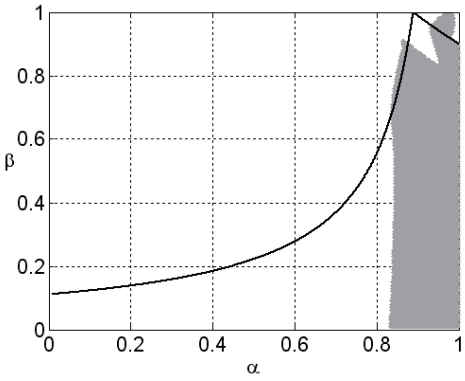
(a) Revenue and Piracy Comparison when c = 0.01



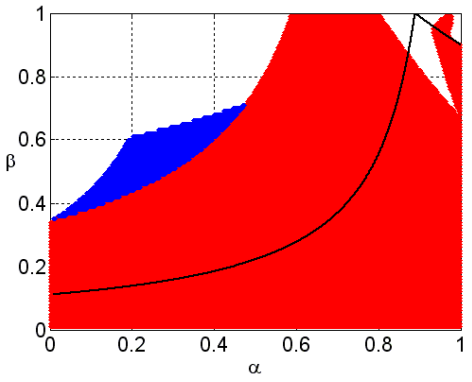
(b) Revenue Comparison for Equal Piracy when c = 0.01



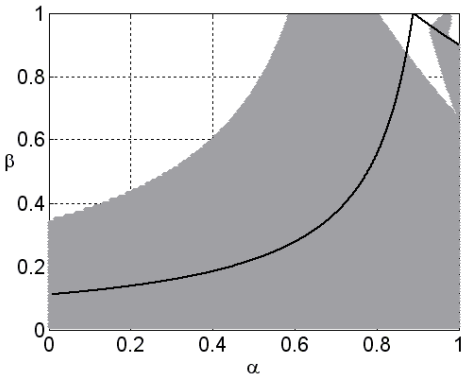
(c) Revenue and Piracy Comparison when c = 0.05



(d) Revenue Comparison for Equal Piracy when c = 0.05

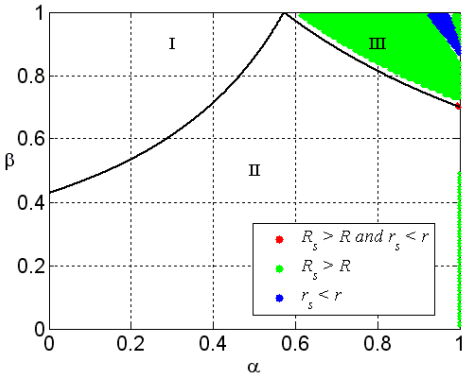


(e) Revenue and Piracy Comparison when c = 0.1

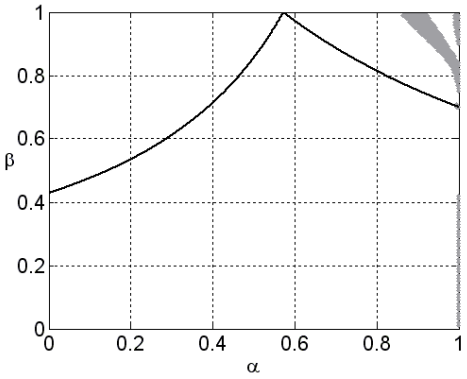


(f) Revenue Comparison for Equal Piracy when c = 0.1

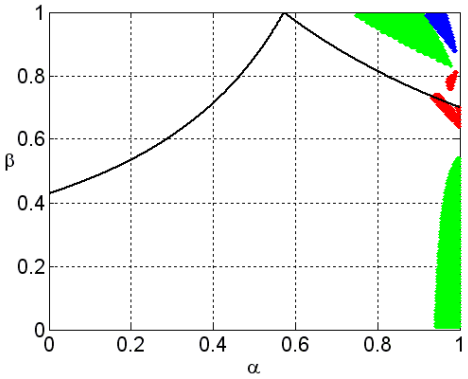
Figure 4.19: Model Results when $\delta = 0.1$



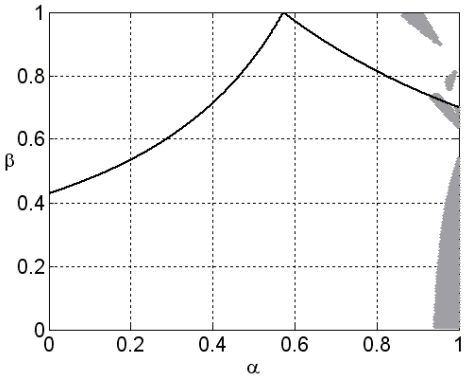
(a) Revenue and Piracy Comparison when c = 0.01



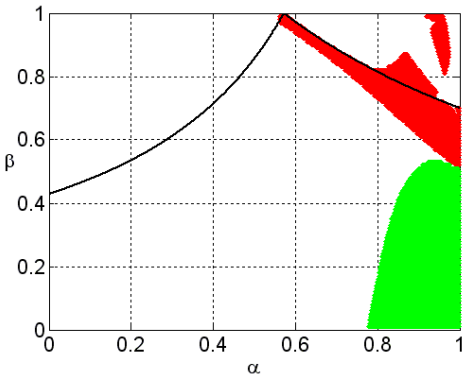
(b) Revenue Comparison for Equal Piracy when c = 0.01



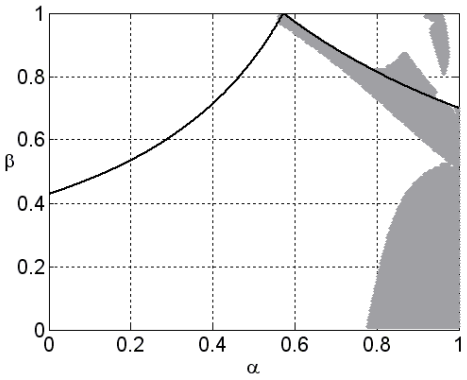
(c) Revenue and Piracy Comparison when c = 0.05



(d) Revenue Comparison for Equal Piracy when c = 0.05

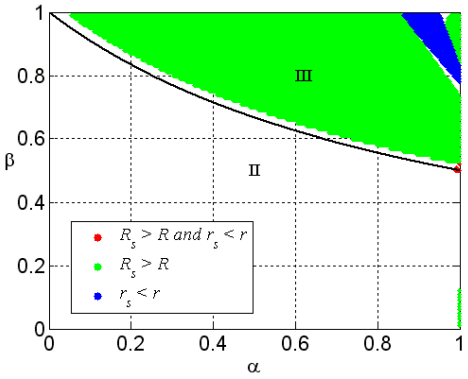


(e) Revenue and Piracy Comparison when c = 0.1

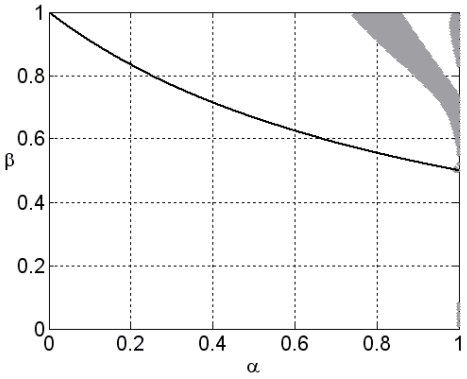


(f) Revenue Comparison for Equal Piracy when c = 0.1

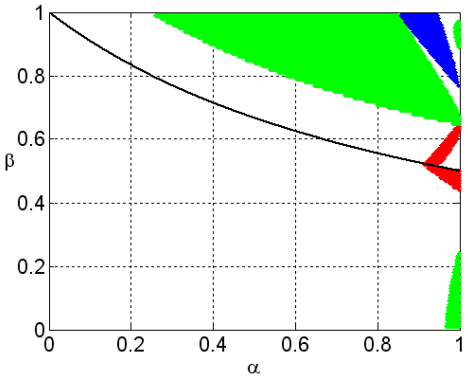
Figure 4.20: Model Results when $\delta = 0.3$



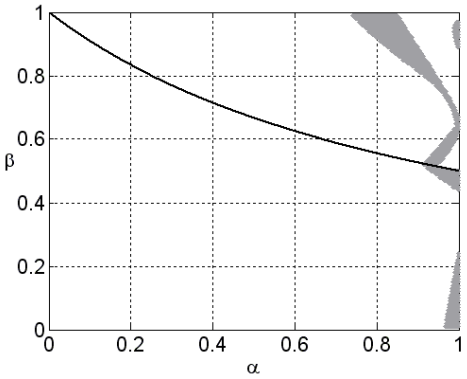
(a) Revenue and Piracy Comparison when c = 0.01



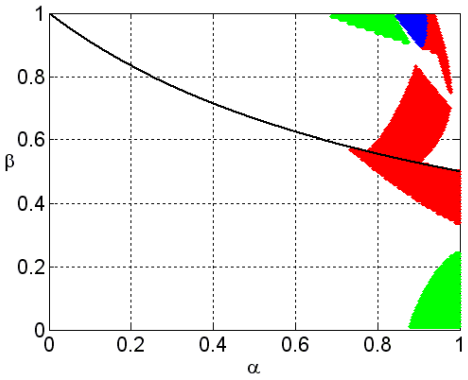
(b) Revenue Comparison for Equal Piracy when c = 0.01



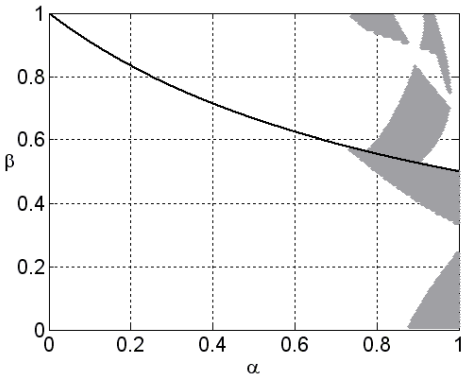
(c) Revenue and Piracy Comparison when c = 0.05



(d) Revenue Comparison for Equal Piracy when c = 0.05

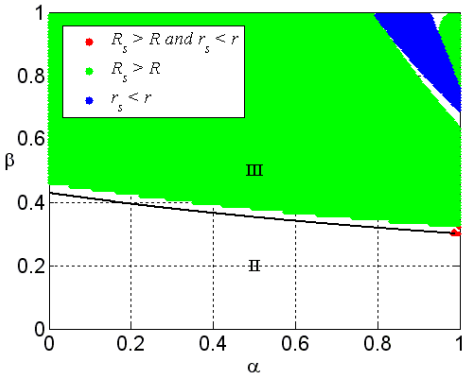


(e) Revenue and Piracy Comparison when c = 0.1

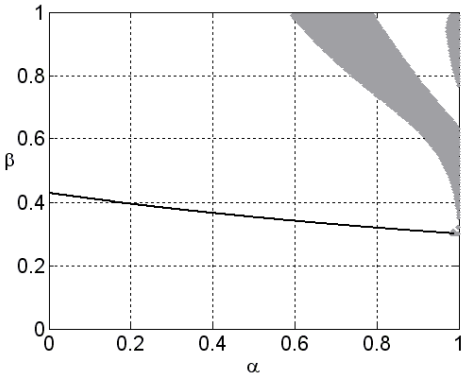


(f) Revenue Comparison for Equal Piracy when c = 0.1

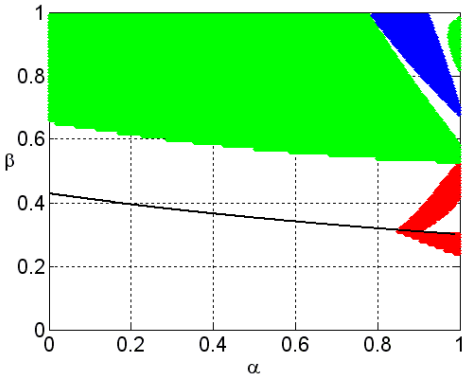
Figure 4.21: Model Results when $\delta = 0.5$



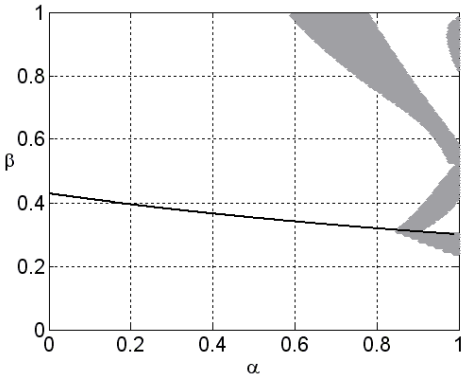
(a) Revenue and Piracy Comparison when c = 0.01



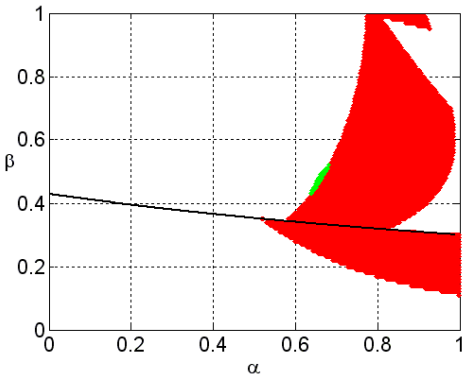
(b) Revenue Comparison for Equal Piracy when c = 0.01



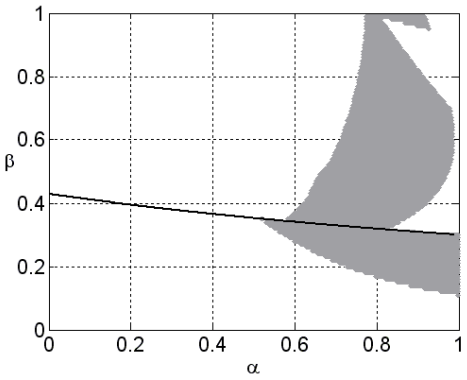
(c) Revenue and Piracy Comparison when c = 0.05



(d) Revenue Comparison for Equal Piracy when c = 0.05

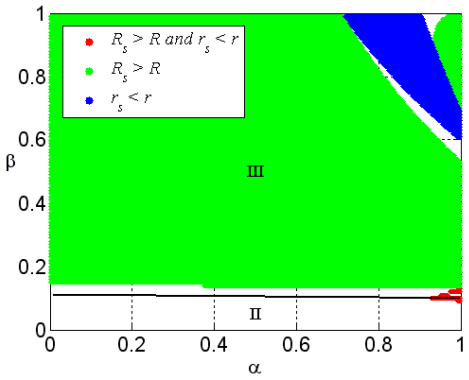


(e) Revenue and Piracy Comparison when c = 0.1

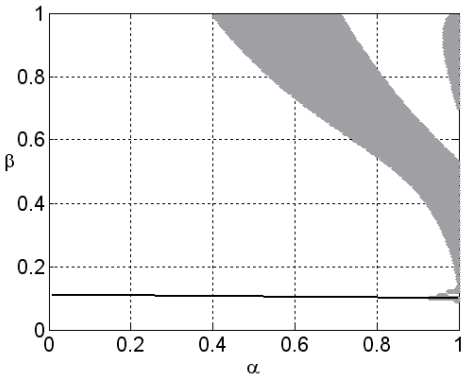


(f) Revenue Comparison for Equal Piracy when c = 0.1

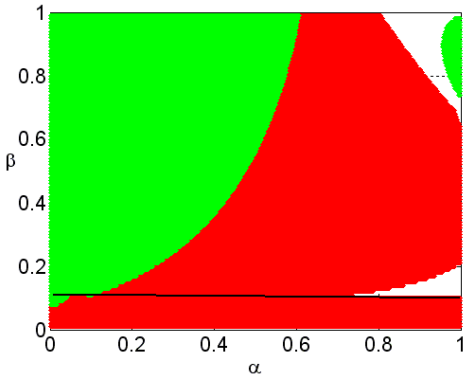
Figure 4.22: Model Results when $\delta = 0.7$



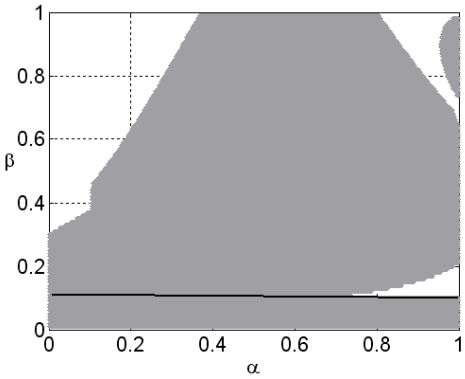
(a) Revenue and Piracy Comparison when c = 0.01



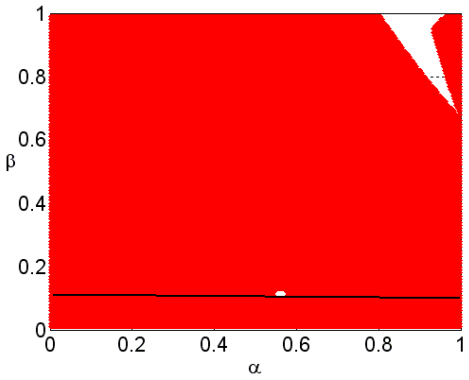
(b) Revenue Comparison for Equal Piracy when c = 0.01



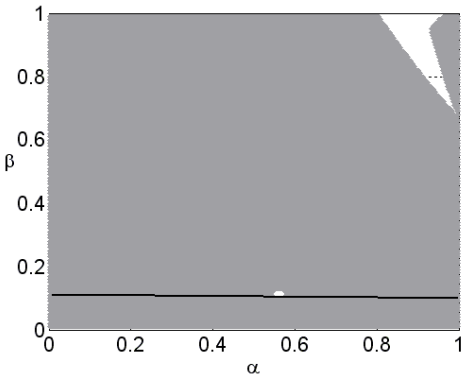
(c) Revenue and Piracy Comparison when c = 0.05



(d) Revenue Comparison for Equal Piracy when c = 0.05



(e) Revenue and Piracy Comparison when c = 0.1



(f) Revenue Comparison for Equal Piracy when c = 0.1

Figure 4.23: Model Results when $\delta = 0.9$

4.4 Concluding Remarks

In this chapter, we develop an analytical model for the proposed dual-channel distribution strategy (the secondary market model) which employs both a primary and a secondary market and compared it with a benchmark model (the 2-price model) which employs a traditional distribution strategy. The analytical model considers that there are two time periods for the consumption of a digital product and a monopolist who provides this product.

First, we provide an existence result for competitive secondary market pricing under general value functions. We show that when the price in the first period and the commission charged in the secondary market are within the desired ranges, there is a unique competitive secondary market price in the second period which clears the market.

Then, we compare total revenues generated and total number of quantities sold in the proposed model and in the benchmark model without considering piracy. Results show that the secondary market model makes more revenue than the 2-price model for most possible cases. The benchmark model performs better only when a product loses almost its entire value in the second period (very high α) and consumers are extremely patient to buy the product (very high β). On the other hand, except a small number of cases, the number of quantities sold in the 2-price model is greater than in the secondary market model. We also looked at revenues when both models sell the same number of quantities. For moderate α, the secondary market model makes more revenue when the market coverage is the same in both models.

Last, we consider two different cases of piracy: when piracy is allowed only in the second period and when piracy is allowed in the first period. When piracy is only observed in the second period, results are almost the same as the case without piracy. Revenues are higher, but more piracy is observed in the secondary market

model for most of the cases. We also check revenues in both models for equal levels of piracy. Again, the secondary market model performs better for moderate α values when same level of piracy is allowed in both models. In the last section, we compare the performances of two models in the presence of piracy in the first period and provide the parameter ranges where the secondary market model outperforms the 2-price model.

The analytical model has several limitations. First, the model does not distinguish between copyright owners and retailers of copyrighted products. The provider of the original copyrighted product which is often the retailer or the distributor does not pay any royalty fees to the copyright owner. Therefore, the model does not consider the price and profit optimization of copyright holders in selling the product to intermediaries. Second, cost of piracy is assumed to be proportional to the consumer's value for the product. While certain piracy costs such as value degradation of the product change with consumer valuations, some cost items related to piracy may be independent of how consumers value the product. Additionally, considering the current technology and advanced file compressing methods, some product types may not lose any value in their qualities when copied. Last, the model considers only two time periods. A more comprehensive model which considers an infinite or indefinite horizon for the lifetime of a product may provide a better insight for the profitability of secondary markets for digital goods.

CHAPTER V

Digital Piracy Experiment

In this chapter, a behavioral intention model is used to test the anti-piracy performance of the proposed distribution and pricing mechanism, and to compare it with a traditional business model using an experiment. The research model is based on expected utility theory (von Neumann and Morgenstern 1944; Bernoulli 1954), equity theory (Adams 1965) and the theory of planned behavior (Ajzen 1985). The theory of planned behavior (TPB) has been applied to the context of piracy of various information goods to explain the factors that affect users' decisions whether or not to pirate. Such examples include software piracy (Lin et al. 1999; Peace et al. 2003), digital music piracy (Kwong and Lee 2002; D'Astous et al. 2005; Coyle et al. 2009; Plowman and Goode 2009; Wang et al. 2009), digital movie piracy (Wang 2005), and digital piracy without specifying the product or industry (Al-Rafee and Cronan 2006; Cronan and Al-Rafee 2008). These studies have found that main constructs of the TPB (attitude toward piracy, subjective norms and perceived behavioral control) significantly influence individuals' intentions to illegally download digital goods. Besides the main constructs of the TPB, two important additional factors used to explain piracy in TPB-based models are computer individuation and perceived equitable relationship. Lin et al. (1999) stated that computer deindividuation, a feeling

of enstranged or separated from others while using a computer, could function as a catalyst for engaging in piracy, since the user works with a computer anonymously most of the time. While Lin et al. (1999) used computer deindividuation to measure perceived behavioral control with computer self-efficacy, Kwong and Lee (2002) included this construct into their models as an interaction variable which moderates the relation between subjective norms and intention to pirate. Perceived equitable relationship is defined as the perceived fairness of a transaction for both parties involved in a social exchange (Adams 1965). It was first used by Glass and Wood (1996) in the context of software piracy. Some other studies applied this idea to the online music context and found that a perceived equitable relationship between an individual and the music copyright holder affect the attitude of an individual and his/her intention to illegally download online music. If an individual perceives an inequity or an unfairness in the exchange with the copyright owner, this inequitable relationship will lead to more positive attitudes towards music piracy (Kwong and Lee 2002; Plowman and Goode 2009; Coyle et al. 2009).

A behavioral intention model is selected for this study because of two main reasons. First, secondary markets for digital goods do not currently exist, so there is no actual data that can be collected from any system using such a model. Second, it is very difficult, if not impossible, to capture the perceived fairness of a transaction (one of the main constructs in our study) with an analytical economic model.

5.1 Research Model and Hypotheses

In this study, a behavioral intention model designed to explain digital piracy behavior is used as a basis to examine the effect of the proposed dual-channel model on digital piracy. Our theoretical model (Figure 5.1) posits that the availability of a secondary market for digital product transactions among consumers affects con-

sumers' intention to pirate. Furthermore, the effect of secondary market availability on piracy intention is mediated by the perceived equitable relationship and attitude toward digital piracy. In addition, the value of the product for a consumer moderates the effect of the dual channel model use on the perceived equitable relationship, which has a direct effect on the intention to download digital products illegally. We develop the rationale for these relationships below.

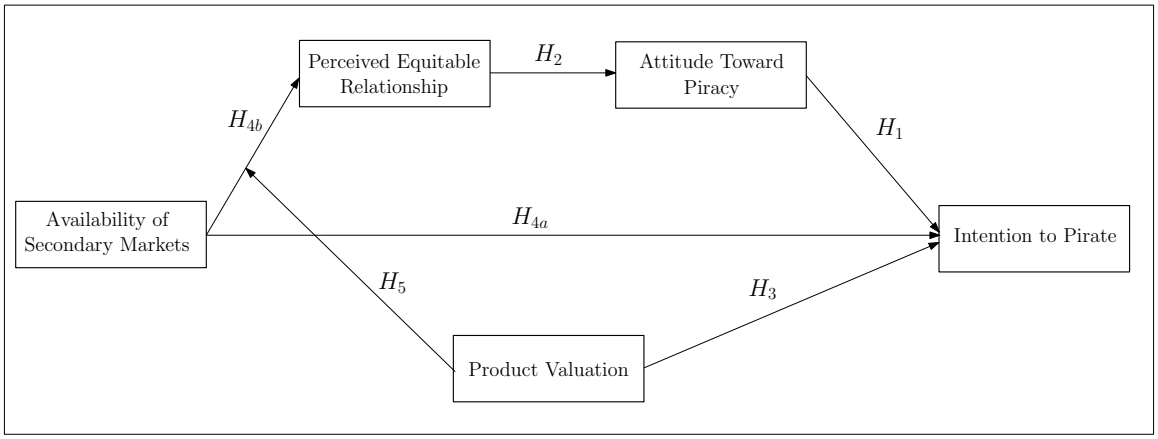


Figure 5.1: Research Model

5.1.1 Intention

Behavioral intention indicates an individual's readiness to perform a specific actual behavior. The TPB suggests that an individual's intention captures the motivational factors that influence actual behavior (Azjen 1991). In this study, we measure behavioral intention rather than actual behavior, which is consistent with much of the research in the IS literature.

5.1.2 Attitude

According to Ajzen (1985), human behavior is guided by behavioral beliefs, normative beliefs and control beliefs. Behavioral beliefs refer to beliefs about possible

consequences of behavior and evaluations of these consequences. These beliefs produce an attitude toward the given behavior (Azjen 1991). Attitude toward behavior refers to the degree to which the individual has a favorable or unfavorable evaluation of the particular behavior. It has been acknowledged as one of the most important constructs in social psychology and one of the most significant factors explaining behavioral intention (Cronan and Al-Rafee 2008). Peace et al. (2003) found that attitude had the strongest effect on intention to pirate software. Therefore, we propose that individuals with a more favorable attitude toward digital piracy will show a greater intention to download digital products illegally.

Hypothesis 1: *Attitude toward digital piracy positively affects intentions of individuals to pirate digital products.*

5.1.3 Perceived Equitable Relationship

Equity Theory (ET) was first introduced by John Stacey Adams to explain an individual's relational satisfaction in terms of perceptions of fair or unfair distributions of resources within interpersonal relationships (Adams 1965). ET describes an individual's desire to search for equity or fairness in social exchanges and states that individuals determine the equity of fairness of an exchange with others by evaluating their inputs and rewards in comparison to others' inputs and rewards (Glass and Wood 1996). A fair exchange or an equitable relationship exists when the individual perceives that both sides in an exchange receive relatively fair returns for the efforts or resources that they put into the exchange. Homans (1961) describes this relationship with the following formula:

$$\frac{Outcomes_A}{Inputs_A} = \frac{Outcomes_B}{Inputs_B} \tag{5.1}$$

where outcomes are perceived as positive or negative consequences that individuals will receive from a relationship and inputs are perceived as contributions that individuals make to the relationship. When individuals perceive that the equation above has an inequity not in their favor, they will become distressed and will be motivated to reduce the inequity. The individual A in Equation 5.1 decides to engage in an exchange with individual B by considering how he perceives the rewards and costs that both parties will receive from the exchange. If an individual finds the exchange unfair, s/he will attempt to equalize the outcome/input ratios of both parties of the exchange by taking certain actions which may increase his outcome/input ratio, or decrease the other party's outcome/input ratio or both.

Glass and Wood (1996) used this theory to explain the act of software piracy among individuals by examining the equity of the relationship between two individuals engaging in an illegal transaction of software. They proposed that if an individual perceives the ratios of outcomes to inputs of both parties to be equitable or fair, the individual will be more likely inclined to illegally provide the software to the other individual. If not, he will be more likely to refrain from being a part of the exchange. They also identified some internal and external factors that can affect perceptions of equity between two parties engaging in software piracy: cost of acquiring the software legitimately, perception of the favorable social outcomes produced by the exchange, debt perceived to be owed to the other party, promise of repayment by the other party, perceived financial difficulty of the other party, and perceived negative outcomes related to the exchange.

The same idea can be used to examine the equity of the relation between consumers and copyright owners in the context of digital piracy. Exchange theory states that an exchange between a buyer and a seller is successful only if both parties "perceive that what was received and rendered in the exchange is that which has been stipulated as

the terms of exchange" (Houston and Gassenheimer 1987). The prevalence of digital piracy can be a result of perceived unfair treatment and misinterpreted expectations among consumers and sellers (Coyle et al. 2009). High prices, low-quality services and limited product usage after purchasing are examples of factors that can lead to the perception of an unfair environment and discourage consumers from participating in legitimate digital good markets. Consumers who believe that an inequitable relationship exists in legal digital good transactions can walk away from the legitimate markets for digital products and consider piracy as an alternative way to acquire the product, where the outcome/income ratio is in their favor. Previous studies (Kwong and Lee 2002; Plowman and Goode 2009) applied this idea to the online music context and found that a perceived equitable relationship between the consumer and music copyright holder affects the attitude of the individual toward piracy and his/her intention to pirate digital music. If an individual perceives an inequity or an unfairness in the exchange with the copyright owner, this inequitable relationship will lead to more positive attitudes towards music piracy. Both studies found that the lack of a perceived equitable relationship between consumers and copyright owners positively affects consumers' attitudes toward music piracy, but did not find any empirical evidence for the direct relationship between perceived equitable relationship and piracy intentions. Moreover, Coyle et al. (2009) used the same factor in their study with a different term "consumer equity and feeling ripped-off". They argue that "consumers who perceive negative treatment at the hands of record companies will be more likely to engage in music piracy". Therefore, we propose that if an individual perceives the transaction of a digital good on a legitimate market to be fair, he will foster a more negative attitude toward piracy.

Hypothesis 2: *Perceived equitable relationship among individuals and copyright owners negatively affects attitudes of individuals toward digital piracy.*

5.1.4 Product Valuation

According to expected utility theory, a rational decision maker chooses an action which maximizes his or her expected utility, when faced with risky or uncertain choices (Bernoulli 1954). The individual making the decision compares the possible choices by weighing the potential outcome of each alternative, considering the expected costs and benefits, and their respective probabilities. Therefore, economic factors such as cost, benefits and income have a critical impact on someone's decision-making. For instance, annual income of individuals have been found to be inversely related to digital piracy (Cheng et al. 1997; Bagchi et al. 2006). Product pricing has also been found to affect consumers' intention to pirate digital materials (Cheng et al. 1997; Bhattacharjee et al. 2003; Peace et al. 2003). These costs and benefits used in utility functions representing consumer preferences do not have to be monetary. Non-monetary examples include product enjoyment, psychological costs, punishment costs or search costs.

Individuals have three possible courses of action to take when faced with the decision of acquiring digital material: purchase the digital good, pirate the good, or do without the good. Each of these actions can be represented by an expected utility which is a function of benefits and costs generated by the corresponding decision. Naturally, a rational individual will prefer to pirate the good if the expected utility of pirating the product is positive and greater than the expected utility of purchasing it. Conner and Rumelt (1991) characterized the decisions of consumers whether to

buy or pirate a product with the following equations:

$$\begin{aligned} \text{BUY} \quad & \text{if} \quad p \leq min(v, c) \\ \text{PIRATE} \quad & \text{if} \quad c < min(v, p) \\ \text{DO WITHOUT} \quad & \text{if} \quad v < min(c, p) \end{aligned}$$

where c is the cost of piracy for an individual, p is the price of the product and v is use-value of the original copy of the product to an individual or the reservation price which is defined as the maximum price a buyer is willing to pay for a good or service. It can be seen in the equations above that if we fix p and c for a given product, increasing v will yield to more "buy" decisions. Consumers will be more likely to buy a product instead of pirating if they place a high value on it. Expected utility theory has been widely used by analytical studies in the area of digital piracy (Sundararajan 2004a; Chellappa and Shivendu 2005; Bae and Choi 2006; Jain 2008; Khouja and Rajagopalan 2009). Considering piracy decisions of consumers, most of the previous analytical work formulates that a consumer will pirate the product if and only if:

$$V_o - P_o < V_p - C_p \tag{5.2}$$

where V_o and V_p denote the values placed by the consumer on the original copy and the pirated copy of the product, respectively, P_o is the price of the original copy of the product and C_p is the total cost of pirating the product, including moral, punishment and search costs. Bhattacharjee et al. (2003) found that consumers with a high value for a product typically tend to purchase rather than to pirate. Moreover, Holm (2003) showed that low-valuation consumers are more prone to pirate digital goods than consumers with higher valuations. Therefore, we hypothesize that consumers carrying higher valuations for the product will be less likely to pirate the product.

Hypothesis 3: *Value of a product for individuals negatively affects intentions of individuals to pirate that product.*

5.1.5 Secondary Markets for Digital Goods

Resale of products through secondary markets has an important effect on their distribution, production and pricing. Secondary markets have always been perceived as a threat by manufacturers, producers and copyright owners because of their substitution effects and potential detrimental effects on market power of monopolies (Bulow 1982). Reducing the durability of the good (Bulow 1982) or restricting the second-hand market (Liebowitz 1982) have been suggested to avoid competition from secondary markets. Miller (1974) argued that a monopolist should increase prices for new-goods in order to maximize its profits due to the availability of second-hand markets. However, a number of previous studies have demonstrated that producers may benefit from secondary markets. First, Liang (1999) showed that the presence of a secondary market makes firms commit to a production sequence because of the available substitutes in the secondary market. Second, there is a sorting benefit of the use of secondary markets (Anderson and Ginsburgh 1994). Secondary markets increase the efficiency of the allocation of new and used products among consumers with heterogeneous product values. The possibility of reselling past purchases raises the willingness of consumers to pay since they are able to make profits by selling the products to other consumers with lower willingness to pay. In this way, firms can charge higher prices and earn more profits by employing indirect price discrimination (Chen et al. 2008).

If we consider that a monopolist coordinates the secondary market with its primary market for digital goods as in the proposed model, he can also collect revenue from the secondary market by charging royalty fees for each transaction among consumers.

Therefore, the monopolist increases not only its profits, but also the percentage of consumers who use legitimate copies by either purchasing from the primary market or the secondary market. Implementing a secondary market makes original copies of products more attractive to purchase for more consumers, which leaves less room for piracy. For a simple demonstration, let us group consumers on the market for a product into three categories: Low-valuation, medium-valuation, and high-valuation consumers. If we modify Equation 5.2 in Section 5.1.4, in the presence of a secondary market, an individual will pirate the product if and only if:

$$V_o - P_o + P_e < V_p - C_p \qquad \wedge \qquad V_o - P_e < V_p - C_p \tag{5.3}$$

where P_e is the expected price of reselling the product on the secondary market. Now, consumers have two markets offering different prices, P_o and P_e, in which to purchase the product. We assume that high-valuation consumers never pirate since they place a high value on the product that always makes the right-hand side of the inequality larger than the left-hand side. For medium-valuation consumers, P_e increases the utility of purchasing the product from the primary market. Therefore, buying the product from the primary market will be more profitable than pirating it for some medium-valuation consumers. For low-valuation consumers, who are generally considered the biggest source of piracy, the expected price of reselling the product may not be enough to raise the utility of buying the product on the primary market above the utility of pirating it. However, they can move to the secondary market and find it more profitable to buy the product from price P_e rather than to pirate it. In either case, the availability of a secondary market will capture some of the former pirates and entice them to purchase the product from either primary or secondary market, which will decrease the level of piracy for that product. Hence, we hypothesize that:

Hypothesis 4a: *The availability of a secondary market for digital goods negatively affects intentions of individuals to pirate those goods.*

The first sale doctrine in the Copyright Act of 1976 (17 U.S.C. §109) allows consumers who have purchased a copyrighted physical product legitimately to resell these products without asking for permission or paying a royalty fee to the copyright owner. Therefore, consumers can resell their physically packaged copyrighted products on secondary markets without any legal issues and make small profits. The ability of selling a used product increases the possibility of making a purchase on the primary market since it creates more value for the product by adding an expected revenue to the consumer utility coming from the resale of the product on a secondary market. Furthermore, lower prices on secondary markets allow low-valuation consumers to buy used products, making secondary markets a win-win platform.

Reselling digital content is a new idea and there is currently a debate on whether the first sale doctrine extends to digital material. For information products, the exclusive right to distribute copies of a copyrighted product is given only to the copyright owner (17 U.S.C. §106). However, the right to distribute is limited by the first sale doctrine. The copyright holder's exclusive right to vend applies only to the initial sale and ends once that copy is sold, as long as no additional copies are made (17 U.S.C. §109). So, the first sale doctrine can only be applied to the first resale of the copyrighted product without keeping a copy of the original product. Furthermore, the subsection 109(a) of the Act states that one with a legitimate copy of a copyrighted work "is entitled to dispose of [the work] by sale, rental, or any other means". This is where the problem starts for the applicability of the first sale doctrine to digital materials. Transferring digital files via a network requires an additional copy of the file, which would interfere with the redistribution rights of copyright owners.

While it still remains as an untested legal question, there have been a number

of initiatives regarding the issue. For instance in 2001, the Copyright Office recommended to Congress that it prevent extending the first resale doctrine to digital products. However, it is still not clear if a consumer is allowed to legitimately sell a digital product that s/he owns, and if so, how s/he can do it. George Hotelling, a web developer, tried to resell a digital copy of a song on eBay that he purchased from iTunes in 2003 just to see if he could sell his purchased digital song (Hansen 2003). eBay canceled his auction due to the violation of its listing policies which prohibits all sales of digital media. Moreover, he was accused of violating Apple's iTunes Terms of Service Agreement, which states in Section 13(a) that "You agree not to modify, rent, lease, loan, sell, distribute, or create derivative works based on the External Services in any manner,...". There was no legal platform to execute this transaction and no way to prove that he did not keep a copy of the product after reselling it.

Another recent example is Vernor v. Autodesk, Inc. case (Liedtke 2009). In 2005, Timothy Vernor purchased a number of copies of AutoCAD software from a customer of Autodesk, which is the copyright owner of the software, and put those copies up for auction on eBay. Autodesk claimed that the sale of these copies violated its exclusive distribution rights under the Copyright Act. Therefore, Vernor filed suit to ask the court to declare that his sales on eBay could not be considered as an infringement to copyright. First, the trial court found in Vernor's favor. Then, after Autodesk's review demand, the court reversed and held that he could not rightly claim that his conduct was protected under first sale doctrine, since "a software user is a licensee rather than an owner of the copy." End-User Licensing Agreements (EULA) state that consumers are not the owners of the product, but only licensees whose entitlement to use the software is subject to certain restrictions specified by the copyright owner.

It can be seen in examples above that "buying" digital content is very confusing for

consumers. When purchasing a song from iTunes, a consumer has to click on a button labeled "Buy it", not "Rent it" or "Buy a License to use it." Furthermore, a consumer, who does not want to go through all the trouble of reading pages of user agreement terms, will never be aware of the fact that he is not the true owner of the product that he has just "purchased." On the other hand, a number of marketing slogans for digital music platforms or devices, such as Apple's "Touch your music", "Watch your music" taglines for its mobile music players, can easily misguide and confuse consumers, giving the impression that purchased digital music is their property, when in fact it is not. This confusion created on the part of the consumer may create a disparity between what consumers expect from digital transactions and what they actually get from these transactions. This affects consumer perceptions regarding the fairness of digital transactions. Some consider their music collections or movie collections to be investments that they can liquidate whenever they want. However, it is not possible if the collector prefers a digital format for his collection, making the investment irreversible.

Proponents for a digital first sale doctrine argue that not allowing the resale of digital goods is not fair for consumers. Fred von Lohhman, a senior staff attorney for the Electronic Frontier Foundation, stated that (quoted in (Davis 2009)):

> We shouldn't lose our first-sale rights just because the second-hand stores involved are online...Up to now, there hasn't been a huge opportunity for people to spend large amounts of money on digital music, but...some music fans will have thousands of dollars invested in their digital libraries...It would be a big change if you weren't allowed to sell them.

In the absence of a legal platform providing a secondary market for digital goods, consumers cannot resell their legitimately purchased digital products while having this ability if they buy the same product in a material form. This issue is more important

for quickly consumed or one-time usable products. For instance, if an individual purchases a video game in a physical package, he can resell it by using a number of available secondary markets. However, if he purchases the same video game digitally by downloading it from a digital store (such as Playstation Network Store), there is no option for the buyer other than deleting the video game after consuming it. Copyright owners do not want consumers to sell their purchased digital goods primarily because of the concern of keeping the copy after reselling it. Their claim is that there is no way to prevent them from using the product or to monitor the usage of the product after the resale. However, this claim also punishes the honest consumers who only want a fair trade. The lack of technology or an established business model which can make reselling digital goods possible over a legitimate platform is obviously not the fault of honest consumers. Therefore, the lack of a legitimate secondary market for digital goods negatively affects the perceived fairness of exchanges on primary markets for consumers. Carrell and Dittrich (1978) argued that measuring "fairness" of the relation is a better way to assess the perceived equity of the exchange. So, it can be said that if an exchange is perceived as unfair, it indicates that there is an inequity in the relationship between two parties.

Let us consider a consumer and a monopolist that offers digital products as two parties of a transaction and place them into Equation 5.1 in Section 5.1.3 to examine how a secondary market can affect a consumer's perception about the equity of a transaction. First, the presence of a secondary market increases the perceived equity of a relationship for a consumer by increasing his/her expected outcome from the transaction. Furthermore, consumers making purchases on the secondary market will be more likely to pay lower prices, which decreases their inputs to the transaction. Second, a consumer may believe that the monopolist makes unfairly high profits without providing quality service in the absence of any competition. However, the

availability of a secondary market will increase the competition and detriment the market power of the monopolist, decreasing the outcome of the monopolist from the digital good transactions. This can also change the consumer's perception about the equity and fairness of the transaction in a positive way.

Hypothesis 4b: *The availability of a secondary market for digital goods will positively affect the perceived equitable relationship between individuals and copyright owners.*

A secondary market for used-goods is especially useful for low-valuation consumers since lower prices on secondary markets allow them to buy products. A consumer with a high value for a product usually finds it more profitable to buy it on a primary market since his/her valuation is more likely higher than the purchase price (Conner and Rumelt 1991). However, consumers with low values for a product do not have a chance to buy and use it in the absence of a secondary market. Therefore, secondary markets are more attractive for low-valuation consumers and they may find the absence of a secondary market for digital products unfair. Furthermore, as a consumer's valuation for the product increases, he/she will choose to keep the product instead of selling it on a secondary market, assuming that he/she has bought the product, since the utility gained from using the product will be higher than the resale price. If a consumer attaches an extremely high value to a product, he may never want to sell it. The existence of a secondary market where the product can be sold does not interest him as much as a low-valuation consumer. Thus, the absence of a secondary market may not be considered unfair treatment of copyright holders for high-valuation consumers due to their already-high expected outcomes from the transaction. We expect that consumers' valuation negatively moderates the effect of the presence of a dual channel model on the perceived equitable relationship (fairness

of the exchange) between individuals and copyright holders, such that the higher the product value for a consumer, the weaker the relationship between the dual channel model use and perceived equitable relationship.

Hypothesis 5: *Value of a product to individuals will negatively moderate the effect of the availability of a secondary market for digital goods on the perceived equitable relationship between individuals and copyright holders.*

5.2 Research Methodology

5.2.1 Experiment Design

The research model (Figure 5.1) was tested using a between-subjects experiment to examine the effect of the availability of a secondary market for digital good transactions on digital piracy. A total of 475 undergraduate students from a diverse, urban university were recruited for the experiment. College students represent a significant market segment targeted by the content industry. Moreover, college students tend to be more inclined to digital piracy, making them a good group of subjects for our study (Sims et al. 1996; Gopal and Sanders 2000). Student samples have been previously used in ethics literature to explain software piracy and ethical behavior (Solomon and O'Brian 1990; Glass and Wood 1996).

The independent variable, availability of a secondary market for digital goods, in the research model was manipulated to test Hypotheses 4a, 4b and 5. Subjects were shown a product randomly selected from a pool of ten products and then asked to choose an action from a set of possible given options to acquire each product assigned. The characteristics of the product to be chosen for the study were important to make the collected data meaningful, given the selected sample. First, the product should

have a significant demand among the student population. Second, the price of the product should be high enough to make subjects consider pirating it, yet affordable to make them consider purchasing it. Most software applications have high prices for students to afford, so most of the student subjects would choose to pirate or do without them. Digital music was another candidate, but the common practice of pirating or purchasing music is downloading individual songs, which are generally priced at $0.99 or $1.29. So, their low prices might have biased the decision of subjects. On the other hand, music albums have higher prices which make them a better candidate than songs. However, a music album is not a single product but rather a bundle of products. Therefore, subject decisions might have been affected by certain songs in an album and made them change their decisions. To avoid the complexity caused by bundling, we selected movies that are not generally bundled and demonstrate the characteristics that are required for our study.

The actions that subjects chose were used to measure our dependent variable, intention to pirate. We randomly assigned the subjects to two groups (treatment and control) depending on the list which included the possible actions that they could choose to acquire the given product. Both groups were given 4 options to choose from: Illegally download a digital copy of the product, purchase a digital copy of the product from either one of the two online stores listed, and do without the product. The only difference was that the list for the treatment group included a store using a dual-channel model which coordinates a primary market and a secondary market for the transaction of digital goods. Action lists assigned to both groups are given in Table 5.1. Definitions of the hypothetical stores used in the study were given to the subjects at the beginning of the questionnaire as:

Store A is an online store (iTunes-like) that consumers can buy and download digital movies for $10. *Store B* is an online store (iTunes-like) that consumers can

buy and download digital movies for $11, a slightly higher price than what Store A offers. *Store C* is an online store that provides a primary market and a secondary market for the transaction of digital movies (an eBay- or Amazon-like store for digital products). Consumers can buy and download digital movies by using the primary market for a slightly higher price, $12. Additionally, by using its secondary market consumers can resell the movies that they have purchased before for $5 on average. When a consumer resells a movie on the secondary market, s/he cannot use the product anymore.

Table 5.1: Action Lists for the Control and the Treatment Group

Control Group	**Treatment Group**
Illegally download a copy of the product	Illegally download a copy of the product
Purchase a legitimate copy of the product from Store A for $10	Purchase a legitimate copy of the product from Store A for $10
Purchase a legitimate copy of the product from Store B $11	Purchase a legitimate copy of the product from Store C $12
Do without the product	Do without the product

For Store A, we selected a price that is commonly practiced by a sampling of popular digital retailers. We set the price at $10 for Store A. We chose a slightly higher price, $11, for Store B to represent an alternative online retailer to Store A. If action lists given to the two groups do not include the same number of available options, such as three actions for the control group and four for the treatment group, the difference in the dependent variable between two groups may be explained by the increase in the number of available options that a subject can choose to perform. To eliminate this possibility, we add a similar but ineffective store (Store B) which offers slightly a higher price to the control group's list to make the number of actions even

for both groups. Store C represents the dual-channel model proposed in this study. Chen et al. (2008) stated that a monopolist can charge higher prices for new goods in the presence of a secondary market. Therefore, we used a higher price for the primary market of Store C than the prices of other stores, which is $12 and a lower resale price for its secondary market, which is $5.

After choosing an action to perform for each product given, subjects were asked to fill out an online questionnaire regarding their online behaviors to measure the other constructs in the model (perceived equitable relationship, attitude toward piracy, value of the product). We also measured other factors that have been cited to affect intention to pirate in our survey. Previous studies demonstrated that males and young people engage in piracy more than females and older population (Gopal and Sanders 1998; Bhattacharjee et al. 2003; Gopal et al. 2004; D'Astous et al. 2005; Coyle et al. 2009). Additionally, it has been found that individuals' decisions to pirate are influenced by their intrinsic moral values about piracy and the severity and probability of the punishment of an illegal action (Hunt and Vitell 1986; Gopal and Sanders 1997; Al-Rafee and Cronan 2006; Cronan and Al-Rafee 2008; Shang et al. 2008). Prior research on digital piracy demonstrated that individuals with stronger ethical concerns regarding piracy show lower intentions to illegally download digital music (Bhattacharjee et al. 2003), digital movies (Wang 2005) and software (Gupta et al. 2004). Therefore, we included subjective norms, perceived behavioral control, deterrent effect of legislations (probability of the punishment of piracy), moral judgement (moral values about piracy), gender and age as control variables in our model.

5.2.2 Instrument

The constructs, "availability of a secondary market" and "intention to pirate" were operationalized as binary variables. Secondary market transactions were not available for the control group and were available for the treatment group. If the subject chose to pirate the product, we coded it as a piracy action. If the subject chose another option other than doing nothing, it was coded as a non-piracy action. If the subject chose to do without the product, we removed his/her answers from our sample since the subject had no interest in the product and did not choose to either pirate or purchase it. These subjects' answers were irrelevant to our study and the results would have biased in the favor of non-pirates if they had not been removed.

The value of the product is a continuous manifest variable and was measured by asking subjects to assign a maximum price to each product that they are willing to pay to purchase it. 10 well-known movies were identified with a pilot study. The average price that consumers are willing to pay for the movies was \$9.83 with a standard deviation of \$6.5 in the pilot study, which shows a good variability in consumer valuations for the selected movies. Considering the probability that a subject had no idea about the product that s/he was assigned to, we provided a cover of the DVD format or a poster of each movie including brief information about the product with which the subject could build an expected value for the product. All information regarding movies used for the study can be seen in Appendix B.

We adapted established scales from prior literature to measure the latent variables in our model. Attitude toward piracy, subjective norms, perceived behavioral control (Taylor and Todd 1995; Kwong and Lee 2002; Al-Rafee and Cronan 2006; Cronan and Al-Rafee 2008; Plowman and Goode 2009), deterrent effect of legislations and moral judgement (Al-Rafee and Cronan 2006; Cronan and Al-Rafee 2008) were measured by the scales developed in previous studies. Since there is no available scale for our

perceived equitable relationship construct, we had to develop a new one to measure it. There are three studies which previously used the perceived equitable relationship construct. However, the scale used by Kwong and Lee (2002) and Plowman and Goode (2009) measures perceived fairness of piracy to a consumer instead of perceived equity of the relationship between the consumer and the copyright owner from the consumer point of view. While they may be related to each other, measuring perceived fairness of piracy can lead to a high margin of error in results, as a consumer's perception of the fairness of piracy may be affected by some other factors such as ethical values and the deterrent effect of existing legislations regarding piracy. Coyle et al. (2009) measured this by asking subjects if the products are overpriced which is only one aspect of the perceived equity of the relationship.

Therefore, we developed a new scale for perceived equitable relationship by modifying the previous scales to reflect how consumers perceive the equity of the *legal* transactions of digital goods rather than how they perceive the fairness of piracy. Face validity of the new scale was obtained by consulting two senior IS faculty members and further validated during a pilot study. All items used to measure each latent variable use a 7-point Likert scale from "strongly disagree" (1) to "strongly agree" (7). Before asking the questions to measure perceived equitable relationship, we made it clear in the survey that sellers do not allow consumers to resell their purchased digital goods, so there is no available legitimate secondary market for digital goods for the subjects in the control group, and there is an available legitimate secondary market for the subjects in the treatment group. We also avoided using the terms "piracy" or "pirating digital goods" and instead used "illegally downloading digital products on the Internet for free by using file-sharing services" to make subjects feel comfortable answering the survey questions. Questionnaires also included questions about demographic information such as gender and age. All of the items of the questionnaire can

be seen in Table 5.3. Furthermore, all questions and movies used in the survey are given in Appendix B.

Prior to a full-scale study, we conducted a pilot study with 28 subjects to test the validity of the scales used and the variance of values of the selected movies for the study. The Cronbach's alpha values for all constructs are above the recommended 0.7 value, which indicates good reliability (Nunnally 1967). All measurement instruments with the pilot test results can be seen in Table 5.2. In addition, the assigned values to each movie selected showed a good variance, so we retained all movies for our full-scale study.

5.3 Data Analysis

5.3.1 Sample and Test of Assumptions

Our sample consists of 475 subjects. The sample has 239 females and 236 males, with an average age of 22.7. We did not ask their incomes or education since all subjects are undergraduate students at a local university. The sample size is 220 for the control group and 255 for the treatment group.

We conducted a number of statistical tests to assess the random assignment of subjects to different experimental conditions. Results of tests show that there were no significant differences in gender ($\chi^2 = 0.448, p = 0.497$), or age ($t - stat = 1.030, p = 0.303$) between the control and the treatment group. We also looked at the product assignments to make sure that products were randomly assigned and equally used in each group. We found no significant difference in products used between the control and the treatment group ($\chi^2 = 5.231, p = 0.186$). The value that subjects assigned to each product is another important variable in the model since it has a hypothesized direct effect on the dependent variable. We also found no significant difference in

Table 5.2: Pilot Test Results

Construct	**Cronbach's Alpha**	**Item Loadings**
Attitude Toward Piracy	0.901	ATT1 0.847 ATT2 0.800 ATT3 0.950 ATT4 0.911
Perceived Equitable Relationship	0.897	PER1 0.897 PER2 0.902 PER3 0.882 PER4 0.811
Subjective Norms	0.882	SN1 0.880 SN2 0.942 SN3 0.874
Perceived Behavioral Control	0.910	PBC1 0.928 PBC2 0.879 PBC3 0.950
Deterrent Effect of Legislation	0.848	DEL1 0.912 DEL2 0.891 DEL3 0.787
Moral Judgement	0.894	MJ1 0.957 MJ2 0.950 MJ3 0.816

values assigned to products by subjects between the control and the treatment group ($t - stat = 0.935, p = 0.350$).

We conducted data analysis using the partial least squares (PLS) path-modeling algorithm (Chin 1998). Before running the model, we removed the subjects who chose to "do without the product" as data collected from these subjects are irrelevant to our study and might have biased the results. Our final sample size is 316, with 144 subjects in the control and 172 subjects in the treatment group. All random

Table 5.3: Survey Instrument

	Construct Scale Items
	Attitude Toward Piracy (ATT):
ATT1	Illegally downloading the given digital product on the Internet for free by using file-sharing services is a good idea.
ATT2	Illegally downloading the given digital product on the Internet for free by using file-sharing services is a wise idea.
ATT3	I like the idea of illegally downloading the given digital product on the Internet for free by using file-sharing services.
ATT4	Illegally downloading the given digital product on the Internet for free by using file-sharing services would be pleasant.
	Perceived Equitable Relationship (PER):
PER1	Purchasing a legitimate digital copy of the given product from an online store is not fair for me.
PER2	Purchasing a legitimate digital copy of the given product from an online store results in injustice for me.
PER3	Copyright owner of the given digital product does not treat me fairly given the price and service it offers.
PER4	Copyright owner of the given digital product overcharges me and makes unfairly high profits given the price and service it offers.
	Subjective Norms (SN):
SN1	People who influence my behavior would expect me to engage in illegally downloading digital products on the Internet for free by using file-sharing services.
SN2	People who are important to me would expect me to engage in illegally downloading digital products on the Internet for free by using file-sharing services.
SN3	People whom I respect would expect me to engage in illegally downloading digital products on the Internet for free by using file-sharing services.
	Perceived Behavioral Control (PBC):
PBC1	I would be able to illegally download digital products on the Internet for free by using file-sharing services.
PBC2	Illegally downloading digital products on the Internet for free by using file-sharing services is entirely within my control.
PBC3	I have the resources and the knowledge and the ability to illegally download digital products on the Internet for free by using file-sharing services.
	Deterrent Effect of Legislation (DEL):
DEL1	Existing laws effectively prohibit illegally downloading digital products on the Internet for free by using file-sharing services.
DEL2	Existing laws provide effective deterrence against illegally downloading digital products on the Internet for free by using file-sharing services.
DEL3	Existing punishment provided by legislation against illegally downloading digital products on the Internet by using file-sharing services is effective.
	Moral Judgement (MJ):
MJ1	I would feel guilty if I illegally downloaded digital products on the Internet for free by using file-sharing services.
MJ2	Illegally Downloading digital products on the Internet for free goes against my principles by using file-sharing services.
MJ3	It would be morally wrong to illegally download digital products on the Internet for free by using file-sharing services.

assignment tests are also valid for the final sample used for the PLS analysis.

Psychometric properties of the instrument were analyzed to confirm the validity of our constructs. Table 5.4 shows composite reliabilities, Cronbach's alpha values and descriptive statistics of all constructs, and factor loadings of all construct items. Item cross-loadings are given in Table 5.5. Factor loadings for all constructs are above the recommended value of 0.7 (Chin 1998) and cross loadings of the items are not above 0.55, showing good convergent validity. Furthermore, it can be seen in Table 5.6 that average variance extracted value (AVE) for each construct is greater than the suggested minimum of 0.5 (Fornell and Larcker 1981). We also looked at the estimates for composite reliability for each construct to evaluate the internal consistency. Composite reliabilities for each construct exceed 0.7 which is the suggested minimum value for good internal consistency (Hair et al. 1998).

Discriminant validity was confirmed by comparing the square root of the AVE values of constructs, which are given on the diagonal in Table 5.6, and the correlation between that construct and other latent constructs. The square root of the AVE of the constructs ranges from 0.861 to 1, while correlations among constructs do not exceed 0.53. Furthermore, the square root of AVE for each construct is substantially higher than the correlation between that construct and all other constructs, indicating good discriminant validity.

5.3.2 Model Results

We first looked at the descriptive statistics of our dependent variable and examined the subject decisions under different experimental conditions. Figure 5.2 shows the decisions of subjects in control and treatment groups. Piracy intention rate decreased from 39.1% in the control group to 20.4% in the treatment group. Also, subjects who chose to purchase a legitimate copy of the product constitute 46.7% of the total

Table 5.4: Scale Reliabilities and Item Loadings

Construct	**Scale Reliability and Descriptives**	**Item**	**Factor Loadings**
Attitude Toward Piracy	Composite Reliability = 0.943, Cronbach's $\alpha = 0.919$, Mean = 3.69, St. Dev. = 2.04	ATT1	0.911
		ATT2	0.858
		ATT3	0.927
		ATT4	0.893
Perceived Equitable Relationship	Composite Reliability = 0.941, Cronbach's $\alpha = 0.917$, Mean = 4.29, St. Dev. = 1.89	PER1	0.882
		PER2	0.913
		PER3	0.908
		PER4	0.876
Subjective Norms	Composite Reliability = 0.945, Cronbach's $\alpha = 0.912$, Mean = 3.01, St. Dev. = 1.82	SN1	0.911
		SN2	0.934
		SN3	0.921
Perceived Behavioral Control	Composite Reliability = 0.917, Cronbach's $\alpha = 0.867$, Mean = 4.80, St. Dev. = 1.95	PBC1	0.923
		PBC2	0.863
		PBC3	0.874
Deterrent Effect of Legislation	Composite Reliability = 0.896, Cronbach's $\alpha = 0.843$, Mean = 3.70, St. Dev. = 1.85	DEL1	0.861
		DEL2	0.917
		DEL3	0.803
Moral Judgement	Composite Reliability = 0.916, Cronbach's $\alpha = 0.863$, Mean = 3.99, St. Dev. = 1.97	MJ1	0.876
		MJ2	0.910
		MJ3	0.870

Table 5.5: Cross Loadings

	ATT	PER	SN	PBC	DEL	MJ
ATT1	**0.911**	-0.243	0.423	0.358	-0.184	-0.490
ATT2	**0.858**	-0.265	0.422	0.284	-0.156	-0.428
ATT3	**0.927**	-0.202	0.472	0.341	-0.150	-0.515
ATT4	**0.893**	-0.205	0.475	0.372	-0.119	-0.472
PER1	-0.241	**0.882**	-0.131	-0.003	-0.069	0.034
PER2	-0.222	**0.913**	-0.086	0.005	-0.116	0.038
PER3	-0.195	**0.908**	-0.070	0.013	-0.065	0.021
PER4	-0.241	**0.876**	-0.082	-0.020	-0.054	0.092
SN1	0.436	-0.088	**0.911**	0.342	-0.106	-0.278
SN2	0.487	-0.096	**0.934**	0.357	-0.080	-0.287
SN3	0.458	-0.102	**0.921**	0.356	-0.086	-0.256
PBC1	0.437	-0.005	0.421	**0.923**	-0.178	-0.320
PBC2	0.260	-0.005	0.264	**0.863**	-0.114	-0.155
PBC3	0.267	0.005	0.296	**0.874**	-0.143	-0.206
DEL1	-0.111	-0.024	-0.058	-0.092	**0.861**	0.211
DEL2	-0.185	-0.110	-0.117	-0.198	**0.917**	0.280
DEL3	-0.148	-0.115	-0.065	-0.145	**0.803**	0.233
MJ1	-0.477	0.000	-0.230	-0.252	0.271	**0.876**
MJ2	-0.548	0.071	-0.314	-0.289	0.235	**0.910**
MJ3	-0.380	0.069	-0.237	-0.168	0.238	**0.870**

Table 5.6: AVE Values and Correlations among Constructs

Constructs	**AVE**	ATT	PER	SN	PBC	DEL	MJ
ATT	0.806	**0.898**					
PER	0.801	-0.253	**0.895**				
SN	0.850	0.499	-0.103	**0.922**			
PBC	0.787	0.378	-0.003	0.381	**0.887**		
DEL	0.742	-0.169	-0.085	-0.098	-0.167	**0.861**	
MJ	0.784	-0.532	0.055	-0.297	-0.269	0.279	**0.885**

number of subjects in the treatment group, while only 27.3% of the subjects in the control group chose to buy the product. 25.5% of subjects preferred to buy the product from Store C (with secondary market support)in the treatment group which is shown in the striped area of Figure 5.2, and 21.2% of subjects chose Store A (without secondary market support) for their legal purchases.

Figure 5.3 shows the breakdown of consumer decisions in the treatment group. It can be seen in the figure that the average of product valuations by subjects who chose to do business with Store C are lower than those of subjects who decided to purchase from Store A. Subjects who chose to pirate the product have lower valuations than those who chose to purchase the product from either store. Finally, subjects who chose to do nothing have the lowest valuations. This figure demonstrates that secondary markets are more attractive for medium-valuation consumers than high- and low-valuation consumers.

We tested our hypotheses in the research model by the PLS structural model. The significance of relationships hypothesized was assessed using the bootstrapping re-sampling method (Tenenhaus et al. 2005). We tested the moderating effect of consumer's product valuation by creating an interaction term between availability

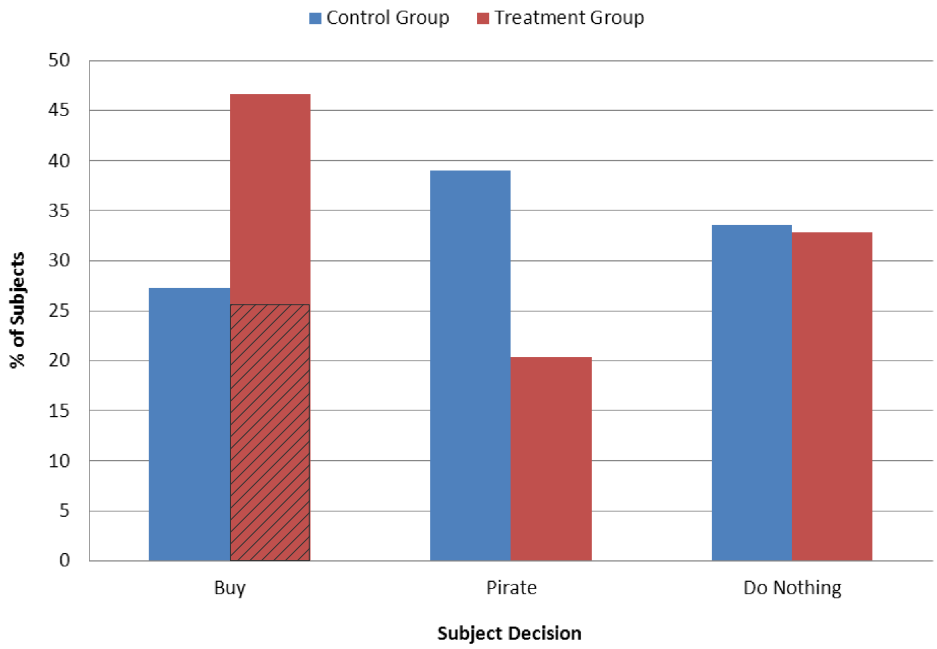
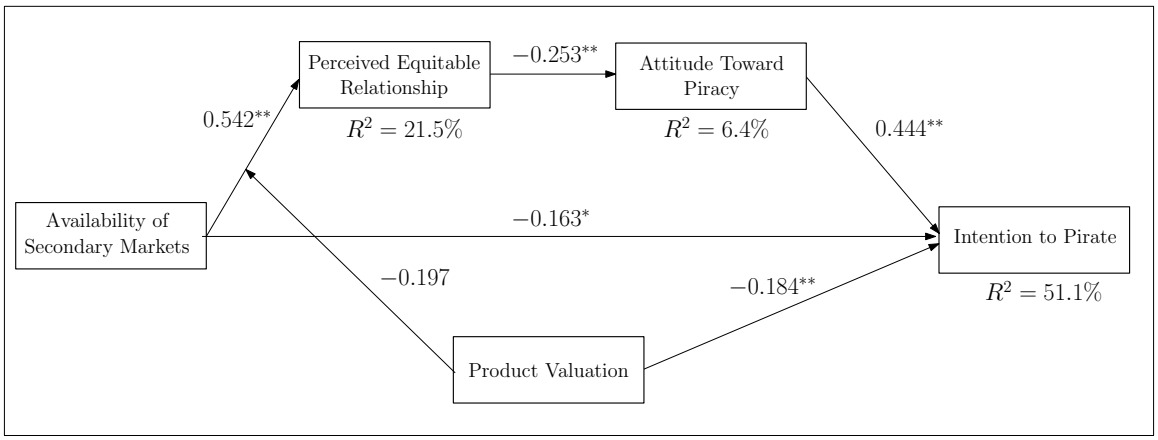


Figure 5.2: Decision of Subjects for Each Group (The striped area denotes the percentage of subjects who chose to buy the product from Store C)

of a secondary market and consumer's product valuation constructs and testing its relationship with perceived equitable relationship. Figure 5.4 shows that all hypotheses with the exception of H5 are supported by the results of the PLS analysis. The coefficient between attitude toward piracy and intention to pirate is positive and significant ($\beta = 0.444, t - stat = 4.01, p < 0.01$), indicating support for H1. The coefficient between perceived equitable relationship and attitude toward piracy is negative and significant ($\beta = -0.253, t - stat = 2.65, p < 0.01$), as is the coefficient between product valuation and intention to pirate ($\beta = -0.184, t - stat = 2.46, p < 0.01$), indicating support for H2 and H3. Results also show empirical support for H4a as the coefficient between secondary market availability and intention to pirate ($\beta = -0.163, t - stat = 2.06, p < 0.05$) and H4b as the coefficient between secondary market availability and perceived equitable relationship is positive and significant

Figure 5.3: Product Valuations in the Treatment Group

($\beta = 0.542, t - stat = 3.49, p < 0.01$). However, the moderating effect of product valuation on the relationship between secondary market availability and perceived equitable relationship is not found to be significant ($\beta = -0.197, t - stat = 0.69, p > 0.05$), indicating no support for H5. In addition, results show that none of the control variables have a significant direct effect on the dependent variable, intention to pirate. Although it is not formally hypothesized in our study, we also looked at the relationship between attitude toward piracy and several control variables. We found that subjective norms and moral judgement significantly affect attitude toward piracy. When we included these two relationships into the model, R^2 of attitude toward piracy increased to 45.2% from 6.4%.



$^{**}p < 0.01; ^{*}p < 0.05$

Figure 5.4: Results of the PLS Analysis

5.4 Discussion

In this study, we investigated the effect of secondary market presence for digital good transactions on consumer online behavior. We built a research model based on previous research on digital piracy to test our hypotheses. Our research model explains 51.1% of the variance in the intention of individuals to pirate digital content. We found that secondary market availability influences the perceived fairness of the legal transactions for digital goods in a positive way, leading consumers to develop more negative attitudes toward piracy. Most importantly, results showed that the availability of a secondary market for digital goods significantly decreases the demand for piracy. While the piracy rate in our control group is 39.1%, we observed a much smaller piracy rate, 20.4%, in our treatment group. Additionally, our study verified that how consumers value products has a significant direct effect on their intentions to pirate digital content. We did not find any empirical support for the moderating effect of product valuation on consumer perceptions regarding the fairness of the legitimate exchanges of digital products. While the relation is in the correct direction as we hypothesized, it is not strong enough to be statistically significant. One of the reasons of this result might be that subjects did not consider purchasing a digital good as a

long-term investment and they made their decisions based on their expected short-term benefits without considering the future benefits of the provided transactions.

This study makes important theoretical contributions to research on digital piracy by extending the understanding of why people engage in piracy. First, we show that how consumers perceive the fairness of legal transactions of digital content significantly affects their attitudes toward piracy. While the construct *perceived equitable relationship* has been used in the piracy literature before (Kwong and Lee 2002; Plowman and Goode 2009), previous studies operationalized this construct as the perceived fairness of pirating digital content for consumers and copyright owners. However, in this study, we define this construct as the equity of the legal transactions under the existing platforms and business models from the consumers' point of view. We developed a new scale to measure this perceived equity using previous research on equity theory and social exchange theory. Consumers' perceptions of the fairness of piracy and legal transactions in the available digital-good markets may be correlated. They, however, do not indicate the same perception. While ethical values about piracy may influence how a consumer perceives the fairness of pirating a product, it is not related to how he perceives the fairness of available legal transactions of digital goods. This new construct allows us and other researchers to measure the relationship between the value proposition offered to consumers in a market and the perceived equity of transactions among consumers and content sellers in this market.

Second, we introduced an antecedent of perceived equitable relationship, which involves a certain type of business model and market design coordinating a primary market and a secondary market for digital goods. Our results show that consumers perceive the legitimate digital good transactions as more fair when there is an available second-hand market for digital goods. This increase in positive consumer perceptions of legal transactions offered by content sellers has an important implication for digital

piracy. As shown in this study, when consumers perceive that the terms of available legitimate transactions are not fair or not in their favor, they build a more positive attitude toward illegal file sharing. A market structure that is perceived as unfair by consumers may lead to an increase in the demand for piracy by causing consumers to build more positive attitudes toward piracy. Increasing the value proposition by enhancing the product experience, extending the product line or employing innovative pricing has been suggested as a way of mitigating piracy (Bhattacharjee et al. 2009). This study extends this argument by showing that providing a fair market design and structure for the transaction of digital goods to consumers is also important. If consumers think that the transactions offered in a digital goods market is fair to them and sellers do not make unfairly high profits due to the terms of transactions and market structure, they may be more willing to purchase the product rather than pirate it.

Third, based on the expected utility theory, we hypothesized that availability of a secondary market would significantly decrease the number of illegal downloaders due to the increasing consumer utilities in the presence of a secondary market. We found a statistically significant relationship between the intention to pirate and secondary market availability. Therefore, it can concluded that the availability of a secondary market increases the expected utilities of legitimate digital good transactions for consumers and this increase in the expected utilities results in more legal purchases and less piracy. We also observed that some subjects with product valuations lower than the net[1] cost of the product chose to purchase the product in contrast to what we had expected due to the expected utility theory. This observation implies that consumer decisions on whether to buy, not buy or pirate a product do not depend

[1] Net cost for the control group is the purchase price. Net cost for the treatment group is the difference between the purchase price and the expected resale price given that purchase price is always higher than the resale price.

on only monetary factors (i.e. purchase price and resale price). This study shows that the perceived fairness of legitimate transactions that consumers are offered may change how they value products. In the presence of an unfair market environment, this perceived inequitable relationship between buyers and sellers can either decrease the product valuations of consumers or create an additional cost for the product or both, which may convert the potential buyers into pirates. Therefore, product prices, expected costs and pure product valuations that are independent of the trading environment are very important considerations for sellers but may not be enough to explain consumer behaviors.

Our study indicates the importance of secondary markets for an efficient market and successful exchanges. Consumers may think that the lack of competition from secondary markets creates an unfair environment in which the monopolist has greater market power and dominance. Hence, secondary markets can be used as a tool to remove this injustice perceived by consumers which may lead to more buyers and less pirates. Furthermore, our results show that medium-valuation consumers value secondary markets more than low- and high-valuation consumers. On the other hand, high-valuation consumers mostly chose to purchase the product in a primary market and low-valuation consumers chose to do without the product or pirate it. This finding gives a unique insight into the market segmentation for digital goods. However, we could not find any empirical support for the moderating effect of product valuations on the relationship between secondary market availability and perceived equitable relationship. This implies that providing a secondary market does not change how consumers perceive the fairness of transactions depending on their valuations.

This study confirms again that an individual's attitude toward piracy significantly affects his intention to pirate. We also verify that the product valuation of an individual is an important factor that determines his intention to illegally download

digital content. On the other hand, we could not find any statistically significant relationships between our control variables and intention to pirate. The other two TPB constructs, subjective norms and perceived behavioral control, do not have a significant direct effect on someone's intention to pirate. Furthermore, age, gender, moral judgement and deterrent effect of legislations were not found to significantly affect consumers' behaviors, whether to pirate or not. The reasons for this finding might be that more consumer segments from almost all age groups have started to use the Internet and Internet tools to acquire and consume digital content. Additionally, there are more tools available to consumers to find and download unauthorized digital goods on the Internet, which might make piracy a common practice among all different types of consumers. It is now very easy to find and download an unauthorized digital good on the Internet since consumers do not need to have special tools and information to pirate goods anymore. Hence, factors that have been previously found to affect a consumer's intention to pirate do not influence online behaviors of consumers today.

Our results have important implications for the content industry. To increase the willingness of consumers to purchase the product, we propose introducing a value-added service in the form of a secondary market that can increase consumers' expected benefits from buying a legitimate copy of the product. Society will always have a certain level of piracy as it will always have stealing or other crimes despite all security efforts and punishment measures. Therefore, in order to decrease piracy levels, content sellers should focus on increasing the product valuations of consumers instead of imposing preventive and deterrent controls that can decrease the value of their products (such as punishing their consumers for pirating digital content or limiting the usage of their products with DRM-like technologies). Furthermore, it has been argued that a certain amount of piracy for digital goods actually helps copyright

owners increase their profits since it provides a free circulation of their products within a network of consumers (Takeyama 1994). Therefore, the main objective of copyright holders should be to push piracy down to an optimal level and maintain it there. Our study contributes to the digital piracy literature by proposing a new business model that utilizes secondary markets for the distribution of digital goods to achieve this goal.

CHAPTER VI

Summary and Conclusions

The proliferation of e-commerce and the ability to digitize information goods have led content creators and retailers to explore innovative pricing policies and distribution channels for digital goods to increase their profits and compete with traditional retailers. While uniform pricing and single channel distribution methods still dominate the retail industry for digital content, the Internet and unique characteristics of digital goods offer more than these traditional policies. This research proposes that a secondary market model for the distribution and pricing of digital goods by adding a second distribution channel which functions as a second-hand good market to the basic distribution model is more profitable than traditional business models for content creators and providers. Because of the unique characteristics of digital products, electronic business models that have been proved to be successful for physical products cannot respond to the consumer demand for digital products. Therefore, buyers and sellers suffer from this unestablished and inefficient nature of markets for digital products.

Coordinating a primary market where consumers can buy new digital goods and a secondary market where consumers can buy used digital goods can also be used as a piracy mitigation mechanism. The model in this study is proposed to encourage

customers to purchase products legally by promoting the value of the purchasing service offered by content creators rather than to punish them for pirating products or to cut their resources used for piracy. We will always have a certain level of piracy in our community as we will always have stealing or other crimes despite all securities and punishment laws. Additionally, it has been discussed that a certain amount of piracy for digital goods actually helps copyright owners increase their profits since it provides a free circulation of their products within a network of consumers (Takeyama 1994). Therefore, the main objective of copyright holders should be to pull piracy to an optimal level and maintain it there and this study contributes to the digital piracy literature by proposing a business model that employs secondary markets for the distribution of digital goods to achieve this goal.

This research seeks to determine if the proposed model generates more revenue for content creators and providers than traditional models of pricing and distributing digital goods, and if the demand for unauthorized copies of products in a market can be reduced by the use of the proposed business model. To answer the former research question, we use a market equilibrium model to compare the revenues generated by the proposed model and a traditional benchmark model in Chapter IV. Results show that most of the time a monopolist collects greater revenue using the secondary market model than the benchmark model without considering the piracy. The benchmark model shows a superior performance only if consumers have a very high degree of patience to purchase a certain product and this product has a very high degree of enjoyment deterioration rate, which is a very rare case, if not impossible. When consumers have the ability to consume unauthorized copies of products, results do not change for the revenue collection. The proposed secondary market model outperforms the benchmark model in most cases. The market equilibrium model also demonstrates that the use of secondary market model leads to higher revenues and

lower piracy levels for consumers with moderate patience and products with moderate enjoyment deterioration. As deterioration becomes large, less patience is required for the secondary market model to dominate in revenue and piracy. Products which intuitively may fit in this category (products for which consumers may be fairly patient but who quickly tire of the product after purchase) are digitally distributed movies and video games.

We develop an analytical model for the proposed dual-channel distribution strategy which employs both a primary and a secondary market and compared it with a benchmark model (the 2-price model) which employs a traditional distribution strategy. The analytical model considers that there are two time periods for the consumption of a digital product and a monopolist who provides this product.

First, we provide an existence result for competitive secondary market pricing under general value functions. We show that when the price in the first period and the commission charged in the secondary market are within the desired ranges, there is a unique competitive secondary market price in the second period which clears the market.

Then, we compare total revenues generated and total number of quantities sold in the proposed model and in the benchmark model without considering piracy. Results show that the secondary market model makes more revenue than the 2-price model for most possible cases. The benchmark model performs better only when a product loses almost its entire value in the second period (very high α) and consumers are extremely patient to buy the product (very high β). On the other hand, except a small number of cases, the number of quantities sold in the 2-price model is greater than in the secondary market model. We also looked at revenues when both models sell the same number of quantities. For moderate α, the secondary market model makes more revenue when the market coverage is the same in both models.

Last, we consider two different cases of piracy: when piracy is allowed only in the second period and when piracy is allowed in the first period. When piracy is only observed in the second period, results are almost the same with the case without piracy. Revenues are higher, but more piracy is observed in the secondary market model for most of the cases. We also check revenues in both models for equal levels of piracy. Again, the secondary market model performs better for moderate α values when same level of piracy is allowed in both models. In the last section, we compare the performances of two models in the presence of piracy in the first period and provide the parameter ranges where the secondary market model outperforms the 2-price model.

To sum up, the proposed secondary market model outperforms the benchmark model in most cases. The market equilibrium model also demonstrates that the use of secondary market model leads to higher revenues and lower piracy levels for consumers with moderate patience and products with moderate enjoyment deterioration. As deterioration becomes large, less patience is required for the secondary market model to dominate in revenue and piracy. Products which intuitively may fit in this category (products for which consumers may be fairly patient but who quickly tire of the product after purchase) are digitally distributed movies and video games.

Chapter V tests the anti-piracy performance of the proposed secondary market model with an experimental survey. A behavioral intention model is built based on the previous piracy literature and used for the experiment. The research model was tested using a between-subjects experiment to examine the effect of the availability of a secondary market for digital good transactions on digital piracy. A total of 381 undergraduate students from a diverse, urban university were recruited for the experiment. The research model explains 51.1% of the variance in the intention of individuals to pirate digital content. We found that secondary market availability in-

fluences the perceived fairness of the legal transactions for digital goods in a positive way, leading consumers to develop more negative attitudes toward piracy. Most importantly, results showed that the availability of a secondary market for digital goods significantly decreases the demand for piracy. While the piracy rate in our control group is 39.1%, we observed a much smaller piracy rate, 20.4%, in our treatment group. Additionally, our study verified that how consumers value products has a significant direct effect on their intentions to pirate digital content. We did not find any empirical support for the moderating effect of product valuation on consumer perceptions regarding the fairness of the legitimate exchanges of digital products. While the relation is in the correct direction as we hypothesized, it is not strong enough to be statistically significant. One of the reasons of this result might be that subjects did not consider purchasing a digital good as a long-term investment and they made their decisions based on their expected short-term benefits without considering the future benefits of the provided transactions.

6.1 Contributions

This research provides an innovative viewpoint for distributing and pricing digital goods. A market equilibrium model is used to analyze the proposed model's performance. The economic model provides all optimal consumer decisions and optimal prices employed by a monopolist providing digital goods for various cases. Furthermore, piracy decisions of consumers are incorporated into the economic model. All possible piracy cases are analyzed, solved and compared with the benchmark model. The economic analysis of the secondary market model with and without piracy provides an important step toward understanding the benefits of utilizing second-hand markets for digital goods. The possible infrastructure examples that can facilitate resale of digital goods are also demonstrated.

One of the most important contributions of this research is demonstrating the conditions under which a secondary market can exist for the transactions of digital goods. The market equilibrium model provides an existence result for competitive secondary market pricing under pretty general value functions, not just the uniform values case which are widely used in the literature. Most importantly, the basic model used in this research is a dynamic model rather than a static model which needs to assume an exogenous fraction of consumers perform certain actions such as participating into various markets. This model type is commonly used in papers studying information economics in the IS literature. On the other hand, in our model consumers optimally decide which market to enter, and we endogenously get the result of how different consumers behave in such a market structure. This is a valuable contribution over previous IS literature which ties digital goods more closely to the standard economic model and opens up extensions to longer time horizons which could prove interesting. Obviously another important focus of our paper is that we analyze coverage and discuss conditions under which a secondary market can add both revenue and coverage, which has intuitive implications for piracy which we later have formalized. Last, the introduction of usage depreciation is a really intuitive parameter to study in the context of secondary markets and digital goods. We showed that usage depreciation of goods is so critical that a secondary market does not exist without it.

The digital piracy experiment makes important theoretical contributions to research on digital piracy by extending the understanding of why people engage in piracy. First, it shows how consumers perceive the fairness of legal transactions of digital content significantly affects their attitudes toward piracy by defining a new scale for the construct "perceived equitable relationship". Furthermore, the research model used in the experiment introduces an antecedent of perceived equitable rela-

tionship, which is a certain type of business model and market design coordinating a primary market and a secondary market for digital goods. Results show that consumers perceive the legitimate digital good transactions as more fair when there is an available second-hand market for digital goods. This increase in positive consumer perceptions of legal transactions offered by content sellers has an important implication for digital piracy. As shown in this study, when consumers perceive that the terms of available legitimate transactions are not fair or not in their favor, they build a more positive attitude toward illegal file sharing. A market structure that is perceived as unfair by consumers may lead to an increase in the demand for piracy by causing consumers to build more positive attitudes toward piracy. This study shows that providing a fair market design and structure for the transaction of digital goods to consumers is as important as the product experience and its price in fighting piracy.

Additionally, based on the expected utility theory, we hypothesized that availability of a secondary market would significantly decrease the number of illegal downloaders due to the increasing consumer utilities in the presence of a secondary market and found a statistically significant relationship between the intention to pirate and secondary market availability. Therefore, it can concluded that the availability of a secondary market increases the expected utilities of legitimate digital good transactions for consumers and this increase in the expected utilities results in more legal purchases and less piracy. We also observed that some subjects with product valuations lower than the net cost of the product chose to purchase the product or vice versa in contrast to what we had expected due to the expected utility theory. This observation implies that consumer decisions on whether to buy, not buy or pirate a product do not depend on only monetary factors (i.e. purchase price and resale price). This study shows that the perceived fairness of legitimate transactions that consumers

are offered may change how they value products. In the presence of an unfair market environment, this perceived inequitable relationship between buyers and sellers can either decrease the product valuations of consumers or create an additional cost for the product or both, which may covert the potential buyers into pirates. Therefore, product prices, expected costs and pure product valuations that are independent of the trading environment are very important considerations for sellers but may not be enough to explain consumer behaviors.

This study also indicates the importance of secondary markets for an efficient market and successful exchanges. Consumers may think that the lack of competition from secondary markets creates an unfair environment in which the monopolist has greater market power and dominance. Hence, secondary markets can be used as a tool to remove this injustice perceived by consumers which may lead to more buyers and less pirates. Furthermore, both the economic model and the experiment show that medium-valuation consumers value secondary markets more than low- and high-valuation consumers. On the other hand, high-valuation consumers mostly chose to purchase the product in a primary market and low-valuation consumers chose to do without the product or pirate it. This finding gives a unique insight into the market segmentation for digital goods. However, we could not find any empirical support for the moderating effect of product valuations on the relationship between secondary market availability and perceived equitable relationship. This implies that providing a secondary market does not change how consumers perceive the fairness of transactions depending on their valuations.

Our research confirms again that an individual's attitude toward piracy significantly affects his intention to pirate. We also verify that the product valuation of an individual is an important factor that determines his intention to illegally download digital content. On the other hand, we could not find any statistically significant

relationships between our control variables and intention to pirate. The other two TPB constructs, subjective norms and perceived behavioral control, do not have a significant direct effect on someone's intention to pirate. Furthermore, age, gender, moral judgement and deterrent effect of legislations were not found to significantly affect consumers' behaviors, whether to pirate or not. The reasons for this finding might be that more consumer segments from almost all age groups have started to use the Internet and Internet tools to acquire and consume digital content. Additionally, there are more tools available to consumers to find and download unauthorized digital goods on the Internet, which might make piracy a common practice among all different types of consumers. It is now very easy to find and download an unauthorized digital good on the Internet since consumers do not need to have special tools and information to pirate goods anymore. Hence, factors that have been previously found to affect a consumer's intention to pirate do not influence online behaviors of consumers today.

Results of this study have important implications for the content industry. To increase the willingness of consumers to purchase the product, introducing a value-added service in the form of a secondary market that can increase consumers' expected benefits from buying a legitimate copy of the product might be helpful for content creators and providers. Content sellers should focus on increasing the product valuations of consumers instead of imposing preventive and deterrent controls that can decrease the value of their products such as punishing their consumers for pirating digital content or limiting the usage of their products with DRM-like technologies.

6.2 Limitations and Future Research

The economic model has several limitations. First, the model does not distinguish between copyright owners and retailers of copyrighted products. The provider of

the original copyrighted product which is often the retailer or the distributor does not pay any royalty fees to the copyright owner. Therefore, the model does not consider the price and profit optimization of copyright holders in selling the product to intermediaries. Second, cost of piracy is assumed to be proportional to the consumer's value for the product. While certain piracy costs such as value degradation of the product change with consumer valuations, some cost items related to piracy may be independent of how consumers value the product. Additionally, considering the current technology and advanced file compressing methods, some product types may not lose any value in their qualities when copied. Last, the model considers only two time periods. A more comprehensive model which considers an infinite or indefinite horizon for the life of a product may provide a better insight for the profitability of secondary markets for digital goods.

One of the limitations of the digital piracy experiment is that it only focuses on transactions of digital movies. Consumer behaviors may vary for different product types which have different prices and different demands. Consumers do not buy movies because they need them. They are luxury products, and the results of our study may not extend to necessity products. Future work studying the same research question for different product types is required to improve the generalizability of our results. Additionally, hypothetical stores that use traditional business models (Stores A and B) in this study employ a single price for products. In fact, the common practice today in the content industry is to drop prices a certain amount of time after the release of the product. Also, subjects were not allowed to buy the products from the secondary market by using Store C. They were only given the option of buying the product today on its primary market with the potential of reselling it after a certain time. Therefore, subjects did not have the option of waiting and buying the products at a later time at lower prices, which might have increased the number of subjects

who chose to "do nothing". Introducing two distinct time periods and different prices for these periods offered by both stores is another future research direction.

APPENDICES

APPENDIX A

Model Solutions for Piracy in Period 1

A.1 Model Solutions for Piracy in Period 1

This section derives optimal pricing decisions by the monopolist for all different possible cases when consumers use unauthorized copies of products in the first period as presented in Section 4.3.2. We first solve the two possible cases for the 2-price model and then continue with the three possible cases for the secondary market model.

A.1.1 The 2-Price Model

As mentioned previously in Section 4.3.2, we have two different piracy scenarios for the 2-price model depending on the slope of the value curve of piracy. If δ is smaller than $\frac{1-\beta\alpha}{1+\beta(1-\alpha)}$, the value curve of piracy will be at position $I\$II$ in Figure 4.12 (between v_0 and v_2), otherwise it will be at position III (below v_2).

A.1.1.1 Case I & II $\left(\delta < \frac{1-\beta\alpha}{1+\beta(1-\alpha)}\right)$

If the constant cost of piracy (c) is high enough to push the utility curve of piracy below the utility curve of buying in the second period (u_2), there will be four consumer

segments along $i \in [0,1]$ as shown in Figure 4.13: buyers in period 1, pirates, buyers in period 2, consumers who choose to do without the product. It should be noted that if c is zero or very small, there will be no consumers who choose to buy the product in period 2. Furthermore, if c is very high, there may be no consumers who find optimal to pirate the product.

Let us assume that c and δ values give the utility functions in Figure 4.13. In this case, there are three marginal consumers. First, the indifferent consumer between buying the good in period 2 and doing nothing is located at $q_1 + q_2 + r$ $(u_2 = 0)$. This gives us

$$p_2 = 1 - q_1 - q_2 - r \tag{A.1}$$

Second, the consumer who is indifferent between buying the product in period 2 and pirating it is located at $q_1 + r$ $(u_p = u_2)$. From this equality, we derive

$$r = \frac{\sigma_1 (1 - q_1) + \beta (1 - q_1 - q_2) - c}{\beta + \sigma_1} \tag{A.2}$$

where $\sigma_1 = 1 - \beta\alpha - \delta(1 + \beta - \beta\alpha)$.

The monopolist maximizes the revenue in period 2, $R_2 = q_2 p_2$, by optimizing the quantity sold in period 2. Substituting r and p_2 into the second period revenue function and solving the first order condition yields

$$q_2* = \frac{c}{2\sigma_1} \tag{A.3}$$

The third marginal consumer is indifferent between buying the product in period 1 and pirating the product, who is located at q_1 $(u_1 = u_p)$. Using this equality, we

obtain

$$p_1 = (1 + \beta(1 - \alpha))\delta(1 - q_1) + c \tag{A.4}$$

The monopolist maximizes the total revenue, $R = q_1 p_1 + \beta q_2 p_2$, by optimizing the quantity sold in period 1. Substituting p_1 and q_2* into the total revenue function and solving the first condition yields

$$q_1* = \frac{\delta\ (1 + \beta - \beta\,\alpha) + c}{2\delta\ (1 + \beta - \beta\,\alpha)} \tag{A.5}$$

A.1.1.2 Case III $\left(\delta > \frac{1-\beta\alpha}{1+\beta(1-\alpha)}\right)$

When the value curve of piracy is at position III ($v_p < v_2$), the piracy segment will be located between $q_1 + q_2$ and 1 on the consumer axis i (Figure 4.14. For a given positive c, the order of consumer segments along i is buyers in period 1, buyers in period 2, pirates and consumers who choose to do nothing. Again, we have three marginal consumers.

First, the indifferent consumer between pirating the good and doing nothing is located at $q_1 + q_2 + r$ ($u_p = 0$). This gives us

$$r = 1 - q_1 - q_2 - \frac{c}{(1 + \beta(1 - \alpha))(1 - \delta)} \tag{A.6}$$

Second, the consumer who is indifferent between buying the good in period 2 and pirating it is located at $q_1 + q_2$ ($u_p = u_2$). Using this equality and substituting r into the equation, we derive

$$p_2 = \frac{c - \sigma_1(1 - q_1 - q_2)}{\beta} \tag{A.7}$$

The monopolist maximizes the revenue in period 2, $R_2 = q_2 p_2$, by optimizing the quantity sold in period 2. Substituting r and p_2 into the second period revenue function and solving the first order condition yields

$$q_2* = \frac{1 - q_1}{2} - \frac{c}{2\sigma_1} \tag{A.8}$$

The third marginal consumer who is indifferent between buying the product in period 1 and period 2 is located at q_1 ($u_1 = u_2$). Using this equality, we obtain

$$p_1 = (1 - \beta\alpha))(1 - q_1) + \beta p_2 \tag{A.9}$$

The monopolist maximizes the total revenue, $R = q_1 p_1 + \beta q_2 p_2$, by optimizing the quantity sold in period 1. Substituting p_1 and q_2* into the total revenue function and solving the first condition yields

$$q_1* = \frac{2(1 - \beta\alpha)}{4(1 - \beta\alpha) - \sigma_1} \tag{A.10}$$

A.1.2 The Secondary Market Model

There are three possible piracy scenarios for the secondary market model if consumers can acquire unauthorized copies in the first period. Depending on the values of δ and c, the value curve of piracy will be at positions I (between v_0 and v_1), II (between v_1 and v_2) or III (below v_2) in Figure 4.15.

A.1.2.1 Case I $\left(\delta < \frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}\right)$

If δ is smaller than $\frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}$, the value curve of piracy is at position I in Figure 4.15. In this case, there will be a certain range of δ and c values which create five different consumer segments in the following order along the consumer continuum i: consumers

who choose to buy the product in period 1 and keep it in period 2, consumers who choose to pirate the product, consumers who choose to buy the product in period 1 and sell it in period 2, consumers who choose to buy the product in period 2, and consumers who choose to do without the product, as shown in Figure 4.16. If there are five consumer segments along the consumer axis, we should have four marginal consumers which will separate these segments.

The first marginal consumer is located at $q_1 + q_2 + r$ and is indifferent between buying the product in period 2 and doing without it ($u_2 = 0$). This gives us

$$p_2 = 1 - q_1 - q_2 - r \tag{A.11}$$

Second, the consumer who is indifferent between buying the product in period 2 and buying it in period 1 and selling it in period 2 ($u_1 = u_2$) is located at $q_1 + r$. From this equality, we derive

$$p_1 = (1 - \beta)(1 - q_1 - r) + \beta p_2(2 - \tau) \tag{A.12}$$

Third, the consumer who is indifferent between buying the product in period 1 and selling it in period 2 and pirating the product ($v_p = v_1$) is located at $q_0 + r$. Substituting the market equilibrium condition ($q_0 = q_1 - q_2$) into the equation yields

$$p_1 = \sigma_2(1 - q_1 + q_2) + \beta p_2(1 - \tau) + c \tag{A.13}$$

where $\sigma_2 = \beta\alpha - \beta + \delta(1 + \beta - \beta\alpha)$.

Last, the consumer who is indifferent between buying the product in period 1 and

keeping it in period 2 and pirating the product ($v_0 = v_p$) is located at q_0.

$$p_1 = (1 + \beta(1 - \alpha))\delta(1 - q_1 + q_2) + c \tag{A.14}$$

Using Equations A.11, A.12 and A.13, we derive

$$r = \frac{(1 - \sigma_2)(1 - q_1) - (\beta + \sigma_2)q_2 - c}{1 - \sigma_2} \tag{A.15}$$

Using Equations A.13 and A.14 and substituting r that we derived in Equation A.15, we find

$$\begin{aligned}
\tau \;=\; & \frac{\delta\,\beta\,\sigma_2 q_2 - \delta\,\beta\,q_1\sigma_2 - \delta\,\beta\,\alpha\,\sigma_2 + 3\,\beta\,\sigma_2 q_2 - \delta - \delta\,\beta\,\alpha\,q_2\sigma_2 - \delta\,\sigma_2 q_1 + \beta^2 q_2}{\beta\ (2\,\sigma_2 q_2 - q_2 + \beta\,q_2 + c)} \\
& + \frac{\delta\,\sigma_2 q_2 + \delta\,\beta\,\sigma_2 + \delta\,\beta\,q_1 - \delta\,\beta\,q_2 + \delta\,\beta\,\alpha - \delta\,\beta\,\alpha\,q_1 + \delta\,\beta\,\alpha\,q_2 - \beta\,q_2 + \sigma_2 q_2}{\beta\ (2\,\sigma_2 q_2 - q_2 + \beta\,q_2 + c)} \\
& + \frac{\beta\,c + \delta\,\sigma_2 + \delta\,q_1 - \delta\,q_2 - \delta\,\beta + c\sigma_2 + \delta\,\beta\,\alpha\,q_1\sigma_2}{\beta\ (2\,\sigma_2 q_2 - q_2 + \beta\,q_2 + c)}
\end{aligned}$$

The monopolist maximizes the revenue in period 2, $R_2 = q_2 p_2 \tau$, by optimizing the quantity sold in period 2. Substituting r, τ and p_2 into the second period revenue function and solving the first order condition yields

$$\begin{aligned}
q_2{*} \;=\; & \frac{-\delta + \delta\,\beta\,\alpha - \delta\,\sigma_2 q_1 + \delta\,\beta\,\sigma_2 - \delta\,\beta\,q_1\sigma_2 - \delta\,\beta\,\alpha\,\sigma_2 - \delta\,\beta\,\alpha\,q_1 + \delta\,\sigma_2 + \delta\,q_1}{2(-\delta\,\beta\,\sigma_2 - 3\,\beta\,\sigma_2 + \delta\,\beta\,\alpha\,\sigma_2 - \delta\,\sigma_2 + \delta\,\beta - \delta\,\beta\,\alpha + \beta - \sigma_2 - \beta^2 + \delta)} \\
& + \frac{c\sigma_2 + \delta\,\beta\,\alpha\,q_1\sigma_2 + \delta\,\beta\,q_1 + \beta\,c - \delta\,\beta}{2(-\delta\,\beta\,\sigma_2 - 3\,\beta\,\sigma_2 + \delta\,\beta\,\alpha\,\sigma_2 - \delta\,\sigma_2 + \delta\,\beta - \delta\,\beta\,\alpha + \beta - \sigma_2 - \beta^2 + \delta)}
\end{aligned}$$

The monopolist maximizes the total revenue, $R = q_1 p_1 + \beta q_2 p_2 \tau$, by optimizing the quantity sold in period 1. Substituting p_1 that is derived in Equation A.12 and

q_2* into the total revenue function and solving the first condition yields

$$\begin{aligned} q_1* &= \frac{2(c\delta\,\beta\,\alpha + \delta\,\beta^2\alpha - 2\,c\delta\,\beta + \beta^2 c - c\delta - \beta\,c - \delta\,\beta - \delta\,\beta^2 c - \delta\,\beta^3\alpha + \delta\,\beta^3)}{\delta\psi} \\ &+\frac{2(\delta\,\beta^2\alpha\,c + 4\,\delta\,\beta\,\sigma_2 + 3\,\delta\,\beta^2\sigma_2 + 3\,\beta\,c\sigma_2 - \delta\,\beta\,\alpha\,\sigma_2 - 3\,\delta\,\beta^2\alpha\,\sigma_2 + \delta\,\sigma_2)}{\delta\psi} \\ &+\frac{2(c\sigma_2)}{\delta\psi} \end{aligned}$$

where

$$\begin{aligned} \psi &= 16\beta\sigma_2 + 4\sigma_2 + 12\,\beta^2\sigma_2 + \delta\beta^2\sigma_2 + 2\,\delta\beta\sigma_2 - 12\,\beta^2\alpha\sigma_2 - 2\,\delta\beta\alpha\sigma_2 - 4\,\alpha\beta\sigma_2 \\ &-2\delta\beta^2\alpha\sigma_2 + \alpha^2\beta^2\delta\sigma_2 + \delta\sigma_2 - \delta\beta^2 - 2\,\delta\beta - \alpha^2\beta^2\delta + 4\,\beta^3 + 2\,\delta\beta^2\alpha - 4\,\beta \\ &+4\,\beta^2\alpha + 2\,\delta\beta\alpha - 4\,\beta^3\alpha - \delta \end{aligned}$$

If c is zero or very small, there will be no consumers who find optimal to use the secondary market for buying and selling products. Also, the optimal solutions of q_1 and q_2 may lead to the case that the number of buyers in the secondary market (q_2) is greater than the number of buyers in the secondary market (q_1). According to the market equilibrium condition, supply and demand in the secondary market should be equal to each other ($q_1 - q_0 = q_2$). When q_2 is greater than q_1, the market equilibrium condition yields a negative q_0. In this case, there will be no consumers who find optimal to buy the product in period 1 and keep it in period 2. Therefore, the monopolist must sell the same quantities in both periods ($q_1 = q_2$).

If $q_0 \leq 0$. Solving the optimization problem of the monopolist given that $q_0 = 0$ and $q_1 = q_2$ gives us that

$$q_1* = q_2* = \frac{c\,(1+\beta)}{2(\beta - \sigma_2 - 3\,\sigma_2\beta - \beta^2)} \tag{A.16}$$

A.1.2.2 Case II $\left(\frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}\delta < \frac{1-\beta\alpha}{1+\beta(1-\alpha)}\right)$

If δ is between $\frac{\beta(1-\alpha)}{1+\beta(1-\alpha)}$ and $\frac{1-\beta\alpha}{1+\beta(1-\alpha)}$, the value curve of piracy is at position II in Figure 4.15. The order of five consumer segments along the consumer continuum i is shown in Figure 4.17: consumers who choose to buy the product in period 1 and keep it in period 2, consumers who choose to buy the product in period 1 and sell it in period 2, consumers who choose to pirate the product, consumers who choose to buy the product in period 2, and consumers who choose to do without the product. Again, we should have four marginal consumers which will separate these consumer segments.

The first marginal consumer is located at $q_1 + q_2 + r$ and is indifferent between buying the product in period 2 and doing without it ($u_2 = 0$). This gives us

$$p_2 = 1 - q_1 - q_2 - r \tag{A.17}$$

Second, the consumer who is indifferent between buying the product in period 2 and pirating it ($u_2 = u_p$) is located at $q_1 + r$. From this equality, substituting p_2 into the equation, we derive

$$r = \frac{\sigma_1 (1 - q_1) + \beta (1 - q_1 - q_2) - c}{\beta + \sigma_1} \tag{A.18}$$

where $\sigma_1 = 1 - \beta\alpha - \delta(1 + \beta - \beta\alpha)$.

The consumer who is indifferent between buying the product in period 1 and keeping it in period 2 and buying the product in period 1 and selling it in period 2 ($v_0 = v_1$) is located at q_0.

$$\tau = 1 - \frac{(1-\alpha)(1 - q_1 + q_2)}{p_2} \tag{A.19}$$

The monopolist maximizes the revenue in period 2, $R_2 = q_2 p_2 \tau$, by optimizing the quantity sold in period 2. Substituting r, τ and p_2 into the second period revenue function and solving the first order condition yields

$$q_2* = \frac{c + \beta\, q_1 + \alpha\, \beta + \alpha\, \sigma_1 + \sigma_1 q_1 - \alpha\, q_1 \sigma_1 - \beta - \sigma_1 - \alpha\, q_1 \beta}{4\, \sigma_1 + 2\, \beta - 2\, \alpha\, \beta - 2\, \alpha\, \sigma_1} \tag{A.20}$$

Last, the consumer who is indifferent between buying the product in period 1 and selling it in period 2 and pirating the product ($v_p = v_1$) is located at q_1.

$$p_1 = \sigma_2(1 - q_1) + \beta p_2(1 - \tau) + c \tag{A.21}$$

where $\sigma_2 = \beta\alpha - \beta + \delta(1 + \beta - \beta\alpha)$.

The monopolist maximizes the total revenue, $R = q_1 p_1 + \beta q_2 p_2 \tau$, by optimizing the quantity sold in period 1. Substituting p_1 and q_2* into the total revenue function and solving the first condition yields

$$q_1* = \frac{2(\sigma_1(2\sigma_2 + \beta + 2c - \sigma_2\alpha - \alpha\beta - c\alpha) + (\sigma_2\beta + 2c\beta)(1 - \alpha))}{4\sigma_2\sigma_1(2 - \alpha) + 4\sigma_2\beta(1 - \alpha) + \beta\sigma_1(5 - 6\alpha) + \beta^2(1 - 2\alpha + \alpha^2(1 + \sigma_1))} \tag{A.22}$$

If $q_0 \leq 0$. Solving the optimization problem of the monopolist given that $q_0 = 0$ and $q_1 = q_2$ gives us that

$$q_1* = q_2* = \frac{\sigma_2\beta + \sigma_2\sigma_1 + 2\,\beta\, c + c\sigma_1}{2(\sigma_2\beta + \sigma_2\sigma_1 + \beta\,\sigma_1)} \tag{A.23}$$

A.1.2.3 Case III $\left(\delta > \frac{1-\beta\alpha}{1+\beta(1-\alpha)}\right)$

If δ is greater than $\frac{1-\beta\alpha}{1+\beta(1-\alpha)}$, the value curve of piracy is at position III in Figure 4.15. The order of five consumer segments along the consumer continuum i is shown

in Figure 4.18: consumers who choose to buy the product in period 1 and keep it in period 2, consumers who choose to buy the product in period 1 and sell it in period 2, consumers who choose to buy the product in period 2, consumers who choose to pirate the product, and consumers who choose to do without the product. Again, there are four marginal consumers.

First, the marginal consumer who is indifferent between pirating the product and doing without it ($u_p = 0$) is located at $q_1 + q_2 + r$. This gives us

$$r = 1 - q_1 - q_2 - \frac{c}{(1 + \beta(1 - \alpha))(1 - \delta)} \tag{A.24}$$

Second, the consumer who is indifferent between buying the good in period 2 and pirating it is located at $q_1 + q_2$ ($u_p = u_2$). Using this equality and substituting r into the equation, we derive

$$p_2 = \frac{c - \sigma_1(1 - q_1 - q_2)}{\beta} \tag{A.25}$$

Additionally, the consumer who is indifferent between buying the product in period 1 and keeping it in period 2 and buying the product in period 1 and selling it in period 2 ($v_0 = v_1$) is located at q_0.

$$\tau = 1 - \frac{(1 - \alpha)(1 - q_1 + q_2)}{p_2} \tag{A.26}$$

The monopolist maximizes the revenue in period 2, $R_2 = q_2 p_2 \tau$, by optimizing the quantity sold in period 2. Substituting r, τ and p_2 into the second period revenue function and solving the first order condition yields

$$q_2* = \frac{c + \sigma_1 q_1 + \beta\, q_1 - \beta\, \alpha\, q_1 - \sigma_1 + \beta\, \alpha - \beta}{2(\beta - \beta\, \alpha - \sigma_1)} \tag{A.27}$$

The consumer who is indifferent between buying the product in period 1 and keeping it in period 2 and selling it in period 2 ($v_0 = v_1$) is located at q_1.

$$p_1 = (1 - \beta\alpha)(1 - q_1) + \beta p_2 \tag{A.28}$$

The monopolist maximizes the total revenue, $R = q_1 p_1 + \beta q_2 p_2 \tau$, by optimizing the quantity sold in period 1. Substituting p_1 and q_2* into the total revenue function and solving the first condition yields

$$q_1* = \frac{2(\beta + 2\,\beta\,\alpha\,c + 4\,\sigma_1\beta\,\alpha - \sigma_1 - 3\,\sigma_1\beta + \beta^2\alpha - \beta^2 - \beta\,\alpha + 2\,\beta\,c)}{14\,\sigma_1\beta\,\alpha - 4\,\beta\,\alpha - 10\,\sigma_1\beta + 2\,\beta^2\alpha + \beta^2\alpha^2 - 4\,\sigma_1 + 4\,\beta - 3\,\beta^2 + {\sigma_1}^2} \tag{A.29}$$

If $q_0 \leq 0$. Solving the optimization problem of the monopolist given that $q_0 = 0$ and $q_1 = q_2$ gives us that

$$q_1* = q_2* = \frac{1 + 2\,c - \beta - 2\,\sigma_1}{2(1 - 4\,\sigma_1 - \beta)} \tag{A.30}$$

A.1.3 No Quantity Sold in Period 2

It may be the case that certain values of δ and c result in zero or negative quantity sold in period 2 (q_2) in both models because the utility of pirating the product is always greater than the utility of buying the product in period 2 within the expected consumer segment for buyers in period 2.

In the 2-price model, when no consumers are willing to buy the product in period 2, there will be only three consumer segments: buyers in period 1, pirates and consumers who choose to do without the product. In the secondary market model, when there are no buyers in period 2, nobody will want to sell the product in period 1. There will be no activity in the secondary market and the model will be reduced to a single-price model again as in the 2-price model.

Therefore, when there is no quantity sold in period 2, both models will turn into a single-price model in which there will be three different consumer segments: buyers in period 1, pirates and consumers who choose to do nothing. We have two marginal consumers in this case.

First, the consumer who is indifferent between pirating the product and doing without it ($v_p = 0$) will be located at $q_1 + r$.

$$r = 1 - q_1 - \frac{c}{(1 + \beta(1 - \alpha))(1 - \delta)} \tag{A.31}$$

Second, the marginal consumer who is indifferent between pirating the good and buying the good in period 1 and keeping it in period 2 ($v_0 = v_p$) will be located at q_2. This gives us

$$p_1 = (1 + \beta(1 - \alpha))\delta(1 - q_1) + c \tag{A.32}$$

Then, the monopolist maximizes the total revenue, $R = q_1 p_1$, by optimizing the quantity sold in period 1 since there are no products sold in period 2. Substituting p_1 into the total revenue function and solving the first condition yields

$$q_1* = \frac{\delta(1 + \beta - \beta\alpha) + c}{2\delta(1 + \beta - \beta\alpha)} \tag{A.33}$$

APPENDIX B

Survey

This section provides all questions and movies used in the questionnaire. All questions of the survey can be found in the first subsection. The movie list used for the survey can be seen in the second subsection.

B.1 Survey Questions

This research used a web-based survey. Screenshots of all pages of the questionnaire can be seen in this section.

Project Title: The effect of the use of secondary markets for digital products on digital piracy behaviors of consumers

Principal Investigator: Mehmet Turan

Department of Statistics and Computer Information Systems (B11-220)

Zicklin School of Business, Baruch College, CUNY, 1 Baruch Way, New York, NY 10010

Informed Consent Form

The primary purpose of this study is to examine the relationship between the use of business models and digital piracy behavior. For this study you are asked to complete a survey and to answer a number of questions about your online behaviors for a given scenario.

Participation is completely voluntary. There are no known risks if you decide to participate in this research study, nor are there any costs for participating in the study. Refusing to participate or discontinuing participation will involve no penalties. Your participation is totally anonymous. Your professors will not be informed about your participation or your answers.

By participating in this study, you will have an opportunity to reflect about your current online behavior and advance the research in this area. **In order to participate you must be 18 (years of age) and over.** The total time required to complete the survey is estimated to be 30 minutes. After completing the survey, for your participation you will receive **1/2** the credit for your CIS2200 class.

All records of this study will be kept confidential. No one other than the PI (Mehmet Turan) will have access to the data, which will be archived in a secure location after use. All information is anonymous. Please do not type your name, ID, or any other identifiable information on your survey. Any resulting publications from this study will not identify individual participants but will refer to aggregate results.

If you have any questions regarding this research, you can call Mehmet Turan at (646) 312-3391. If you have any questions concerning your rights as a participant in this study, you can contact the Baruch IRB Office at (646)-312-3785.

The IRB (Institutional Review Board) is the college committee that protects the rights of human subjects in research. For information of how your rights are protected if you participate on this survey, please contact Keisha Peterson, IRB Administrator (Keisha.Peterson@baruch.cuny.edu)

By checking the text box below, you understand and accept the terms of this research study as stated above and that your participation is completely voluntary.

Please check box to indicate consent:

☐ I consent to the Survey Submit

Figure B.1: Survey - Page 1

Description: The purpose of this study is to explore online purchasing and digital piracy behaviors under different scenarios. Your participation in this study will help advance the research in this area. There are no risks in this research as no penalties will be assigned to your responses. All information will be recorded anonymously. No individual respondents will be identified. You will be given 3 digital products and asked to answer a number of questions related to these products.

Please consider the following definitions as you complete the questions below.

Digital product: is a good or service that can be digitized or converted into a sequence of binary digits and can be distributed through electronic channels. Examples include music, movies, e-books, video games etc. Digital products do not have physical packages as DVDs or CDs do.

Primary market: is a market where consumers can buy products or services directly from retailers or producers such as iTunes.

Secondary market: is a second-hand market where consumers buy and sell used goods from/to other consumers such as eBay.

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1. What is the maximum price that you are willing to pay to purchase the movie below? $

Get Him to the Greek (2010)

Figure B.2: Survey - Page 2

Please read the following descriptions carefully. You will be asked to answer a number of questions related to the following description.

This study assumes that there are two different types of online stores offering digital products:

Store A is an online store (iTunes-like) where consumers can buy and download digital movies for a certain price, $10.

Store B is an online store (iTunes-like) where consumers can buy and download digital movies for $11, a slightly higher price than what Store A offers.

2. Considering that there are two different online stores (Store A and B) from which you can buy digital movies, please choose an action from the list to acquire **Get Him to the Greek (2010)**.

○	It is likely that I will illegally download a copy of **Get Him to the Greek (2010)** on the Internet for free by using a file-sharing server.
○	It is likely that I will buy **Get Him to the Greek (2010)** from Store A, an iTunes-like store that you can buy and download products digitally for $10.
○	It is likely that I will buy **Get Him to the Greek (2010)** from Store B, an iTunes-like store that you can buy and download products digitally for $11.
○	Do nothing (neither buy nor download).

Please select the number that best reflects your opinion of the statements below.

3. Illegally downloading **Get Him to the Greek (2010)** on the Internet for free by using file-sharing services is a good idea.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

4. Illegally downloading **Get Him to the Greek (2010)** on the Internet for free by using file-sharing services is a wise idea

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

5. I like the idea of illegally downloading **Get Him to the Greek (2010)** on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

6. Illegally downloading **Get Him to the Greek (2010)** on the Internet for free by using file-sharing services would be pleasant.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

Figure B.3: Survey - Page 3 (For the control group)

This study assumes that there are two different types of online stores offering digital products.

Store A is an online store (iTunes-like) where consumers can buy and download digital movies for a certain price, .

Store C provides a primary market and a secondary market for the transaction of digital movies (an eBay- or Amazon-like store for digital products). Consumers can buy and download digital movies by using the primary market (new goods market) for a slightly higher price, $12. Additionally, by using its secondary market (used goods market) consumers can resell the movies that they have purchased before for on average. When a consumer resells a movie on the secondary market, s/he can not use the product anymore.

2. Considering that there are two different online stores (Store A and C) from which you can buy digital movies, please choose an action from the list to acquire **Fight Club (1999)**.

○	It is likely that I will illegally download a copy of **Fight Club (1999)** on the Internet for free by using a file-sharing server.
○	It is likely that I will buy **Fight Club (1999)** from Store A, an iTunes-like store that you can buy and download products digitally for $10.
○	It is likely that I will buy **Fight Club (1999)** from Store C, a digital store where you can buy and download digital products for $12. Additionally, you can sell the product that you have bought from store C for on average $7.
○	Do nothing (neither buy nor download).

Please select the number that best reflects your opinion of the statements below.

3. Illegally downloading **Fight Club (1999)** on the Internet for free by using file-sharing services is a good idea.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

4. Illegally downloading **Fight Club (1999)** on the Internet for free by using file-sharing services is a wise idea

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

5. I like the idea of illegally downloading **Fight Club (1999)** on the Internet for free by using a file sharing service.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

6. Illegally downloading **Fight Club (1999)** on the Internet for free by using a file-sharing service would be pleasant.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

Figure B.4: Survey - Page 3 (For the treatment group)

Please answer the questions 7, 8, 9 and 10 assuming that there is NO available store that provides a legitimate secondary market where you can buy and sell used digital movies.

7. Considering that there is NO available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before, purchasing a legitimate digital copy of **Get Him to the Greek (2010)** from an online store is not fair for me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

8. Considering that there is NO available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before, purchasing a legitimate digital copy of **Get Him to the Greek (2010)** from an online store results in an injustice for me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

9. Considering that there is NO available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before, the copyright owner of **Get Him to the Greek (2010)** does not treat me fairly in terms of the price and service it offers.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

10. Considering that there is NO available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before legally, the copyright owner of **Get Him to the Greek (2010)** overcharges me for the digital good and makes unfairly high profits.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

Submit Answers

Figure B.5: Survey - Page 4 (For the control group)

Please answer the questions 7,8, 9 and 10, assuming that there is an available store that provides a legitimate secondary market where you can buy and sell used digital movies.

7. Considering that there is an available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before, purchasing a legitimate digital copy of **Fight Club (1999)** from an online store is not fair for me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

8. Considering that there is an available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before, purchasing a legitimate digital copy of **Fight Club (1999)** from an online store results in an injustice for me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

9. Considering that there is an available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before, the copyright owner of **Fight Club (1999)** does not treat me fairly in terms of the price and service it offers.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

10. Considering that there is an available legitimate secondary market that allows consumers to sell their used digital products that they have purchased before legally, the copyright owner of **Fight Club (1999)** overcharges me for the digital good and makes unfairly high profits.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

Submit Answers

Figure B.6: Survey - Page 4 (For the treatment group)

Concluding Questions

Please select the number that best reflects your opinion of the statements below.

11. People who influence my behavior would expect me to engage in illegally downloading digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

12. People who are important to me would expect me to engage in illegally downloading digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

13. People whom I respect would expect me to engage in illegally downloading digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

14. I would be able to illegally download digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

15. Illegally downloading digital products on the Internet for free by using file-sharing services is entirely within my control.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

16. I have the resources and the knowledge and the ability to illegally download digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

17. Existing laws effectively prohibit illegally downloading digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

Figure B.7: Survey - Page 5

18. Existing laws provide effective deterrence against illegally downloading digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

19. Existing punishment provided by legislation against illegally downloading digital products on the Internet for free by using file-sharing services is effective.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

20. I would feel guilty if I illegally downloaded digital products on the Internet for free using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

21. Illegally downloading digital products on the Internet for free by using file-sharing services goes against my principles.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

22. It would be morally wrong to illegally download digital products on the Internet for free by using file-sharing services.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
	○	○	○	○	○	○	○	

Age:

Sex: ○ Male ○ Female

What is your total household annual income, including all earners in your household? $ Please select...

Where were you born? Please select...

If you were born in the U.S., with which of the following ethnicities do you identify?
Please select...

Submit Answers

Figure B.8: Survey - Page 6

B.2 Movies Used in the Questionnaire

Figure B.9: Movie #1: The Matrix

Figure B.10: Movie #2: Star Wars - A New Hope

Figure B.11: Movie #3: The Dark Knight

Figure B.12: Movie #4: Inception

Figure B.13: Movie #5: The Hangover

Figure B.14: Movie #6: The Departed

Figure B.15: Movie #7: Avatar

Figure B.16: Movie #8: Get Him to the Greek

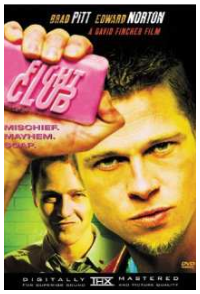

Figure B.17: Movie #9: Fight Club

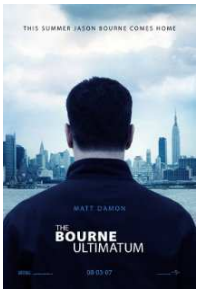

Figure B.18: Movie #10: The Bourne Ultimatum

BIBLIOGRAPHY

REFERENCES

Abkowitz, A. and Cendrowski, S. 2009. "Global 500." *Fortune Magazine*.

Adams, J.S. 1965. *Inequity in Social Exchange*. New York: Academic Press.

Adams, W.J. and Yellen, J.L. 1976. "Commodity Bundling and the Burden of Monopoly." *Quarterly Journal of Economics*, 90(3), pp. 475–498.

Ahmad, S.N. 2003. "Business Models of P2P Companies." Working Paper.

Ahn, I. and Yoon, K. 2009. "On the Impact of Digital Music Distribution." *CESifo Economic Studies*, 55(2), pp. 306–325.

Ahrens, A. 2003. "RIAAs Lawsuits Meet Surprised Targets." *Washington Post*.

Ajzen, I. 1985. "From Intentions to Actions: A Theory of Planned Behavior." In *Action Control: From Cognition to Behavior*, J. Kuhl and J. Beckmann, eds. Springer-Verlag, pp. 11–39.

Al-Rafee, S. and Cronan, T.P. 2006. "Digital Piracy:Factors that Influence Attitude Toward Behavior." *Journal of Business Ethics*, 63, pp. 237–259.

Altinkemer, K. and Bandyopadhay, S. 2000. "Bundling and Distribution of Digitized Music Over the Internet." *Journal of Organizational Computing and Electronic Commerce*, 10(3), pp. 209–224.

Anderson, S. and Ginsburgh, V. 1994. "Price Discrimination by Second-Hand Markets." *European Economic Review*, 38(1), pp. 23–44.

Androutsellis-Theotokis, S. and Spinellis, D. 2004. "A Survey of Peer-to-Peer Content Distribution Technologies." *ACM Computing Surveys*, 36(4), pp. 335–371.

Ang, S.H., Cheng, P.S., Lim, E.A.C., and Tambyah, S.K. 2001. "Spot the Difference: Consumer Responses Towards Counterfeits." *Journal of Consumer Marketing*, 18(3), pp. 219–233.

Armbrust, M., Fox, A., Griffith, R., Joseph, A.D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., and Zaharia, M. 2010. "A View of Cloud Computing." *Communications of the ACM*, 53(4), pp. 50–58.

Armstrong, M. 1996. "Multiproduct Nonlinear Pricing." *Econometrica*, 64(1), pp. 51–75.

Associated Press. 2003. "Kazaa Looks to Legitimate Arm for Salvation." *Associated Press Newswires*.

Aufah, A. and Tucci, C.L. 2001. "Internet Business Models and Strategies." Working Paper.

Azjen, I. 1991. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes*, 50, pp. 179–211.

Bae, S.H. and Choi, J.P. 2006. "A Model of Piracy." *Information Economics and Policy*, 18, pp. 303–320.

Bagchi, K., Kirs, P., and Cerveny, R. 2006. "Global Software Piracy: Can Economic Factors Alone Explain the Trend?" *Communications of the ACM*, 49(6).

Bailey, J.P. 1998. "Electronic Commerce: Prices and Consumer Issues for Three Products: Books, Compact Discs, and Software." *Organization for Economic Co-Operation and Development*, 98(4).

Bakos, Y. 1997. "Reducing Buyer Search Costs: Implications for Electronic Marketplaces." *Management Science*, 43(12), pp. 1676–1692.

Bakos, Y. 1998. "The Emerging Role of Electronic Marketplaces on the Internet." *Communications of the ACM*, 41(8), pp. 35–42.

Bakos, Y. and Brynjolfsson, E. 1999. "Bundling Information Goods: Pricing, Profits, and Efficiency." *Management Science*, 45(12), pp. 1613–1630.

Banerjee, D.S., Banerjee, T., and Raychaudhuri, A. 2008. "Optimal Enforcement and Anti-Copying Strategies to Counter Copyright Infringement." *The Japanese Economic Review*, 59(4), pp. 519–536.

Ben-Shahar, D. and Jacob, A. 2001. "Preach for a Breach: Selective Enforcement of Copyrights as an Optimal Monopolistic Behavior." WorkingPaper.

Benjamin, R.I. and Wigand, R.T. 1995. "Electronic Commerce: Effects on Electronic Markets." *Journal of Computer-Mediated Communication*, 1(3).

Bernoulli, D. 1954. "Exposition of a New Theory on the Measurement of Risk." *Econometrica*, 22(1), pp. 23–36.

Berryman, K., Harrington, L., Layton-rodin, D., and Rerolle, V. 1998. "Electronic Commerce: Three Emerging Strategies." *The McKinsey Quarterly*, 1, pp. 152–159.

Besen, S. and Kirby, S. 1989. "Private Copying, Appropriability and Optimal Copying Royalties." *Journal of Law and Economics*, 32, pp. 255–280.

Bhargava, H.K. and Choudhary, V. 2001. "Information Goods and Vertical Differentiation." *Journal of Management Information Systems*, 18(2), pp. 89–106.

Bhargava, H.K. and Choudhary, V. 2004. "Economics of An Electronic Intermediary with Aggregation Benefit." *Information Systems Research*, 18, pp. 22–36.

Bhattacharjee, S., Gopal, R.D., Lertwachara, K., and Marsden, J.R. 2006. "Impact of Legal Threats On Online Music Sharing Activity: An Analysis of Music Industry Legal Actions." *Journal of Law and Economics*, 49(April), pp. 91–114.

Bhattacharjee, S., Gopal, R.D., Lertwachara, K., Marsden, J.R., and Telang, R. 2007. "The Effect of Digital Sharing Technologies on Music Markets: A Survival Analysis of Albums on Ranking Charts." *Management Science*, 53(9), pp. 1359–1374.

Bhattacharjee, S., Gopal, R.D., Marsden, J.R., and Sankaranarayanan, R. 2009. "Re-Tuning the Music Industry - Can They Re-Attain Business Resonance?" *Communications of the ACM*, 52(6).

Bhattacharjee, S., Gopal, R.D., and Sanders, G.L. 2003. "Digital Music and Online Sharing: Software Piracy 2.0?" *Communications of the ACM*, 46(7), pp. 107–111.

Blumstein, A., Cohen, J., and Nagin, D. 1978. *Deterrence and Incapacitation: Estimating the Effects of Criminal Sanctions on Crime Rates*. Washington, DC: National Academy of Sciences.

Bockstedt, J.C., Kauffman, R.J., and Riggins, F.J. 2005. "The Move to Artist-Led Online Music Distribution: Explaining Structural Changes in the Digital Music Market." In *Proceedings of the Proceedings of the 38th Annual Hawaii International Conference on System Sciences*. Hawaii, USA.

Boldrin, M. and Levine, D. 2002. "The Case against Intellectual Property." *The American Economic Review*, 92(2), pp. 209–212.

Bond, E. and Samuelson, L. 1984. "Durable Good Monopolies with Rational Expectations and Replacement Sales." *Rand Journal of Economics*, 15(3), pp. 336–345.

Boorstin, E. 2004. "Music Sales in the Age of File Sharing." Ph.D. thesis, Princeton University.

Brynjolfsson, E., Hu, Y., and Smith, M.D. 2003. "Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers." *Management Science*, 49(11), pp. 1580–1596.

Brynjolfsson, E. and Smith, M.D. 2000. "Frictionless Commerce? A Comparison of Internet and COnventional Retailers." *Management Science*, 46(4), pp. 563–585.

BSA. 2004. *Piracy Study*. Washington, DC: Business Software Alliance.

BSA. 2009. *A Fifth of PC Software in United States is Pirated, Posing Challenges to High Tech Sector and Cyber Security*. Washington, DC: Business Software Alliance.

Bulow, J. 1982. "Durable-Goods Monopolist." *Journal of Political Economy*, 90(2), pp. 314–322.

Burke, D. 2007. "Controlled Explosions." *ITNow*, July, pp. 8–9.

Buxmann, P., Strube, J., and Pohl, G. 2007. "Cooperative Pricing in Digital Value Chains - The Case of Online Music." *Journal of Electronic Commerce Research*, 8(1), pp. 32–40.

Carrell, M.R. and Dittrich, J.E. 1978. "Equity Theory: The Recent Literature, Methodological Considerations and New Directions." *The Academy of Management Review*, 3(2), pp. 202–210.

Casadesus-Masanell, R. and Hervas-Drane, A. 2007. "Peer-to-Peer Filesharing and the Market for Digital Information Goods." Working Paper, Harvard University.

Cattelan, R., He, S., and Kirovski, D. 2006. "Prototyping A Novel Platform for Free-Trade of Digital Content." In *Proceedings of the 12th Brazilian Symposium on Multimedia and the Web*, R.F. Rodrigues and L.F.G. Soares, eds. ACM Press, pp. 79–88.

Chellappa, R.K. and Shivendu, S. 2005. "Managing Piracy: Pricing and Sampling Strategies for Digital Experience Goods in Vertically Segmented Markets." *Information Systems Research*, 16(4), pp. 400–417.

Chen, J., Esteban, S., and Shum, M. 2008. "How Much Competition is a Secondary Market?" Working Paper.

Chen, Y. and Png, I. 2003. "Information Goods Pricing and Copyright Enforcement: Welfare Analysis." *Information Systems Research*, 14(1), pp. 107–123.

Chen, Y. and Seshadri, S. 2007. "Product Development and Pricing Strategy for Information Goods Under Heterogeneous Outside Opportunities." *Information Systems Research*, 18(2), pp. 150–172.

Cheng, H.K., Sims, R.R., and Teegen, H. 1997. "To Purchase or to Pirate Software: An Empirical Study." *Journal of Management Information Systems*, 13(4), pp. 49–60.

Chin, W.W. 1998. "The Partial Least Squares Approach for Structural Equation Modeling." In *Modem Methods for Business Research*, G.A. Marcoulides, ed. Hillsdale: Lawrence Erlbaum Associates.

Choi, D.Y. and Perez, A. 2007. "Online Piracy, Innovation, and Legitimate Business Models." *Technovation*, 27, pp. 168–178.

Chuang, J.C. and Sirbu, M.A. 1999. "Optimal Bundling Strategy for Digital Information Goods: Network Delivery of Articles and Subscriptions." *Information Economics and Policy*, 11(2), pp. 147–176.

Clark, T. 1998. "Software Piracy Put at $11.4 Billion." *CNET News*.

Clemons, E.K., Gu, B., and Lang, K.R. 2003. "Newly Vulnerable Markets in an Age of Pure Information Products: An Analysis of Online Music and Online News." *Journal of Management Information Systems*, 19(3), pp. 17–41.

Clemons, E.K., Hitt, L.M., and Hann, I. 1998. "The Nature of Competition in Electronic Markets: A Comparison of Online Travel Agent Offerings." Working Paper.

Coase, R. 1972. "Durability and Monopoly." *Journal of Law and Economics*, 15, pp. 143–149.

Cohen, E. and Cornwell, L. 1989. "College Students Believe Piracy Is Acceptable." *CIS Educators Forum*, pp. 2–5.

Conner, K.R. and Rumelt, R.P. 1991. "Software Piracy: An Analysis of Protection Strategies." *Management Science*, 37(2), pp. 125–139.

Cosgrove, J.G. and Lindhart, P.B. 1979. "Customer Choices Under Local Measured Telephone Service." *Public Utilities Fortnightly*, pp. 27–31.

Courcoubetis, P. and Antoniadis, C. 2002. "Market Models for P2P Content Distribution." In *First International Workshop on Agents and Peer-To-Peer Computing*.

Coyle, J.R., Gould, S.J., Gupta, P., and Gupta, R. 2009. ""To Buy or To Pirate": The Matrix of Music Consumers' Acquisition-Mode Decision-Making." *Journal of Business Research*, 62, pp. 1031–1037.

Cremer, H. and Pestieau, P. 2009. "Piracy Prevention and the Pricing of Information Goods." *Information Economics and Policy*, 21, pp. 34–42.

Cronan, T.P. and Al-Rafee, S. 2008. "Factors that Influence the Intention to Pirate Software and Media." *Journal of Business Ethics*, 78, pp. 527–545.

Danaher, B., Dhanasobhon, S., Smith, M.D., and Telang, R. 2009. "Converting Pirates without Cannibalizing Purchasers: The Impact of Digital Distribution on Physical Sales and Internet Piracy." Working Paper, University of Pennsylvania.

D'Astous, A., Colbert, F., and Montpetit, D. 2005. "Music Piracy on the Web-How Effective are Anti-Piracy Arguments? Evidence From the Theory of Planned Behaviour." *Journal of Consumer Policy*, 28(2), pp. 289–310.

Davenport, T.H. 1993. *Process Innovation, Reengineering Work through Information Technology*. Harvard Business School Press.

Davis, N. 2009. "Is There a Digital First Sale Doctrine?" *Loyola of Los Angeles Entertainment Law Review*, 29(3), pp. 363–373.

Dean, K. 2004. "File Sharing Growing Like a Weed." *Wired News*.

Dejean, S. 2009. "What Can We Learn from Empirical Studies About Piracy?" *CESifo Economic Studies*, 55(2), pp. 326–352.

Dibb, S., Simkin, L., Pride, W.M., and Ferrell, O.C. 2005. *Marketing Concepts and Strategies*. Boston, Abingdon: Houghton Mifflin.

Dignan, L. 2002. "Report: File Swapping Sites to Thrive." *ZDNet News*.

Dubosson-Torbay, M., Pigneur, Y., and Usunier, J. 2004. "Business Models for Music Distribution after the P2P Revolution." In *Proceedings of the Web Delivering of Music, Fourth International Conference*, volume September. pp. 172–179.

Duchene, A. and Waelbroeck, P. 2006. "The Legal and Technological Battle in the Music Industry: Information-Push Versus Information-Pull Technologies." *International Review of Law and Economics*, 26(4), pp. 565–580.

Easley, R.F., Michel, J.G., and Devaraj, S. 2003. "The MP3 Open Standard and the Music Industry's Response to Internet Piracy." *Communications of the ACM*, 46(11), pp. 91–96.

Eining, M.M. and Christensen, A.L. 1991. *A Psycho-Social Model of Software Piracy: The Development and Test of a Model*. South-Western Publishing, pp. 182–189.

Eppen, G.D., Hanson, W.A., and Martin, R.K. 1991. "Bundling New Products, New Markets, Low Risk." *Sloan Management Review*, 32(4), pp. 7–14.

Evangelista, B. 2002. "Napster Runs Out of Lives - Judge Rules Against Sale." *San Francisco Chronicle*.

Fan, M., Kumar, S., and Whinston, A.B. 2008. "Selling or Advertising: Strategies for Providing Digital Media Online." *Journal of Management Information Systems*, 24(3), pp. 143–166.

Feng, Y., Guo, Z., and Chiang, W.K. 2009. "Optimal Digital Content Distribution Strategy in the Presence of the Consumer-to-Consumer Channel." *Journal of Management Information Systems*, 25(4), pp. 241–270.

Fishburn, P.C., Odlyzko, A.M., and Siders, R.C. 1997. *Fixed Fee Versus Unit Pricing for Information Goods: Competition, Equilibria, and Price Wars*. Cambridge, MA: MIT Press, pp. 167–189.

Fornell, C. and Larcker, D.F. 1981. "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error." *Journal of Marketing Research*, 18(1), pp. 39–50.

Francis, J.E. and White, L. 2004. "Value across Fulfilment-product Categories of Internet Shopping." *Managing Service Quality*, 14(2/3), pp. 226–234.

Franz, H. 2000. "Drowning in Information When Surfing the Web? Or Going with the Flow." In *Proceedings of the 33rd Hawaii International Conference on System Sciences*. Hawaii, USA: IEEE Computer Society Press.

Freedman, D. 2003. "Managing Pirate Culture: Corporate Responses to Peer-to-Peer Networking." *International Journal on Media Management*, 5(3), pp. 173–179.

Furnell, S.M. and Karweni, T. 1999. "Security Implications of Electronic Commerce: A Survey of Consumers and Businesses." *Internet Research: Electronic Networking Applications and Policy*, 9(5), pp. 372–382.

Gallaugher, J.M., Auger, P., and Barnir, A. 2001. "Revenue Streams and Digital Content Providers: An Empirical Investigation." *Information & Management*, 38, pp. 473–485.

Gang, Y. and Li, T. 2003. "A Decentralized E-Marketplace Based on Improved Gnutella Network." In *Proceeding of International Conference on Intelligent Agents, Web Technology and Internet Commerce*. Vienna, Austria.

Gayer, A. and Shy, O. 2006. "Publishers, Artists, and Copyright Enforcement." *Information Economics and Policy*, 18, pp. 374–384.

Geng, X., Stinchcombe, M.B., and Whinston, A.B. 2005. "Bundling Information Goods of Decreasing Value." *Management Science*, 51(4), pp. 662–667.

Ghose, A., Smith, M., and Telang, R. 2006. "Internet Exchanges for Used Books: An Empirical Analysis of Product Cannibalization and Welfare Impact." *Information Systems Research*, 17(1), pp. 3–19.

Ghose, A., Telang, R., and Krishnan, R. 2005. "Effect of Electronic Secondary Markets on the Supply Chain." *Journal of Management Information Systems*, 22(2), pp. 91–120.

Ghosemajumder, S. 2002. "Advanced Peer-Based Technology Business Models: A New Economic Framework for the Digital Distribution of Music, Film, and Other Intellectual Property Works." Working Paper.

Givon, M., Mahajan, V., and Muller, E. 1995. "Software Piracy: Estimation of Lost Sales and the Impact on Software Diffusion." *Journal of Marketing*, 59(1), pp. 29–37.

Glass, R. and Wood, W. 1996. "Situational Determinants of Software Piracy: An Equity Theory Perspective." *Journal of Business Ethics*, 15(11), pp. 1189–1198.

Golle, P., Leyton-Brown, K., Mironov, I., and Lillibridge, M. 2001. "Incentives for Sharing in Peer-to-Peer Networks." In *Proceedings of the Second International Workshop on Electronic Commerce*. pp. 75–87.

Goodell, J. 2003. "Steve Jobs: The Rolling Stone Interview." *Rolling Stone Magazine*.

Gopal, R.D., Bhattacharjee, S., and Sanders, G.L. 2002. "Economics of Online Music Sharing: Cui Bono?" Working Paper, University of Connecticut.

Gopal, R.D., Bhattacharjee, S., and Sanders, G.L. 2006. "Do Artists Benefit from Online Music Sharing?" *Journal of Business*, 79(3), pp. 1503–1533.

Gopal, R.D. and Sanders, G.L. 1997. "Preventive and Deterrent Controls for Software Piracy." *Journal of Management Information Systems*, 13(4), pp. 29–47.

Gopal, R.D. and Sanders, G.L. 1998. "International Software Piracy: Analysis of Key Issues and Impacts." *Information Systems Research*, 9(4), pp. 380–397.

Gopal, R.D. and Sanders, G.L. 2000. "Global Software Piracy: You Can't Get Blood Out of a Turnip." *Communications of the ACM*, 43(9), pp. 82–89.

Gopal, R.D., Sanders, G.L., Bhattacharjee, S., Agrawal, M., and Wagner, S.C. 2004. "A Behavioral Model of Digital Music Piracy." *Journal of Organizational Computing and Electronic Commerce*, 14(2), pp. 89–105.

Gosain, S. and Lee, Z. 2001. "The Internet and the Reshaping of the Music CD Market." *Electronic Markets*, 11(2), pp. 140–145.

Graham, J. 2003. "RIAA Lawsuits Bring Consternation, Chaos." *USA Today Online*.

Granados, N.F., Gupta, A., and Kauffman, R.J. 2006. "The Impact of IT on Market Information and Transparency: A Unified Theoretical Framework." *Journal of the Association for Information Systems*, 7(3), pp. 148–178.

Grimm, R. and Nutzel, J. 2002. "A Friendly Peer-to-Peer File Sharing System with Profit but Without Copy Protection." In *Innovative Internet Computing Systems*. Springer Berlin / Heidelberg, pp. 133–142.

Gulati, R. and Galino, J. 2000. "Get the Right Mix of Bricks and Clicks." *Harvard Business Review*, 78(3), pp. 107–114.

Gupta, P., Gould, S.J., and Pola, B. 2004. ""To Pirate or Not to Pirate": A Comparative Study of the Ethical versus Other Influences on the Consumer's Software Acquisition-Mode Decision." *Journal of Business Ethics*, 55(3), pp. 255–274.

Hair, J.F., Anderson, R.E., Tatham, R.L., and Black, W.C. 1998. *Multivariate Data Analysis*. Englewood Cliffs, NJ: Prentice-Hall.

Hansen, E. 2003. "Apple Customer Resells iTunes Song." *CNET News*. URL `http://news.cnet.com/2100-1027\_3-5074086.html`.

Harmon, R., Raffo, D., and Faulk, S. 2004. "Value-Based Pricing For New Software Products: Strategy Insights for Developers." In *Proceedings of the Portland International Conference on the Management of Engineering and Technology*. Portland, OR.

Harrast, S.A. and Bean, L. 2002. "Should You Outsource via the Web?" *The Journal of Corporate Accounting & Finance*, 13(5), pp. 3–9.

Harrington, S. 1989. "Why People Copy Software and Create Computer Viruses: Individual Characteristics and Situational Factors." *Information Resource Management Journal*, pp. 28–37.

He, S., Cattelan, R., and Kirovski, D. 2008. "Modeling Viral Economies for Digital Media." *ACM SIGOPS Operating Systems Review*, 42(4), pp. 149–162.

Healey, J. 2004. "Music Industry Taking Cues From File Sharing." *Los Angeles Times*.

Hill, C.W.L. 2007. "Digital Piracy: Causes, Consequences, and Strategic Responses." *Asia Pacific Journal of Management*, 24(9), pp. 9–25.

Hinduja, S. 2003. "Trends and Patterns among Online Software Pirates." *Ethics and Information Technology*, 5, pp. 49–61.

Hitt, L.M. and Chen, P. 2005. "Bundling with Customer Self-Selection: A Simple Approach to Bundling Low-Marginal-Cost Goods." *Management Science*, 51(10), pp. 1481–1493.

Hoffman, D.L., Novak, T.P., and Chatterjee, P. 1995. "Commercial Scenarios for the Web: Opportunities and Challenges." *Journal of Computer-Mediated Communication*, 1(3).

Hoffman, D.L., Novak, T.P., and Peralta, M. 1999. "Building Consumer Trust Online." *Communications of the ACM*, 42(4), pp. 80–85.

Holm, H.J. 2003. "Can Economic Theory Explain Piracy Behavior?" *Topics in Economic Analysis & Policy*, 3(1).

Homans, G.C. 1961. *Social Behavior: Its Elementary Forms*. New York: Hartcourt, Brace & World.

Houston, F.S. and Gassenheimer, J.B. 1987. "Marketing and Exchange." *The Journal of Marketing*, 51(4), pp. 3–18.

Hughes, J. and Lang, K.R. 2003. "If I Had a Song: The Culture of Digital Community Networks and Its Impact on the Music Industry." *The International Journal on Media Management*, 5(111), pp. 180–190.

Hughes, J., Lang, K.R., and Vragov, R. 2008. "An Analytical Framework for Evaluation of Peer-to-Peer Business Models." *Electronic Commerce Research and Applications*, 7(1), pp. 105–118.

Hui, K.L. and Chau, P.Y.K. 2002. "Classifying Digital Products." *Communications of the ACM*, 45(6), pp. 73–79.

Hui, K.L. and Png, I.P.G. 2003. "Piracy and the Legitimate Demand for Recorded Music." *Contributions to Economic Analysis and Policy*, 2(1).

Hunt, S. and Vitell, S. 1986. "A General Theory of Marketing Ethics." *Journal of Micromarketing*, 6, pp. 5–16.

Ian, J. 2002. "The Internet Debacle - An Alternative View." *Performing Songwriter Magazine*.

IFPI. 2003. *Fighting Piracy and Growing a Legal Online Business*. London, UK: International Federation Of The Phonographic Industry.

IFPI. 2009. *IFPI Digital Music Report 2009*. London, UK: International Federation Of The Phonographic Industry.

IFPI. 2010. *IFPI Digital Music Report 2010*. London, UK: International Federation Of The Phonographic Industry.

IFPI. 2011. *IFPI Digital Music Report 2011*. London, UK: International Federation Of The Phonographic Industry.

Iwao, T., Wada, Y., Yamasaki, S., Shiouchi, M., Okada, M., and Amamiya, M. 2001. "A Framework for the Next Generation of E-commerce by Peer-to-Peer Contact: Virtual Private Community." In *Proceedings of the 10th International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises*. Cambridge, MA, pp. 340–341.

Jain, S. 2008. "Digital Piracy: A Competitive Analysis." *Marketing Science*, 27(4), pp. 610–626.

Jallat, F. and Capek, M.J. 2001. "Disintermediation in Question: New Economy, New Networks, New Middlemen." *Business Horizons*, 44(2), pp. 55–60.

Jarvenpaa, S.L. and Todd, P.A. 1996. "Consumer Reactions to Electronic Shopping on the World Wide Web." *International Journal of Electronic Commerce*, 1(2), pp. 59–88.

Jing, B. 2006. "Market Segmentation for Information Goods with Network Externality." *Economic Letters*.

Johnson, C. and Tesch, B. 2005. "US eCommerce: 2005 To 2010." *Forrester Research*.

Jones, R. and Mendelson, H. 1998. "Product and Price Competition for Information Goods." Working Paper, Graduate School of Business, Stanford University.

Jordan, J. and Bolton, S. 2004. "Peer-to-Peer File-Sharing: Capturing Value from Digital Products." *European Business Journal*, 16(3), pp. 105–112.

Kangis, P. and Rankin, K. 1996. "Interactive Services: How to Identify and Target the New Markets." *Journal of Marketing Practice: Applied Marketing Science*, 2(3), pp. 44–67.

Karagiannis, T., Broido, A., Brownlee, N., Claffy, K.C., and Faloutsos, M. 2004. "Is P2P Dying or Just Hiding?" In *Proceedings of the GLOBECOM 2004 Conference*. Dallas, TX.

Kato, T. and Yokoi, S. 2003. "Application of P2P (Peer-to-Peer) Technology to Marketing." In *Proceedings of the 2003 International Conference on Cyberworlds*. pp. 372–379.

Keegan, P. 2004. "Is the Music Store Over?" *Business 2.0 Online*.

Khouja, M. and Park, S. 2007. "Optimal Pricing of Digital Experience Goods Under Piracy." *Journal of Management Information Systems*, 24(3), pp. 109–141.

Khouja, M. and Rajagopalan, H.K. 2009. "Can Piracy Lead to Higher Prices in the Music and Motion Picture Industries?" *Journal of the Operational Research Society*, 60, pp. 372–383.

Khouja, M. and Smith, M.A. 2007. "Optimal Pricing for Information Goods with Piracy and Saturation Effect." *European Journal of Operational Research*, 176, pp. 482–497.

Ki, E., Chang, B., and Khang, H. 2006. "Exploring Influential Factors on Music Piracy Across Countries." *Journal of Communication*, 56, pp. 406–426.

King, S.P. and Lampe, R. 2003. "Network Externalities, Price Discrimination and Profitable Piracy." *Information Economics and Policy*, 15, pp. 271–290.

Kini, R.B., Ramakrishna, H.V., and Vijayaraman, V. 2004. "Shaping Moral Intensity Regarding Software Piracy: A Comparison between Thailand and U.S. Students." *Journal of Business Ethics*, 49, pp. 91–104.

Koiso-Kanttila, N. 2004. "Digital Content Marketing: A Literature Synthesis." *Journal of Marketing Management*, 20, pp. 45–65.

Krishnan, R., Smith, M.D., Tang, Z., and Telang, R. 2007. "Digital Business Models for Peer-to-Peer Networks: Analysis and Economic Issue." *Review of Network Economics*, 6(2), pp. 194–213.

Krishnan, R., Smith, M.D., and Telang, R. 2003. "The Economics of Peer-To-Peer Networks." *Journal on Information Technology Theory and Applications*, 5(3), pp. 31–44.

Kuo, F. and Hsu, M. 2001. "Development and Validation of Ethical Computer Self-Efficacy Measure: The Case of Softlifting." *Journal of Business Ethics*, 32, pp. 299–315.

Kwok, S.H. 2002. "Digital Rights Management for the Online Music Business." *ACM SIGecom Exchanges*, 3(3), pp. 17–24.

Kwok, S.H., Cheung, S.C., Wong, K.C., Tsang, K.F., Lui, S.M., and Tam, K.Y. 2003. "Integration of Digital Rights Management into the Internet Open Trading Protocol." *Decision Support Systems*, 34(4), pp. 413–425.

Kwong, T.C.H. and Lee, M.K.O. 2002. "Behavioral Intention Model for the Exchange Mode Internet Music Piracy." In *Proceedings of the 35th Hawaii International Conference on System Sciences*. Hawaii, USA.

Lam, C.K.M. and Tan, B.C.Y. 2001. "The Internet is Changing the Music Industry." *Communications of the ACM*, 44(8), pp. 62–68.

Lam, L.W. and Harrison-Walker, L.J. 2003. "Toward an Objective-Based Typology of e-Business Models." *Business Horizons*, 46(6), pp. 17–26.

Lang, K.R. and Vragov, R. 2005. "A Pricing Mechanism for Digital Content Distribution Over Computer Networks." *Journal of Management Information Systems*, 22(2), pp. 121–139.

Lesk, M. 2003. "Chicken Little and the Recorded Music Crisis." *IEEE Security and Privacy*, 1(5), pp. 73–75.

Li, Y. and Lin, C. 2009. "Pricing Schemes for Digital Content with DRM Mechanisms." *Decision Support Systems*, 47, pp. 528–539.

Liang, M. 1999. "Does a Second-Hand Market Limit a Durable Goods Monopolist's Market Power?" Working Paper, University of Western Ontario.

Liebowitz, S.J. 1982. "Durability, Market Structure and New-Used Goods Model." *American Economic Review*, 72(9), pp. 816–824.

Liebowitz, S.J. 1985. "Copying and Indirect Appropriability: Photocopying of Journals." *Journal of Political Economy*, 93, pp. 945–957.

Liebowitz, S.J. 2004. "Will MP3 Downloads Annihilate the Record Industry? The Evidence so Far." *Advances in the Study of Entrepreneurship, Innovation, and Economic Growth*, 15, pp. 229–260.

Liedtke, M. 2009. "Appeals Court Ruling Threatens Used Software Sales." *Associated Press*.

Limayem, M., Khalifa, M., and Chin, W.W. 1999. "Factors Motivating Software Piracy: A Longitudinal Study." In *Proceedings of the International Conference on Information Systems*. pp. 124–131.

Lin, T., Hsu, M., and Sun, P. 1999. "An Intention Model-based Study of Software Piracy." In *Proceedings of the 32nd Hawaii International Conference on System Sciences*. Hawaii, USA: IEEE Computer Society.

Linder, J. and Cantrell, S. 2000. "Changing Business Models: Surveying the Landscape." *Accenture Institute for Strategic Change*.

Liu, Q., Safavi-Naini, R., and Sheppard, N. 2003. "Digital Rights Management for Content Distribution." In *Proceedings of the Australasian Information Security Workshop*. pp. 49–58.

Madden, M. and Lenhart, A. 2003. "Pew Internet Project Data Memo." *Pew Internet and American Life Project*.

Madhukar, A. and Williamson, C. 2006. "A Longitudinal Study of P2P Traffic Classification." In *Proceedings of the 14th IEEE International Symposium on Modeling, Analysis, and Simulation*. IEEE Computer Society, pp. 179–188.

Mahadevan, B. 2000. "Business Models for Internet-Based E-Commerce: An Anatomy." *California Management Review*, 42(4), pp. 55–70.

Malhotra, Y. 1994. "Controlling Copyright Infringements of Intellectual Property: The Case of Computer Software." *IS Management*, 45(13).

Malone, T.W., Yates, J., and Benjamin, R.I. 1987. "Electronic Markets and Electronic Hierarchies." *Communications of the ACM*, 30, pp. 484–497.

Mason, J. 1990. "Crackdown on Software Pirates." *ComputerWorld*, 24, pp. 107–115.

Mcafee, R.P., McMillan, J., and Whinston, M.D. 1989. "Multiproduct Monopoly, Commodity Bundling, and Correlation of Values." *Quarterly Journal of Economics*, 104(2), pp. 371–383.

Mendelsohn, T., Johnson, C.A., and Meyr, S. 2006. "Trends: Understanding U.S. Cross-Channel Shoppers: Demystifying Consumers Who Influence More Than $125 Billion in Offline Sales." *Forrester Research*.

Miller, H. 1974. "On Killing off the Market for Used Textbooks and the Relationship between Markets for New and Secondhand Goods." *Journal of Political Economy*, 82(3), pp. 612–619.

Molteni, L. and Ordanini, A. 2003. "Consumption Patterns, Digital Technology and Music Downloading." *Long Range Planning Journal*, 36, pp. 389–406.

Moores, T.T. and Dhillon, G. 2003. "Software Piracy: A View from Hong Kong." *Communications of the ACM*, 46(9), pp. 207–215.

Murphy, V. 2003. "The Enemy Strikes Back." *Forbes*, p. 218.

NPD. 2008. *Digital Music Study*. Port Washington, NY: The NPD Group.

Nunnally, J.C. 1967. *Psychometric Theory*. New York: McGraw-Hill.

Odlyzko, A. 2003. "Privacy, Economics, and Price Discrimination on the Internet." In *Proceedings of the Fifth International Conference on Electronic Commerce*. pp. 355–366.

OPA. 2006. *A Day in the Life: An Ethnographic Study of Media Consumption*. New York, NY: Online Publishers Association.

Osterwalder, A. and Pigneur, Y. 2002. "An e-Business Model Ontology for Modeling e-Business." In *Proceedings of the 15th Bled Electronic Commerce Conference*. Bled, Slovenia.

Osterwalder, A., Pigneur, Y., and Tucci, C.L. 2005. "Clarifying Business Models: Origins, Present, and Future of the Concept." *Communications of the Association for Information Systems*, 15(1), pp. 1–25.

Oz, E. 1990. "The Attitude of Managers-To-Be Software Piracy." *OR/MS Today*, 17(4), pp. 24–26.

Parameswaran, M., Susarla, A., and Whinston, A.B. 2001. "P2P Networking: An Information- Sharing Alternative." *IEEE Computer*, 34(7), pp. 1–8.

Parsons, A.G. 2002. "Non-Functional Motives for Online Shoppers: Why We Click." *Journal of Consumer Marketing*, 19(5), pp. 380–392.

Peace, A.G., Galletta, D.F., and Thong, J.Y. 2003. "Development and Examination of a Predictive Model of Software Piracy Behavior." *Journal of Management Information Systems*, 20(1), pp. 153–178.

Peitz, M. and Waelbroeck, P. 2006. "Piracy of Digital Products: A Critical Review of the Theoretical Literature." *Information Economics and Policy*, 18(4), pp. 449–476.

Peppers, D. and Rogers, M. 1999. *The One to One Manager. Real-World Lessons in Customer Relationship Management*. New York: Currency Doubleday.

Perpetua, M. 2011. "Amazon Launches Cloud-Based Streaming Service." *Rolling Stone Magazine*.

Peterovic, O., Kittl, C., and Teksten, R.D. 2001. "Developing Business Models for eBusiness." In *Proceedings of the International Conference on Electronic Commerce 2001*. Vienna, Austria.

Peterson, R.A., Balasubramanian, S., and Bronnenberg, B.J. 1997. "Exploring the Implications of the Internet for Consumer Marketing." *Journal of the Academy of Marketing Science*, 25(4), pp. 329–346.

Phau, I. and Poon, S.M. 2001. "Factors Influencing the Types of Products and Services Purchased over the Internet." *Internet Research: Electronic Networking Applications and Policy*, 10(2), pp. 102–113.

Phlips, L. 1983. *The Economics of Price Discrimination*. Cambridge, MA: Cambridge Univ. Press.

Plowman, S. and Goode, S. 2009. "Factors Affecting the Intention to Download Music: Quality Perceptions and Downloading Intensity." *The Journal of Computer Information Systems*, 49(4), pp. 84–97.

Premkumar, G.P. 2003. "Alternate Distribution Stratefies for Digital Music." *Communications of the ACM*, 46(9), pp. 89–95.

Rajala, R., Rossi, M., and Tuunainen, V.K. 2003. "A Framework for Analyzing Software Business Models." In *Proceedings of the ECIS 2003, Conference on Information Systems*. Naples, Italy.

Rangan, S. and Adner, R. 2001. "Profits and the Internet: Seven Misconceptions." *MIT Sloan Management Review*, 42(4), pp. 44–53.

Rappa, M. 2001. "Managing the Digital Enterprise - Business Models on the Web." URL `http://ecommerce.ncsu.edu/business\_models.html`. Working Paper.

Reding, V. 2009. "Europe's Fast Track to Economic Recovery The Ludwig Erhard Lecture 2009 Lisbon Council." *EU Press Release*. URL `http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/09/336`.

Reuters. 2004. "Promo Uses P2P Networks to Sell Songs." URL `http://legalminds.lp.findlaw.com/list/cyberia-l/msg45074.html`.

RIAA. 2007. *RIAA Annual Music Sales Data 2007 Year End*. Washington, DC: Recording Industry Association of America.

RIAA. 2010. *Piracy: Online and on the Street*. Washington, DC: Recording Industry Association of America.

Rob, R. and Waldfogel, J. 2006. "Piracy on the High Cs: Music Downloading, Sales Displacement, and Social Welfare in a Sample of College Students." *Journal of Law and Economics*, 49, p. 1.

Rogers, E. 1983. *The Diffusion of Innovations*. New York: Free Press.

Rose, G., Khoo, H., and Straub, D.W. 1999. "Current Technological Impediments to Business-to- Consumer Electronic Commerce." *Communications of the Association for Information Systems*, 1(16).

Rowley, J. 2002. *Information Marketing*. Aldershot: Ashgate.

Rowley, J. 2008. "Understanding Digital Content Marketing." *Journal of Marketing Management*, 24(5), pp. 517–540.

Salinger, M.A. 1995. "A Graphical Analysis of Bundling." *Journal of Business*, 68(1), pp. 85–98.

Sandulli, F.D. and Martin-Barbero, S. 2007. "99 Cents per Song: A Fair Price for Digital Music? The Effects of Music Industry Srategies to Raise the Willingness to Pay by P2P Users." *Strategies*, 2(3), pp. 3–16.

Schmalensee, R.L. 1984. "Gaussian Demand and Commodity Bundling." *Journal of Business*, 57, pp. 5211–5230.

Schneider, J. 1987. "Users Must Take Responsibility to Control the Illegal Copying of Software." *InfoWorld*, 9(56).

Schonfeld, E. 2009. "iTunes Sells 6 Billion Songs, And Other Fun Stats From The Philnote." *TechCrunch*.

Shang, R., Chen, Y., and P, C. 2008. "Ethical Decisions About Sharing Music Files in the P2P Environment." *Journal of Business Ethics*, 80, pp. 349–365.

Shapiro, C. and Varian, H. 1999. *Information Rules*. Cambridge, MA: Harvard Business School Press.

Shapiro, C. and Varian, H.R. 1998. "Versioning: The Smart Way to Sell Information." *Harvard Business Review*, November-D, pp. 106–114.

Shin, N. 2001. "Strategies for Competitive Advantage in Electronic Commerce." *Journal of Electronic Commerce Research*, 2(4), pp. 34–41.

Shulman, J.D. and Coughlan, A.T. 2007. "Used Goods, Not Used Bads: Profitable Secondary Market Sales for a Durable Goods Channel." *Quantitative Marketing and Economics*, 5(2), pp. 191–210.

Sims, R., Cheng, H.K., and Teegen, H. 1996. "Toward a Profile of Student Software Piraters." *Journal of Business Ethics*, 15, pp. 839–849.

Sinha, R.K. and Mandel, N. 2008. "Preventing Digital Music Piracy: The Carrot or the Stick?" *Journal of Marketing*, 72, pp. 1–15.

Slater, D., Smith, M., Bambauer, D., Gasser, U., and Palfrey, J. 2005. "Content and Control: Assessing the Impact of Policy Choices on Potential Online Business Models in the Music and Film Industries." Working Paper.

Smith, M.D. and Telang, R. 2009. "Competing with Free: The Impact of Movie Broadcasts on DVD Sales and Internet Piracy." *MIS Quarterly*, 33(2), pp. 321–338.

Solomon, S.L. and O'Brian, J.L. 1990. "The Effect of Demographic Factors on Attitudes Toward Software Piracy." *Journal of Computer Information Systems*.

Stigler, G.J. 1963. "United States v. Loew's Inc.: A Note on Block Booking." *Supreme Court Review*, pp. 152–157.

Strader, T.J. and Shaw, M.J. 2000. *Electronic Markets: Impact and Implications*. Berlin: Springer, pp. 77–98.

Straub, D.W. 1990. "Effective IS Security: An Empirical Study." *Information Systems Research*, 1(3), pp. 255–276.

Strauss, J. and Frost, R. 2001. *E-marketing*. Upper Sad- dle River, NJ: Prentice-Hall.

Sundararajan, A. 2004a. "Managing Digital Piracy: Pricing and Protection." *Information Systems Research*, 15(3), pp. 287–308.

Sundararajan, A. 2004b. "Nonlinear Pricing of Information Goods." *Management Science*, 50(12), pp. 1660–1673.

Sutanonpaiboon, J. and Abuhamdieh, A. 2008. "Factors Influencing Trust in Online Consumer-to-Consumer (C2C) Transactions." *Journal of Internet Commerce*, 7(2), pp. 203–219.

Takeyama, L. 1994. "The Welfare Implications of Unauthorized Reproduction of Intellectual Property in the Presence of Network Externalities." *Journal of Industrial Economics*, 62, pp. 155–166.

Takeyama, L. 1997. "The Intertemporal Consequences of Unauthorized Reproduction of Intellectual Property." *Journal of Law and Economics*, 40(2), pp. 511–522.

Takeyama, L. 2003. *Piracy, Asymmetric Information and Product Quality*. Edward Elgar Publishing, pp. 55 – 65.

Tan, B. 2002. "Understanding Consumer Ethical Decision Making with Respect to Purchase of Pirated Software." *Journal of Consumer Marketing*, 19, pp. 96–111.

Tapscott, D., Lowi, A., and Ticoll, D. 2000. *Digital Capital - Harnessing the Power of Business Webs*. Boston: Harvard Business School Press.

Taylor, S. and Todd, P.A. 1995. "Understanding Information Technology Usage: A Test of Competing Models." *Information Systems Research*, 8(2), pp. 144–176.

Telang, R. and Smith, M.D. 2008. "Internet Exchanges for Used Digital Goods." Working Paper, Carnegie Mellon University.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M., and Lauro, C. 2005. "PLS Path Modeling." *Computational Statistics and Data Analysis*, 48(1), pp. 159–205.

Thong, J.Y.L. and Yap, C.S. 1998. "Testing an Ethical Decision-Making Theory: The Case of Softlifting." *Journal of Management Information Systems*, 15(1), pp. 213–237.

Timmers, P. 1998. "Business Models for Electronic Markets." *Electronic Markets*, 8(2), pp. 3–8.

Tirole, J. 1988. *The Theory of Industrial Organization*. Cambridge, MA: MIT Press.

Turner, A. 2001. *Just Capital: The Liberal Economy*. London: Macmillan.

Umeh, J. 2007. *The World beyond Digital Rights Management*. London: British Computer Society.

U.S. Census Bureau. 2009. "Quarterly Retail E-Commerce Sales."

Varian, H.R. 1998. "Markets for Information Goods." URL `http://people.ischool.berkeley.edu/\~{}hal/Papers/japan/index.html`.

Varian, H.R. 2000. "Buying, Sharing and Renting Information Goods." *The Journal of Industrial Economics*, 48(4), pp. 473–488.

Vassos, T. 1996. *Strategic Internet Marketing*. Indianapolis: Que.

Vernik, D.A. 2009. "Essays on Digital Distribution of Information Goods." Ph.D. thesis, Duke University.

Vijayasarathy, L.R. 2002. "Product Characteristics and Internet Shopping Intentions." *Internet Research*, 12(5), pp. 411–426.

Vijayasarathy, L.R. and Jones, J.M. 2000. "Intentions to Shop Using Internet Catalogues: Exploring the Effects of Product Types, Shopping Orientations, and Attitudes towards Computers." *Electronic Markets*, 10(1), pp. 29–38.

Vishnumurthy, V., Chandrakumar, S., and Sirer, E.G. 2003. "KARMA : A Secure Economic Framework for Peer-to-Peer Resource Sharing." In *Proceedings of the 1st Workshop on Economics of Peer-to-Peer Systems*. Berkeley, CA.

von Neumann, J. and Morgenstern, O. 1944. *Theory of Games and Economic Behavior*. Princeton: Princeton University Press.

Wagner, S. and Sanders, G. 2001. "Considerations in Ethical Decision-Making and Software Piracy." *Journal of Business Ethics*, 29(1/2), pp. 161–167.

Wang, C. 2005. "Factors that Influence the Piracy of DVD/VCD Motion Pictures." *Journal of American Academy of Business*, 6(1), pp. 231–237.

Wang, C., Chen, C., Yang, S., and Farn, C. 2009. "Pirate or Buy? The Moderating Effect of Idolatry." *Journal of Business Ethics*, 90, pp. 81–93.

Whinston, A.B., Choi, S., and Stahl, D.O. 1997. *The Economics of Electronic Commerce*. Indianapolis: Macmillan Technical Publishing.

Wigand, R.T. and Benjamin, R.I. 1995. "Electronic Commerce: Effects on Electronic Markets." *Journal of Computer-Mediated Communication*, 1(3).

Wolf, D. 2006. "Technique for Facilitating Resale of Digital Content over a Computer Network." US Patent No 2006/0010075 A1.

Wu, S., Chen, P., and Anandalingam, G. 2003. "Fighting Information Goods Piracy with Versioning." In *Proceedings of the Twenty-fourth International Conference on Information Systems*. Seattle, WA.

Yoon, K. 2002. "The Optimal Level of Copyright Protection." *Information Economics and Policy*, 14, pp. 327–348.

Young, K.S., Thomas, B.J., Pahl, T.B., and Engle, M.K. 2005. "Peer-to-Peer File-Sharing Technology: Consumer Protection and Competition Issues." *Federal Trade Commission*.

Yu, B. and Singh, M.P. 2003. "Incentive Mechanisms for Peer-to-Peer Systems." In *Proceedings of the Second International Workshop on Agents and Peer-to-Peer Computing*. Melbourne, Australia.

Zentner, A. 2006. "Measuring the Effect of File Sharing on Music Purchases." *Journal of Law and Economics*, 49, pp. 63–90.