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A Theoretical and Empirical Analysis of the Impact of the Digital Age on the Music Industry

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A THEORETICAL AND EMPIRICAL ANALYSIS OF THE IMPACT OF THE DIGITAL AGE ON THE MUSIC INDUSTRY

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Abstract

We present an in-depth analysis of the music industry and use our findings to judge the practical assumptions and design of an original theoretical model. The model is in three stages, where, in a Hotelling-type framework, the last agents to act are consumers who choose between copying, purchasing, or staying out of the market for music. Prior to the last stage, the record label chooses its profit maximizing price and, in the first stage, we incorporate the artist-label bargaining agreement into a theoretical framework using the Nash cooperative bargaining solution. The current structure of the music industry is a combination of the oligopoly and monopolistic competition models, consisting of five major labels and many independents. Despite major labels' advantage in large-scale distribution, we argue that digital downloading has the potential to radically alter the current industry structure, and that artists would be unable to sell their music in such an environment without enforceable copyrights. Our model assumes that the most important determinants of CD and copy demand are consumers' tastes and transaction costs of copying, CD prices, and the substitutability between CDs and copies. We hypothesize that Internet file-sharing has been undertaken by both consumers who were previously not in the market, and by those who decided to copy rather than buy. In regard to firm strategy, the model suggests that labels could increase the sales of CDs by trying to increase consumers' taste for music, perhaps by reducing the price of CDs. Our model also predicts a positive relationship between artists' optimal share of album sales and their bargaining power, as well as a negative relationship between artists' optimal share and their risk aversion. Since lowering the reliance on labels for distribution would increase artists' bargaining power, our model predicts that artists' share of profits should increase as legitimate digital distribution gains prominence. We also provide empirical testing of our hypothesis that some music file-sharing has been done by consumers frequently not in the market. After examining consumers' expenditures and aggregate industry sales, we are unable to reject our hypothesis.

Chapter 1, Introduction

The impact of Internet file-sharing on the music industry has been hotly debated since the launch of the first file-sharing software, Napster, in 1999. Since anything that can be digitized – books, music, movies, photographs, etc. – has the potential to be simultaneously "shared" online, understanding the effects of file-sharing is important for other intellectual property related industries as well. Although several researchers have examined the impact of copying on firms and consumers in other contexts, very little empirical work exists that considers the effect of copying in an industry where firms serve as intermediaries for the creators of intellectual property ("artists"). This dissertation contributes to the literature by developing a simple theoretical model that describes the interactions of consumers, record labels and artists, and by providing an empirical analysis of the impact Internet file-sharing has had on the music industry.

The first chapter of this dissertation surveys the professional literature on Hotelling-type location models in industrial organization and on the economics of copying. By combining insights from both areas of existing work, we then develop an in-depth analysis of the music industry that is used to judge the practical assumptions of various models and the design of an original theoretical model. The model is in three stages, where the last agents to act are consumers who choose between copying, purchasing, or staying out of the market for music. Prior to the last stage, record labels choose a price for music (supplied in the form of CDs) so as to maximize profit. The first stage of the model incorporates the bargaining agreement between the artist and label into a theoretical framework using the Nash cooperative bargaining solution. Throughout, we relate our findings to the actual practices in the music industry.

The current market structure of the music industry is a combination of the oligopoly and monopolistic competition models. The market consists of five major labels and thousands of independent labels. Major labels have a clear advantage over independents in the following two areas: (1) national/international distribution; and (2) national promotion on commercial radio. Record labels can offer intermediary services to artists precisely because distribution and promotion currently require substantial real resources and entail the assumption of significant financial risk. In addition to the statutory copyright that labels hold, these economic factors contribute to the pricing structure of the music market. If digital downloading on the Internet does become the preferred method of distribution in the future, it is likely that the structure of the market will radically change, with lower prices and greater choices for consumers being the most obvious outcomes. Still, even in this environment, it is unlikely that artists would be able to sell their music in the absence of enforceable copyrights.

The Internet sharing platform essentially replaces the distribution function of the label, but this state of affairs appears unsustainable in the long run. Since music legitimately offered for sale by artists and labels would be competing with copies that are nearly perfect substitutes available free of charge, artists and labels would not be able to charge positive prices for their music. In the long-run, this problem becomes the familiar fallacy of composition. When most consumers can copy music for free, the music that they hope to copy will eventually cease to exist. To avoid this conundrum, one possible way to ensure the continuing existence of the market is to have a selectively enforceable copyright. In other words, while labels and artists should not be overly concerned with consumers who give copies to one or two friends, they should invoke copyright law to prevent large-scale sharing on the Internet. In the

presence of such enforceable copyrights, the new technologies would allow artists to distribute their music directly to consumers, increasing artists' bargaining power with record labels. As a result, the future structure of the industry will probably shift to a more competitive one, where record companies' primary intermediary functions would center around marketing and promotional activities. Formalizing the interactions between artists, labels and consumers is one of the primary goals of our theoretical model.

Our model assumes that the most important determinants of the demand for CDs and copies are consumers' tastes, transaction costs involved in copying, the price of CDs, and the degree of substitutability between CDs and copies. Depending on the combination of these factors, consumers will choose to either buy CDs, copy music or stay out of the market completely. Our model predicts that, as the transaction costs of copying fall and the relative quality of the copy rises, more consumers will enter the market (through copying); these are consumers who formerly stayed out of the market completely. Given the recent dramatic increase in copy quality and the significant reduction in the transaction costs of copying (provided by Napster and other file-sharing services), the model suggests that some Internet file-sharing was undertaken by consumers who previously did not buy significant amounts of music. Similarly, the model implies that some consumers, with different tastes and transaction costs, decided to copy rather than buy. In addition to those conclusions related to consumers' choices, the model also provides several implications for the firms' strategy.

To increase CD sales, the model suggests that labels should try to increase consumers' taste for music by either reducing the price of CDs, increasing the cost of copying (perhaps by altering its copy protection techniques), or increasing the difference in the quality of legitimate CDs and copies. Since the firms may no longer be able to increase the quality difference between CDs and copies, they may have to focus on either increasing the cost of copying and/or lowering the prices of CDs.[1] Not surprisingly, the model predicts that by increasing copy protection and raising CD prices, record labels can increase profits on CDs. However, the model also demonstrates that the optimal price of a CD is negatively related to the relative quality of the copy, suggesting that some consumers may have viewed CD prices as too high once file-sharing services went online. Another innovation of our model is that it formalizes the artist-label bargaining arrangement and then demonstrates the implications of this process for consumers.

The model predicts a positive relationship between artists' optimal share of album sales and their bargaining power, as well as a negative relationship between artists' optimal share and their level of risk aversion. According to the model, artists can also increase their optimal share of sales by improving their fallback position, perhaps by building a solid fan base and successfully selling albums as independent artists. By improving artists' ability to increase their fan base and sell their own music, the Internet and digital downloading could end up strengthening artists' bargaining position, thus lowering their reliance on labels for distribution. Since lowering the reliance on labels for distribution would greatly increase artists' bargaining power, our model predicts that artists' share of profits should increase as legitimate digital distribution on the internet gains prominence. However, the model also predicts that, for any given distribution method, a label will respond to paying a higher share of album sales to artists by raising the price of CDs. Naturally, the model predicts that labels will sign very few artists to contracts which give away a particularly high share of sales and, when they do, that the firms will charge a relatively higher price for these albums. Though a direct test of this hypothesis is desirable, evidence suggests that only the "best" artists sign for a noticeably higher share of album sales, and that the suggested retail price of these CDs is relatively higher than those of lesser known artists. The last chapter of this dissertation empirically tests our hypothesis that some of the music file-sharing since 1999 has been done by low-valuation consumers, many of whom are frequently not in the market.

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[1] Since September 2003, at least one major label has announced plans to lower list prices on CDs *and* to litigate against file-sharers. (Smith (2003))

After examining both aggregate and micro-level consumer expenditure data, we are unable to reject our hypothesis that some of the music file-sharing was undertaken by consumers who previously did not buy significant amounts of music. Our hypothesis requires consumers with heterogeneous tastes for music to be affected differently by the various factors of music demand, and our aggregate-level OLS results show that consumer heterogeneity exists across different types of consumers within three distinct entertainment expenditure categories. In the micro-level data, we find a positive relationship between computer ownership and CD expenditures, and we cannot reject the hypothesis that this relationship was the same in 2001 as in 1998 (pre and post file-sharing). Therefore, despite the downward trend in computer owning consumers' real mean CD expenditures, we cannot report any evidence of a wide-spread effect from file sharing on CD sales.

Chapter 2, Literature Survey

2.0 Introduction

This literature survey is divided into two subcategories: (1) the literature concerned with copying issues; and, (2) the industrial organization literature that was used to develop the theoretical model of the recording industry in Chapter 4. In addition to the references below, several chapters of three textbooks – Cabral (2000), Shy (1995), and Tirole (2001) – were used in developing the model in Chapter 4. These textbooks detail many of the concepts in the articles summarized below.

2.1 Copying Literature

The initial copying literature was fairly diffuse, with references to copying mixed throughout various articles as subtopics. For example, Hirshleifer and Riley (1979), while focusing mainly on the roles of uncertainty and information in economics, argued that increased copyright protection could both improve social welfare due to a larger supply of copyrighted works and reduce social welfare since the copyrighted works would be underutilized.

The loss in social welfare from underproduction of (unprotected) works arises when firms produce below the socially optimal quantity (or quality) because some consumers copy the product without paying for it. Since producers of copyrighted works typically price their goods above marginal cost, a welfare loss due to underutilization of copyrighted works arises. The welfare loss from underutilization has two components. The first is that some consumers are only willing to pay the (lower) marginal cost of production, and thus choose not to consume the good (a loss from allocative inefficiencies). The second is that some consumers choose to copy but end up expending more real resources than the firm in producing and selling the original (a loss from productive inefficiencies). Most of the early literature made reference to these two aspects of copyrights (social welfare loss caused by underproduction and social welfare loss due to underutilization) without challenge until the early 1980's.

Novos and Waldman (1984) found "partial support" for the idea that increased copyright protection leads to a welfare loss from underproduction of unprotected works. At the same time, Novos and Waldman argued that there is "little or no support" for the possibility of increased copyright protection causing a welfare loss from underutilization. Constructing a formal model, they showed that differences in consumers' reproduction costs could lead to increased copyright protection *decreasing* the social welfare loss from underutilization. They demonstrated that when consumers were forced to return to the primary market because of increased copyright protection, there would be gains in productive efficiencies, a possibility not considered in earlier literature. While these findings generally support increasing copyright protection, several authors later took the opposite stance.

Using empirical data from scholarly journal publishers, Liebowitz (1985) argued that unauthorized copying of intellectual properties could actually be beneficial to the sellers of these goods. Liebowitz introduced his "indirect appropriability" hypothesis, whereby copying allows sellers to charge a higher price to some consumers and, therefore, indirectly appropriate revenues from users who did not purchase the original goods. In addition to his original theory, Liebowitz (1985) was the first to offer empirical evidence that unauthorized copying of intellectual properties could be beneficial to producers. Still, photocopying of journals in libraries is authorized copying, and the market is easily segregated to

facilitate price discrimination. From this point forward, the literature has continued to produce conflicting points of view on the net benefits of copying.

For instance, Besen (1986) developed a model[1] that essentially served as a formal statement of Liebowitz's indirect appropriability hypothesis. His model showed that copying would increase *both* consumer welfare and producer profits in the short run, provided copying technologies were efficient *and* producers could price discriminate. Later, Besen and Kirby (1989) argued that most of the differing conclusions in the copying literature could be traced to various models' dependence on the two mutually exclusive ideas of indirect and direct appropriability (where the cost of originals is borne entirely by direct purchasers and copiers pay only the cost of making copies). They integrated both types of appropriability into one model and demonstrated that when originals and copies are perfect substitutes and the marginal cost of copying is rising, the effects from copying depend on the number of consumers sharing (the number of members in a "club").

In what appeared to be a key shift in the literature, Takeyama (1994) argued that previous models failed to consider demand network externalities, and that these externalities could generate additional surplus for the consumers of originals. Takeyama demonstrated that the presence of the externalities allows the unauthorized reproduction of intellectual property goods to induce greater firm profits *and* leads to a Pareto improvement in social welfare. Still, Takeyama's model did depend on firms' ability to price discriminate and, therefore, indirectly appropriate revenue from copying consumers. In addition, the later findings in Takeyama (1997) conflicted with those presented in Takeyama (1994).

Takeyama (1997), using an intertemporal theoretical framework, argued that since most of the models in the literature were static rather than dynamic, they had *understated* the harm suffered by firms from unauthorized reproduction of their products. The dynamic framework Takeyama introduced was analogous to durable good monopolists' time inconsistency problem, according to which consumers may be unwilling to purchase the durable good at the initial price because they know the monopolist will rationally reduce the price in the future. Takeyama argued that copying therefore results in a greater reduction in future prices beyond that which would normally occur without copying, thus reducing the appropriable surplus from *all* consumers (even in the presence of indirect appropriability). If Takeyama's hypothesis is correct, the distinction between indirect and direct appropriability becomes even more difficult for empirical studies to observe because measuring these effects would require distinct estimates among buying and copying consumers through time.

Focusing instead on the idea of "sharing clubs," Bakos, Brynjolfsson, and Lichtman (1999) extended Besen and Kirby's (1989) work by focusing on small-scale sharing, the type that is present when family members share cable television or computer software. The authors modeled two effects – an *aggregation effect* and a *team diversity effect* – and argued that sharing could *increase* producer profits even when copying is more inefficient than the firm producing the additional units, and that sharing could *decrease* profits even when net distribution costs are reduced by copying. Under their aggregation effect, team formation makes consumer valuations more predictable, thus facilitating price discrimination, and copying tends to increase firm profits. With the team diversity effect, on the other hand, team patterns are largely out of the firms' control, so copying makes price discrimination more difficult and, therefore, tends to decrease profits. Their finding that sharing can decrease profits even when net distribution costs are reduced is most relevant to the issues surrounding Internet file-sharing and, therefore, this dissertation.

Even though digital distribution of intellectual property goods (any type that can be digitized) on the Internet is much more efficient than traditional distribution methods, digital distribution would not be

[1] Besen's model was based on Benjamin and Kormendi's (1974) durable goods model.

viable without some degree of copy protection. In the absence of sufficient protection (in whichever form it takes), the peer-to-peer (P2P) networks replace the firms' distribution function, and the firms fail to receive any compensation for their goods. This idea is reflected in Bakos et al.'s team diversity effect; the Internet P2P networks introduce team patterns that are entirely out of the firm's control, thus reducing firm profits. Still, the theoretical approach most closely followed in this dissertation is that of Johnson (1985), which is itself a variation of a Hotelling-type model.

2.2 Hotelling Model Literature

In the original article, which has spurred countless variations, Hotelling (1929) did not examine the copying/sharing of goods. Instead, he was interested in explaining the fact that consumers buy similar commodities from different sellers despite moderate differences in prices. Hotelling modeled consumers as being located along a line segment of length one (uniformly distributed), with two businesses occupying the two ends of the line (selling homogenous products). Hotelling hypothesized that consumers would make their decisions on which business to frequent based on both the prices offered at the two locations and the cost of transportation that consumers would have to pay. Hotelling argued that, as long as firms are free to choose their location, a long run equilibrium must involve the two firms fixing their location in the middle of the market. This long run equilibrium, according to Hotelling, is less than socially optimal.

As noted above, a large literature has grown around Hotelling's original contribution. For instance, D'Aspremont, Gabszewizc and Thisse (1979) pointed out that a pure strategy equilibrium may not always exist in the standard Hotelling model if, as usually assumed, consumers are distributed uniformly and transportation costs are linear. This possible non-existence problem disappears, however, when transportation costs are quadratic. Tabuchi (1994), using a two dimensional model, which allows commodities to be differentiated according to two characteristics, also found that a quadratic transportation cost function leads to the existence of an equilibrium solution.

Hotelling used the concept of location in a very general sense, which implies that the notion of location can be used to describe virtually any dimension of a product or, as in our model, a person. We will differentiate consumers of music according to the cost that digital copying of music would impose on them (location of consumers along a "geekness" axis). As a second dimension of differentiation between consumers, we use their taste for music, represented by a separate parameter. The theoretical work that comes closest to the model presented in this dissertation is by Johnson (1985). Johnson used two variations of a Hotelling-type location model to examine the economics of copying. Based on earlier work by Salop (1979) (a circular Hotelling model), Johnson modeled the diversity of creative works around a circle. Rather than choosing to locate at a particular point on a line segment, in Johnson's model firms locate at a particular point on a circle.

Johnson's first model variation regarded copying as household production activity, in which marginal reproduction costs vary across households. Johnson showed that, in the short run, copying reduces the price and revenue generated from the sales of original products, while consumer surplus rises due to increased consumption and lower prices. In the long run, Johnson argued that copying can reduce consumer surplus *and* social surplus depending on how many consumers decide to switch from purchasing to copying and on how much this decrease in revenue diminishes the supply of creative works (the number of firms will not remain fixed in the long run). Because creative works are not perfect substitutes, the severity of this reduction in supply is positively related to consumers' preferences for variety.

The second variation of Johnson's model assumes that the marginal cost of copying is zero for all households, but requires that a large fixed cost of reproduction must be met before households can copy. In the short run, this model demonstrates that if the fixed costs are large enough and if enough high demand consumers switch to copying, social welfare may decline. In the long run, just as in the first model variation, copying can reduce consumer surplus *and* social surplus if the revenue decrease in sales of originals is large enough to reduce the supply of creative works.

One complicating factor not considered by Johnson but considered in this dissertation, is that creative works are not simply produced by a firm. Instead, these works are created by individuals (artists) who contract with firms as intermediaries. We also respond to Johnson's call for empirical studies in the area. According to him, empirical work is needed to quantify (1) the degree to which copying reduces the demand for originals as opposed to increasing total consumption, (2) the elasticity of supply of creative works, and (3) the value consumers place on variety. As of this writing, nearly twenty years after the publication of Johnson's article, there is still a void in the literature in all three of these areas.

Chapter 3, A Case Study of the Music Industry

3.0 Introduction

The structure of the music industry does not neatly fit any one standard economic definition for market structure. Basically, the industry is a combination of the oligopoly and monopolistic competition models. The industry is comprised of five multi-national conglomerates (Sony, AOL Time-Warner, Bertelsmann, EMI, and Universal), known as the *major labels*, and several thousand smaller companies known as *independent labels*. Both of these groups serve intermediary functions for artists –whether songwriters, musicians, vocalists, or individuals who perform all of these activities – by offering specialization at tasks such as recording and promoting records. These groups also serve as intermediaries between the artists and the consumers by assisting in the task of distributing records.

Although the major labels typically operate their own network of distributors, the independents rely on both the majors' network and an independent network of distributors which, based on *The Industry Yellow Pages*, numbers at least 500 firms. In essence, artists supply record companies with their talent (the raw materials) and record companies, in turn, supply consumers with music (the finished product). This relationship, with the added consumer choice of copying, is illustrated in Figure 3-1. As a supplier of raw material, artists currently have very little market power. Not only are there many more artists than record labels (Census data shows approximately 161,000 *employed* musicians and composers as of year 2000), but artists are largely dependent on record companies for distribution. As to the market power of record companies when selling to consumers, an important difference relates to the majors and independents.

While both majors and independents typically own the exclusive right to manufacture and sell the sound recordings of their artists, the majors enjoy a much larger degree of control over the distribution chain than do the independents. In fact, sales of music by the five major labels combined accounted for an 83% market share of world-wide album sales in 2001 (see Figure 3-2). Still, both the majors and the independents operate on nearly identical business principles, with the ultimate goal of selling records. The forthcoming sections of this dissertation are intended to give a clear explanation of how the music industry functions and the issues that it now faces in the digital age. While there is no section devoted solely to the artist, all of the sections are developed based on how their respective topics relate to the artist.

Figure 3-1

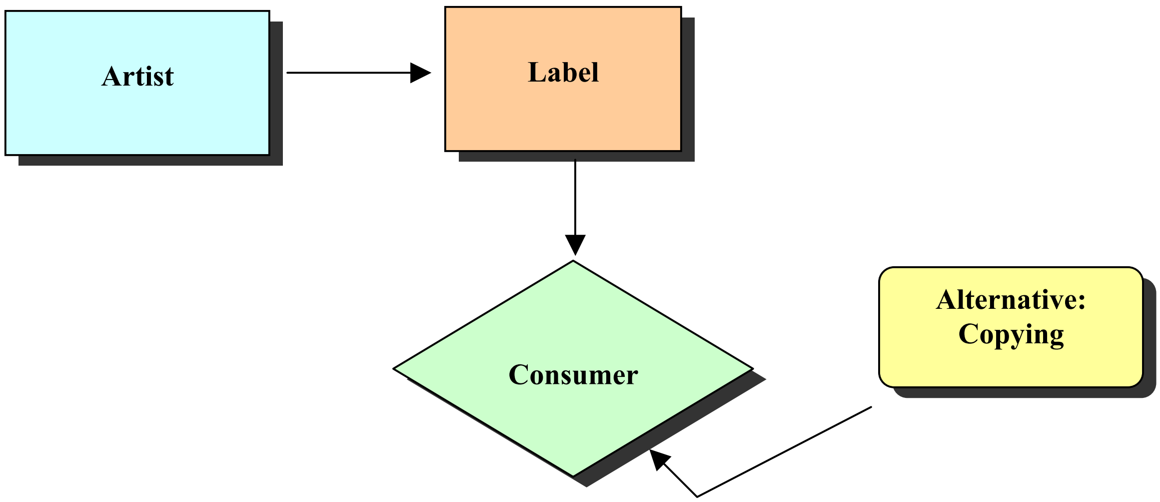
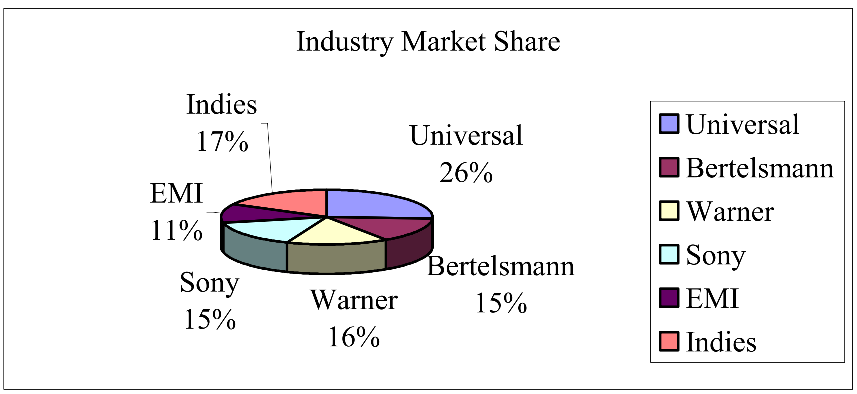


Figure 3-2



Source: Billboard's Market Watch report

3.1 The Record Label

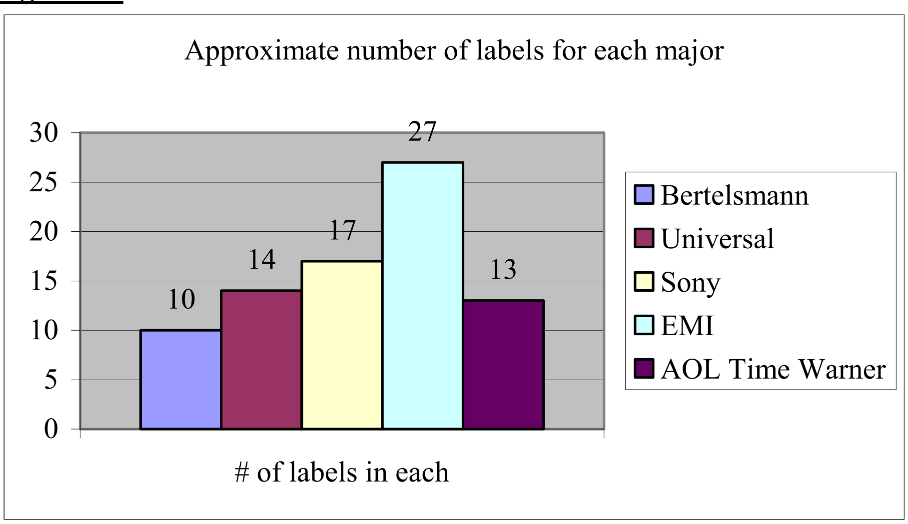
The foundation of the music industry is the relationship between the artist and the record company. More specifically, an artist can be a person who writes music, plays an instrument, performs vocals, or carries out some combination of each – alone or in a group. Likewise, the term "record company" can be used in several interrelated ways which also add to the complexity of this relationship.

Record companies can be viewed as belonging to one of two groups: the majors or the independents. The majors are comprised of five multinational conglomerates, which collectively hold the rights to most of the world's "hit" songs. These firms achieve this all-inclusive nature by vertically integrating at various levels of the industry and, most importantly, by owning several companies known as record *labels* (Figure 3-3 shows the approximate number of labels owned by each major). These labels are known in the industry as the "major labels," and each one usually specializes in either a particular genre of music or group of similar genres. For example, Sony owns more than 20 labels with several in the "pop-rock" genre, several in the "classical" genre,

etc. So, while under contract with Sony, an artist could work with, for instance, Sony's *Epic Records* label. The *Epic* label would then work with any number of Sony's manufacturers, promoters, and distributors (not necessarily exclusively) to sell copies of the artist's album and to license the music for various uses. To understand exactly how these functions are carried out, it is helpful to look at the other group of record companies, the independents.

Not only do most artists never sign with a major label, but most independents operate in a very similar fashion to the major labels – just on a smaller scale and with less vertical integration. In fact, many of the major labels look to the independents for sources of new talent. When a major signs an artist already under contract with an independent, some sort of sharing arrangement, usually a 50/50 split of revenues, is worked out between the two labels.[1] When artists become well known by selling, for example, a multi-platinum album, they usually sign with a major – and the independent remains an independent. The multi-platinum selling artist is, however, somewhat of an exception to the rule. Most artists do not even sign with majors, whereby a comprehensive examination of the music industry would be incomplete without analyzing the independents. Therefore, much of this chapter will examine the artist-label relationship based on the independent label. Fortunately, this focus does not weaken the overall analysis since the intermediary functions performed by both independents and majors are very similar. In both cases, the record company will either perform, or arrange to have performed, the following tasks: (1) managing, (2) recording, (3) manufacturing, (4) promoting and (5) distributing. These interactions are represented graphically in Figure 3-4. As will be seen below, the recording and promoting functions comprise the label's total fixed cost, while the managing, manufacturing, and distributing functions comprise their total variable cost.

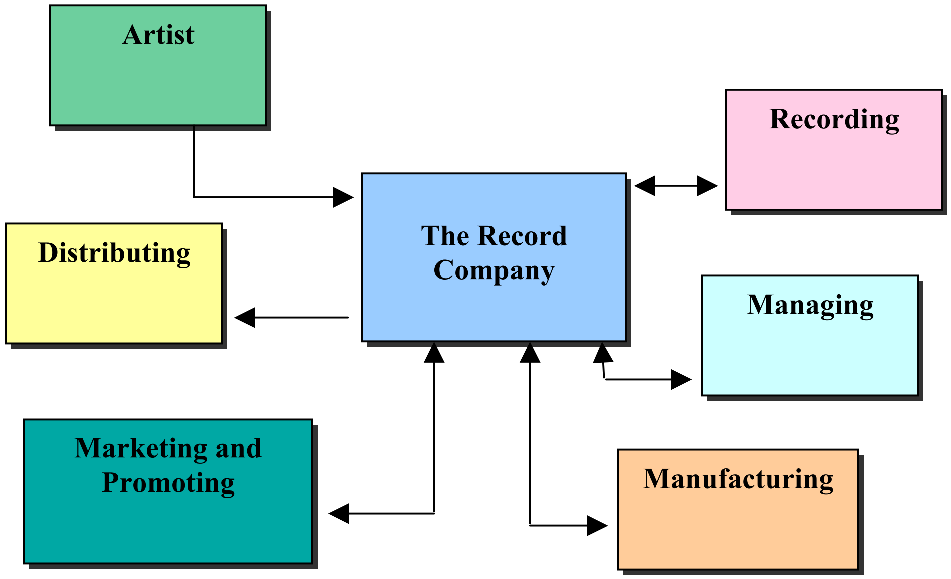
<u>Figure 3-3</u>



Source: Corporate Documents

[1] Artists cannot just walk away from the independent if they are under contract, so some sort of agreement is usually worked out. If, however, the independent does not like the major's offer, the artist can be stuck with the independent. Instead of becoming a major label, the independent remains an independent – it is simply distributed by a major. This information was gathered from an email interview with Daylle Deanna Schwartz.

Figure 3-4



Historically, an artist who solely wrote songs depended on a *music publisher* to act as an agent, lawyer and promoter, as well as to find recording artists. The publisher, in turn, usually relied on a record label for assistance with finding artists, recording the songs and promoting the finished product. Through the years, however, fundamental changes have gradually altered this publisher-label relationship. In the last decade or so, it has become a dominant characteristic of the industry that most artists who write music also perform their own material. This sort of change, as well as what appears to be a natural confluence of operations between the two, has severely blurred the lines differentiating the label and the publisher. In fact, while many publishers have taken on the responsibility of securing recording contracts with record labels, for both *recording artists* and *songwriters*, many record labels (as well as successful artists) have started their own publishing companies. While the main differences will be explained in greater detail below, as the record labels and the publishing companies serve similar/identical functions, we will collectively refer to these entities as *the label* for the remainder of this section.

A useful starting point for examining the artist-label relationship can be found by answering the question "Why does an artist create music?" Basically, an artist will create music because it is enjoyable and/or financially rewarding. For now, we will assume that the artist creates music for both these reasons, or at least because it is financially rewarding to some minimal extent. Initially, the artist either writes/memorizes an original composition and/or fashions some sort of self-made, rudimentary recording of it. The typical unknown artist's initial problem is that he or she possess nothing more than the raw material needed to create a finished product (a music CD).

To create and sell the finished goods, the artist can either self-perform all the tasks of the label (see Figure 3-4), or work with a label to gain assistance with these functions. Naturally, if the artist self-performs all of these tasks, there will be much less time available to create music. Furthermore, since substantial record sales for new/unknown artists usually do not occur for many months (perhaps years), the unknown artist really cannot depend on record sales as a main source of income. Clearly, if the artist tries to perform all of these tasks while trying to hold down another job, the time to devote to creating music will be severely limited. Scarcity of both

the artist's time and financial resources, then, seems to be a key reason that the label can fulfill its intermediary role. Still, the idea that an artist merely takes unfinished goods to the label that creates, promotes, distributes and sells the finished product is inaccurate. In reality, some of the label's tasks have to be self-performed by the artist at least initially. Risk is a key reason for this sort of role-sharing. A label who contracts with an artist takes on the risk of financing the recording, manufacturing, promoting and distributing of the artist's material until sales are made. The label is also faced with the risk that the artist will not sell nearly enough to earn a profit. Consequently, depending on the situation, there are some fundamental tasks that an unknown artist has to perform before signing with a label.

Typically, the artist has to have some sort of professional recording, some basic following from live performances and, preferably, some sort of notoriety in media publications. When approaching a label, artists have to be able to successfully argue that their product can be worked into a saleable album. Daylle Deanna Schwartz, former owner/founder of independent label *Revenge Records*, says that she "…always tried signing artists with finished, or almost finished, products. It obviously saves money on studio expenses, but that wasn't my main concern. If the material was at least close to its final state, I didn't have to worry about whether the artist carried out his or her potential. I don't like gambling." (Schwartz, 1998, p. 82) The artist also has to start performing concerts in local venues to build a fan base.[2] Most prudent label owners would rather sign an artist who has both a professional recording and a budding local fan base from live performances.

These actions show the label owner that the artist is serious about developing a saleable finished product and, more importantly, that an audience exists for the music. Once the artist completes these tasks and signs with a label, assistance is provided with the all important tasks of recording, promoting, distributing, advising and, ultimately, selling records. Since specific legalities of the contract will be discussed in Section 3.2, we will now focus on the exact nature of each of the aforementioned tasks.

3.1.1 Recording

To obtain an initial recording, the artist will most likely have to go to a local studio and cover these expenses directly out of pocket. Depending on the exact nature of the studio arrangement, these costs could range from being rather nominal to quite expensive. For example, independently owned studios could charge anywhere from $35 to $95 per hour for use of the studio (with the best rates for larger blocks of time) and, perhaps, additional charges for working with a particular producer or engineer.

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[2] The extent of successful live performances necessary will partially depend on the music genre. For example, if an artist is trying to sell dance music that is commonly played in clubs, it may be more important to focus on getting local DJ's to play the music first as opposed to starting out with her own live performances. In this case, the artist needs to be able to show that local DJ's are actively playing her music in clubs. For other genres, such as new age, classical/instrumental music, the level of live performance buzz probably does not need to be as high. These genres will sell to a limited number of specifically targeted music consumers as opposed to appealing to the mass market. The genre will also be a determining factor in how much material the artist needs to record. For example, while the rock/pop genre practically necessitates that the artist creates a full-length album, artists in the dance genre can do just as well with only a single. The genre also dictates the overall cost of the promotional campaign used to develop and promote the artist. Again, the dance genre requires very little expense in this area relative to the rock/pop genre.

After signing with a label, however, the actual transforming of the artist's music into an album takes on a new dimension. The ensuing costs, which can range from approximately $40,000 to $150,000 for a new artist, are treated as an advance to the artist and are later recouped by the label from the artist's royalty payments. The recording costs should be viewed as part of the label's fixed cost; all new artists in a particular genre will be allocated nearly the same amount for recording expenses, and the label will recoup these expenses before the artists receive royalties. In fact, the typical recording contract calls for these expenses to be recouped not only from the album for which they were incurred, but from subsequent recordings as well. Therefore, it is entirely possible, even somewhat likely, that an artist will not receive any royalty payments from the first album or, in many cases, the first few albums released.

After artists gain more popularity and sell more albums, the label usually allocates a recording fund to them. For example, the label could allow the artist a recording fund of $200,000 and then administer payments from the fund on an as needed basis. If the recording were to come in under budget, the label would give the balance of the recording fund to the artist as an advance. Of course, the label would view the *entire* fund as an advance and would recoup the total amount from the artist's future royalties. The exact amount of the recording expenses depends on several factors.

Typically, the studio itself is an independently owned entity which offers a wide range of services. The smallest of the labels, for example, would probably buy all of their own supplies (computer discs, DAT's, tapes, etc…) from outside sources and then use the producer/engineer that works at the studio. On the other hand, a more established label would probably arrange for a high quality recording team (producer, engineers, session musicians, etc.) to use a studio which provides all the needed equipment and supplies for the recording.[3] The actual recording process can be very time consuming and the need for competent people working to get the best possible recording in the shortest amount of time is vital. According to Schwartz, "…be careful about choosing your recording team. Putting the right players together can mean the difference between a mediocre and a great recording." (Schwartz, 1998, p. 96) Once a high quality master is produced, the saleable copies can be manufactured.

3.1.2 Manufacturing

The manufacturing costs of the record are actually one of the largest expenses that the label and, therefore, the artist, will incur. In a manner similar to the recouping of recording expenses, the label deducts the manufacturing costs from the artist's royalty *base*. This expense ranges from 15% to 25% of the suggested list price and varies depending on the status of the artist, the manufacturing company itself and the exact configuration used for packaging. So, for example, if the suggested list price for an album is $20, 25% will be deducted from this amount and the artist's royalties will be calculated based on $15 instead of $20. These costs are part of the label's variable costs – the more CDs manufactured, the greater the manufacturing costs incurred by the label.

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[3] This does not mean to imply that smaller studios do not have high quality sound engineers and/or producers. Many small studios are owned and operated by extremely competent individuals. The distinction here is being made only to point out where some of the differences in recording expenses could arise. This is just like any other business in that there are expensive, "high-end," firms which can provide a comprehensive array of services, and inexpensive, "low-end" firms which provide the customer with the basic necessities. It is also important to point out that the type of music being recorded and the skills of the artist will also drive many of these studio decisions and, therefore, the overall recording expenses.

Tony van Veen, VP of Sales and Marketing for America's largest CD manufacturer for independents (Disc Makers), gives valuable insight into the significance of these costs. According to van Veen, "CD and cassette manufacturing is both the easiest and the most difficult part of running a record label. It's easy because as long as you have a master tape and cash there are plenty of companies able to deliver CDs to you. But it's really tough to finance and manage a growing record label, and manufacturing costs figure to be the most significant consumer of your precious cash during the start up and growth phase of your label." (Schwartz, 1998, p. 104) It is not uncommon for the initial number of records pressed/CDs burned to be between 1,000 and 5,000, depending on the situation. Since the cost per item is usually between $3 and $5, artists trying to pay these expenses out of pocket would need to have considerable capital for the manufacturing process. Assisting the artist by financing these expenses is a clear example of why the label can offer its intermediary services. Of course, regardless of who is paying for it, simply manufacturing the CDs would be both costly and wasteful unless consumers are able to purchase them.

3.1.3 Distribution

The process of distributing the finished product so that sales can be made is just as vital as recording and manufacturing a quality product. As the recording and manufacturing processes are being carried out, the label is simultaneously promoting the artist so that people will buy the records. Since sales really are the goal of both the artist and the label, not having a record available for purchase when it is sought by the consumer could be a fatal mistake.

While music is sold online and through mail order clubs, the overwhelming majority of record sales are still made in stores (these are now commonly referred to as "brick and mortar" stores as opposed to the "cyberstores" of the Internet). Naturally, then, somebody has to get the finished product into these stores. According to the Recording Industry Association of America's (the RIAA) *2000 Consumer Profile*, approximately 87% (see Figure 3-5) of all record sales in year 2000 were made in stores.[4] While the complete RIAA profile will be examined in greater detail in Section 3.5, the report does exhibit some interesting trends which are relevant to this section.

To begin, while the total percentage of industry sales in *record* stores has been declining over the last ten years, the portion of total sales in the category of *other* stores has been steadily increasing over the same period. This category of *other* stores includes such places as Wal-Mart, Circuit City, Barnes and Noble, etc. While record stores' share has slipped from over 60% in 1991 to about 42% in 2000, the share captured by *other* stores has risen from a low of 23% in 1991 to just under 41% in 2000. Since these mass merchants typically sell CDs at lower prices than record stores, it appears that many consumers like to pay less for their music. Furthermore, the percentage sold through mail-order clubs has been steadily declining, from about 15% in 1994 to just over 7% in 2000. Finally, while total Internet sales increased 118% and 33% over the last two years, respectively, the net's total share of the market still stood at less than 3.5% in 2000. Even though the Internet, especially through the downloading of music files, appears to pose a major threat to the *future* of the traditional methods of music distribution, the bulk of record sales are clearly still being made in actual stores rather than in cyberspace. Aside from technological issues, which will be fully discussed in Section 3.4, there are at least two basic reasons that more artists do not distribute their own albums.

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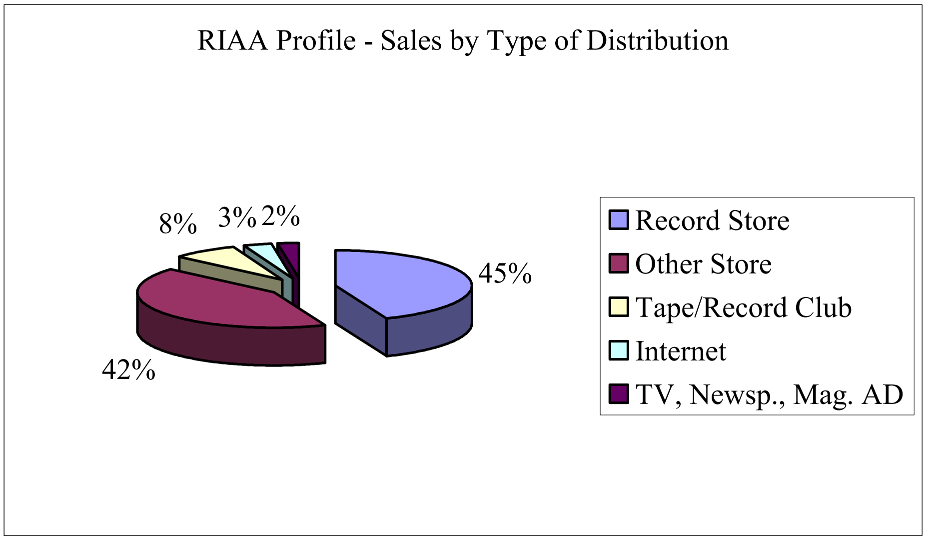
[4] The category "record sales" includes full length CDs and cassettes, all types of singles, vinyl LPs, and even music videos.

Figure 3-5



Source: 2000 RIAA Consumer Profile

First, many stores will not buy directly from artists. Not only do retailers have limited shelf space, but they do not want to be concerned with judging which artists will be popular. Secondly, as an artist's music gains in popularity and starts to sell in larger markets, keeping up with distribution becomes increasingly complex. In fact, this logistical aspect of record distribution is a key reason that the label can fulfill its intermediary role.

To begin to understand how music distributors operate, one should first recognize that they too are concerned with making a profit. It should also be realized that distributors are not promoters in any way; they are middlemen between labels and stores. When distributors do not have faith in both the label's ability to consistently promote the artist *and* in the artist's talent, they simply will not carry the product. While distributors do take records on consignment, they do not get paid unless the retail stores actually sell the records. Therefore, the distribution costs can be viewed as part of the label's variable costs – they will vary based on the quantity of sales. Once the retailers make sales, the distributors get paid and, in turn, pay the labels a pre-agreed upon price less *all* returns.

Since music distributors decide on their own which records to carry, the label has to convincingly show the distributor that the product will sell. Consequently, a label with a proven track record of signing and promoting successful artists will find this task easier. According to Schwartz, "Distributors are looking for records that will sell, that already have a market, and that have a label behind them ready to work its butt off to promote them." (Schwartz, 1998, p. 129) More pointedly, distributors mitigate their sales risk by carrying music backed by established labels. According to Michael Koch, the president of distributor Koch International Corp., "The first ingredient for a new label is a great song and an artist to deliver the song. But, without knowledgeable management and adequate financing, the chances for success are greatly diminished. Do whatever is necessary to secure [those] requirements." (Schwartz, 1998, p. 129) So, aside from the logistical concerns discussed earlier, there are also financial reasons which allow the label to function as an intermediary for the artist. Another important aspect of the

traditional distribution chain is that there are significant differences between how independents and majors distribute there recordings.

First, while some independents do distribute nationally, the vast majority of independent recordings are distributed locally and/or regionally, frequently into specialty music stores which are not part of a chain.[5] Since most independents do not have the wherewithal to actively promote an artist nationwide, most national distributors will not distribute their recordings nationwide. The majors, on the other hand, own their own network of national/international distributors and, consequently, are more easily able to place their own artists into the national retail chains. Another advantage possessed by the majors is that they own a network of labels which consistently produces top-selling artists – a clear risk mitigating factor for retailers. To see how much of an advantage the majors have in this area, it is helpful to closely examine the Billboard charts.

The Billboard charts, commonly called the "pop charts," are updated weekly and principally reflect the following two factors: (1) which albums are selling the most and, (2) which releases from those albums are getting the most airplay on radio stations.[6] Based on these criteria, the 2001 year-end *Billboard Top 200* compiles ratings across most genres. Of the top 100 titles, exclusive of 3 soundtracks, only 27 were from an artist *not* signed to a major label. However, six of these 27 titles were from the *Zomba* label which is recognized as the largest independent label in the world and represents artists such as Britney Spears, 'N Sync, and the Backstreet Boys.

Also, four of these titles were from the Dreamworks label which is aptly funded by Stephen Spielberg, Jeffery Katzenberg and David Geffen. Out of the remaining 17 titles from artists not signed to major labels, 11 were *distributed* by a major label. So, out of 97 titles on the Billboard Top 100, only 8 titles were not affiliated with one of the major labels (or with Zomba and Dreamworks).

Even Billboard's genre specific charts are dominated by the majors. Figure 3-6, taken directly from the Billboard charts, lists these charts and their corresponding number of independent affiliated artists. While the "Country" chart does list 8 non-major-affiliated artists, 6 of these 8 are from the label *Curb*, which is recognized as the largest of all *country* music labels. Additionally, two of the four titles from the "Pop" chart are from the same artist, both of the titles on the "Jazz" chart are from the same label, and the lone title on the "Hot Dance" chart is from the *Zomba* label. The next function to be discussed is that of promoting the artist – an area where the majors do not appear to have such a clear *overall* advantage on the independents.

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[5] Many independents actually use a combination of distributors – those which sell regionally and those which are referred to as *one-stops*. The one-stop distributors are the main suppliers for the mom & pop type music stores, and they typically specialize in one particular genre and/or geographical area.

[6] While they are not nearly as popular nor consolidated, independents also have charts. In fact, although it is based solely on sales data (as opposed to radio play *and* sales data), even Billboard posts a weekly "Independent Music" chart. There really is no one main source for independent music charts – college radio stations issue there own, various organizations issue there own, and IUMA issues several.

Figure 3-6

Billboard Chart	# of Artists Not Affiliated With A Major
Top 20 R&B/Hip Hop	1
Top 20 Country	8
Top 20 Pop	4
Top 10 Electronic	4
Top 10 Classical	0
Top 10 Jazz	2
Top 10 Contemporary	2
Top 10 Hot Dance Club	1

Source: Billboard Charts

3.1.4 Marketing and Promotion

As previously alluded to, before they will be signed by a label, artists have to start building a fan base from, among other things, successful live performances. While artists can, on their own, post flyers and give away promotional CDs to attract would be fans, it would be incorrect to think that a sustained marketing campaign can be orchestrated without any help.[7] Since the distributors want to see proof of a fan base, media coverage, radio play and the financial backing needed to sustain a marketing campaign, much more than passing out flyers will be necessary. Even if the music is terrific, if consumers do not hear it on the radio, read about it in publications, see it performed on videos and/or hear it at live performances, the chances of them finding out about it are greatly diminished. By offering specialization in these promotional areas, the label is able to provide intermediary services to artists.

All of the promotional tasks performed by the label – attracting the attention of radio professionals, advertising concerts, paying for radio commercials, giving away recordings, making videos, securing interviews, etc…, are all aimed at increasing sales. Depending on the size and expertise of the label, outside publicists and marketing experts are frequently hired to work with the label's own people to promote the artist's music. Just as with the other expenses examined above, these marketing/promotion costs are also usually treated as advances to artists and then recouped from their royalties.[8] These costs, for any given genre, can be viewed as part of the label's fixed costs. For example, practically all new artists in the "pop" genre would be allocated $100,000 for promotional expenses, all those in the "instrumental" genre $30,000, etc. In all the various promotional tasks that are performed, the majors do have the financial resources to easily promote an artist nationally/internationally. Still, given their ability to use third-party

[7] This is not to say that no artists are capable of handling their own promotions. In fact, some artists do handle some of their own promotions even after they are signed. This statement is made only to show that this function, just as the others that have been discussed, requires an investment of both time and money. Additionally, the promotion function requires that a great deal of time be devoted to it *on an ongoing basis*. The scope of the marketing campaign will depend on the genre of the music. For example, since instrumental music does not have as wide of an appeal as pop/rock, massive national campaigns and extensive artist development are not needed.
[8] More established artists are sometimes able to negotiate with the label so that only a portion (up to 50%) of these expenses will be recouped from royalty payments. An unknown artist, however, usually does not have any leverage with which to bargain for such a deal.

publicists and marketing experts, it is not entirely clear that the independents suffer from an *overall* disadvantage in the marketing/promotion area. Nonetheless, the majors do have a clear promotional advantage over the independents in the area of commercial radio.

For many independent labels, the only radio play that can be secured for their artists is on college radio. Commercial radio is dominated by the artists signed to majors and is much more difficult for an independent to break into. One of the main reasons for this dominance is that commercial radio depends heavily on advertising revenue. The stations get most of their revenue from advertisers who, naturally, want to know that the music being played on the station has a large audience. A key indicator of this audience size is, of course, sales quantities. Still, it is interesting to note the circularity of the relationship between distribution, radio play, the billboard charts, and record sales. For example, an artist makes it onto the charts through extensive sales and radio play, but commercial radio play is typically reserved for artists who sell extensively. Furthermore, the records which sell the most are those that are distributed by the majors and receive extensive commercial radio play. As of December 2001, while only two titles on Billboard's Top 20 *Independent* chart sold over 500,000 copies, 14 of the artists on Billboard's *Top* 20 Pop chart sold over 1 million copies. Still, as will be discussed more fully in Section 3.5, there is not necessarily a direct correlation between radio play and sales. In many cases, independents sell music which, relative to that of the majors, does not have a large fan base. The last major function that will be discussed is the managing of the artist's career.

3.1.5 Managing

Depending on the situation, the label will have a team of people on staff to manage and assist artists through the daily demands of their career. While the size of this team is not necessarily too large at first, as the artist gains more exposure, sells more records and begins touring on a regular basis, a larger group will be needed. Therefore, these costs can be viewed as part of the label's variable costs. Additionally, when artists' CDs start selling in large enough quantities, major labels are likely to become interested and will want their own specialists involved. Since the artist is usually already signed to an independent, however, the specifics of these arrangements will depend on the negotiations between the two labels. Usually, the artist is likely to have, at the very least, some input in these decisions. So, exactly what is the role of a manager?

The manager is responsible for "….the day to day career development, personal advice and guidance, and planning the long-range direction of the artist's career." (Krasilovsky & Shemel, 2000, p. 352) Depending on the relationship with the label, the manager performs tasks such as choosing material, handling public relations and publicity matters, selecting booking agents, determining which engagements are best for the artist's career, and selecting and supervising the artist's attorneys and accountants.[9] Typically, managers receive commissions of 15% to 25% of the artist's gross earnings plus expenses, all of which are usually recouped from the artist's royalty payments. Since very few people, much less unknown artists, can afford to have their own highly skilled attorney advising them on every important choice they make, it is of the utmost importance that an artist builds a good relationship with a reputable independent before signing. The next section will describe some of the specifics of a recording contract and how the artist actually receives money from the sales of records.

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[9] In many cases, the independent may consist of an owner and one or two employees. In this type of situation, the label owner would probably be responsible for most of these managerial tasks.

3.2 Recording Contracts and Royalties

In this section, to discuss exactly how artists are paid and what they are obliged to do under recording contracts, the record label and the publisher will be examined separately. A distinction between the type of artist will consistently be made in this section. Specifically, an artist will now be referred to as either a *songwriter*, a *recording artist* or, in the cases where the artist performs both functions, as a *songwriter/recording artist*.

Under the typical recording contract, the artist is legally bound to render services as a *recording artist* "…on an exclusive basis for the purpose of making recordings from which phonograph records can be manufactured. The term phonograph records encompasses compact discs, cassettes, and any and all other devices, including audiovisual devices that contain an artist's recorded performances. A device includes all technology, whether presently known or invented in the future, that is capable of transmitting music through cyberspace, with the possible exception of digital audio broadcasting."[10] (Krasilovsky & Shemel, 2000, p. 13) The standard contract typically runs for a term based both on the *recording artist* delivering a minimum number of songs (usually enough for one album) and on some period of time thereafter (usually 9 months). In most cases, the record company reserves the right to extend the contract by picking up options. While *songwriters* also sign exclusive contracts, they sign contracts with *music publishers* who, in turn, work out agreements with record labels to have the songs performed by *recording artists*. In the end, the exact nature of these interrelationships determines how the royalties from music sales are divided.

There are three main types of royalties which *songwriters* are entitled to– mechanical royalties, synchronization royalties, and performance royalties. *Mechanical* royalties are those paid to the songwriter by the record label – or, as will be explained shortly, by anyone else – for the right to manufacture and sell recordings of the songwriter's songs. The publisher holding the copyright on a song issues the record label a license which gives it permission to manufacture and distribute a recording of that song. This license, called a mechanical license, provides that "If phonorecords of a non-dramatic composition have been distributed to the public with the authorization of the copyright owner, any other person may record and distribute phonorecords of the work by giving a specified notice and paying a statutory royalty. A record is considered distributed if it has been 'voluntarily and permanently parted with'."[11] (Krasilovsky & Shemel, 2000, p. 176) Literally anyone, by virtue of giving notice and paying a statutory royalty, can re-record and distribute a copyrighted work which has already been distributed.

Until recently, this practice, known as *compulsory licensing*, was generally opposed by top-selling artists and favored by record companies. More pointedly, "While authors and music publishing groups have argued vehemently against the continuation of the compulsory mechanical license, record industry representatives have fought strongly and successfully for its retention." (Krasilovsky & Shemel, 2000, p. 111) Possible reasons for each group's stance on compulsory licensing will be analyzed more completely in Section 3.4. Notwithstanding the controversy, the statutory rate for a mechanical license is currently set at $0.0755 per composition.[12] So, for every recording of a composition that is *sold*, the holder of the copyright is

[10] While it is still being debated, digital audio broadcasting appears to fall under the category of a public performance and, as such, is subject to the same licensing process as any other performance right.
[11] Until the Copyright Act of 1909, anyone could reproduce music through mechanical means and was not obligated to compensate the copyright owner.
[12] The Copyright Act of 1976 established the Copyright Royalty Tribunal (CRT) to

paid \$0.0755. From this total, the *songwriter* is initially entitled to a 50% share and the publisher the other 50%. However, in the case of a *recording artist/songwriter*, a co-publishing agreement is frequently signed which entitles the artist to 50% of the publisher's share as well – for a total of 75% of all mechanical royalties.[13]

Synchronization royalties are those which are paid to the songwriter for the use of a song in commercials, TV shows, movies, theatrical performances, etc. The rates for synchronization licenses are not statutory, and the dollar amount negotiated tends to vary based on exactly what the song is being used for. Still, the same sort of writer/publisher split used with mechanical royalties typically applies to synchronization royalties as well. Incidentally, over 20,000 music publishers are represented by the Harry Fox Agency, an organization which issues and collects, on a commission basis, both synchronization and mechanical license fees for its members. The agency's gross collections have grown an average of 26% per year over the last decade and, in 1997, they exceeded \$400 million per year. (Krasilovsky & Shemel, 2000, p. 180) The third type of royalty the songwriter receives is referred to as the *performance* royalty.

The *performance* royalty is collected when a musical composition is played or performed in public venues – at clubs, on the radio, in jukeboxes, etc. "For most songwriters, background scorers, and music publishers, the performing rights area represents their greatest source of continuing royalty income." (Brabec & Brabec, 2000, p. 237) Performance rights licenses are issued (and fees are collected) by, mainly, three organizations representing music publishers and composers. While the fees charged by each group are similar, each determines its own fee schedule. Also, while each organization is free to negotiate the type of license it issues, either a blanket license or a per-use license, blanket licenses are the most common. As their name suggests, blanket licenses give the licensee unlimited use for one set fee. For example, the organization will negotiate to allow a radio station unlimited use of its catalog for a fee of about 2% of the station's adjusted gross revenues.

These membership organizations are *The American Society of Composers, Authors and Publishers (ASCAP)*, *Broadcast Music, Inc. (BMI)*, and the newest of the three, *SESAC*.[14] Dual membership in either of these organizations is disallowed. ASCAP is the oldest of the three organizations, has over 100,000 members, and collects the bulk of its license fees by issuing blanket licenses to TV and radio stations. ASCAP's annual gross receipts have been over \$500 million since 1998. BMI, while much younger, claims to have approximately 200,000 members,

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determine statutory rates. In 1992, this tribunal was replaced by a three person ad hoc panel called the Copyright Arbitration Royalty Panel (CARP). Future rate adjustments were stipulated to be based on CPI changes from September to September every two years. It was also stipulated that the rate could not fall below \$0.05 per composition up to five minutes in duration nor rise more than 25% within any two year period regardless of the actual change in the CPI.

[13] In the case of the *recording artist/songwriter*, the record label frequently inserts a "controlled composition" clause into the contract. A controlled composition refers to any composition written, owned or controlled, in whole or in part by the artist. Under this clause, the record label reduces the amount of the mechanical royalty that it pays to the artist. Typically, 75% of the statutory rate is paid as opposed to the full rate.

[14] The following quote is taken directly from the company's web site (www.sesac.com), "SESAC is not an acronym for anything these days. For history's sake, we can tell you the name originally stood for Society of European Stage Authors & Composers, a fitting moniker back in 1930 when the company was founded to serve European composers not adequately represented in the United States. Today, however, the company is known simply as SESAC. With an international reach and a vast repertory that spans virtually every genre of music, SESAC is the fastest growing and most technologically adept of the nation's performing rights companies."

and also collects the bulk of its fees under blanket license agreements with the broadcasting industry. As of 1998, BMI's annual gross receipts were over $450 million. According to Krasilovsky and Shemel, "…the same licensees who use the music of both societies pay somewhat less to BMI than to ASCAP." (Krasilovsky & Shemel, 2000, p. 154) SESAC, which does not disclose its financial information, is a privately held corporation that represents only about 2,000 members. According to published 1999 data, BMI and ASCAP distributed to their members 81.5% and 77.7% of their gross receipts, respectively. Based on these figures, the average songwriter belonging to BMI and ASCAP received $1,850 and $4,350, respectively.[15] The royalty payments for a *recording artist*, however, are calculated and collected somewhat differently.

A typical royalty clause in a recording contract reads as follows: "The artist shall be paid a royalty of 15% of the applicable suggested retail list price in respect of all long-playing albums manufactured and sold for which payment has been received." (Brabec & Brabec, 2000, p. 71) The exact percentage of the *album royalty rate* is completely negotiable and depends mainly on the stature of the artist. New artists typically receive between 10% and 12%, while the most successful artists can receive as much as 17% to 25%. Alternatively, the record label will issue royalty payments on the wholesale price of the record and, since the wholesale price is roughly half of the retail list price, double the royalty percentage for the artist. At least, the record company *should* double the royalty rate.[16] This is just one of the many examples of why an artist has to be well informed about industry practices before signing a recording contract. Careful negotiations are critical because album royalties (see Figure 3-7), for both a *recording artist* and a *recording artist/songwriter*, are the most lucrative source of income for an artist.[17] While many of the deductions a record company makes from the artist's royalties have already been discussed, there are several additional recoupable expenses that should be mentioned.

To begin, even though the CD has been the widely accepted format in the market for many years, many labels still charge the artist a "new technology" fee by reducing royalties by roughly 10% of the applicable royalty rate.[18] Because many U.S. record companies use some type of licensing agreement with foreign distributors, royalty rates are also reduced on album sales in foreign countries, sometimes by as much as 50%. Additionally, in the case of a well-

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[15] These are only averages - the exact formulas and rate schedules used by each of these organizations varies significantly as does, consequently, the amount collected by each artist. Typically, the higher the number of "performances," the higher the artist's royalty payments. The performance royalties from TV and radio play for a *top-selling* artist would, naturally, be much higher than average. For more information on the specifics of their rate calculations and payment formulas, the reader should go to their respective web sites: www.sesac.com and www.bmi.com.

[16] Many new artists are also able to negotiate escalating royalty clauses so that the royalty rate paid on sales of albums escalates with the number of sales or that the rate increases when a record company picks up its option to extend the contract with the artist. On the other hand, the record company often inserts clauses which lower the artist's royalty rate if it decides to reduce the price of the album and/or sell the album through TV/mail order record clubs – frequently by as much as 50%.

[17] Many record labels only pay royalties on 90% of the albums sold *and* hold a portion of the artist's royalties in reserve to guard against excessive returns. Typically 25% to 30% is held in reserve for long play albums and 30% to 40% for singles. In some cases, however, as much as 50% will be held pending a final accounting. These figures are completely negotiable and depend largely on the stature of the artist. The record company usually remits mechanical and album royalties due its artist twice per year.

[18] Some artists, especially more recently, have been able to negotiate that this reduction only apply to the newest of mediums (such as mini-discs and downloads). Additionally, many artists negotiate a cutoff date for this lower payment so that it will not reduce their royalty payment for more than, for example, two years. Also, some artists may negotiate a rate lower than 10%.

funded independent and/or a major label, cash advances are commonly given to the artist upon signing a record deal, with *further* advances made when certain milestones are reached. For example, advances would be made when the recording of the album actually begins and when certain sales plateaus are reached. Additionally, the record label typically provides separate funds to support the recording artist on a live tour and to create videos for the singles released off an album.[19] These accounts, as is the case with the other disbursements discussed above, are treated as advances and are recouped from the artist's royalties. Of course, a key reason that the record companies are able to sell artists' recordings in the first place is that they have copyright protection.

3.3 The Music Industry and Copyright Law

The origin of the copyright can be traced to the late 1400's, shortly after the invention of the printing press. Initially, copying was regulated by monarchs in that certain individuals were granted the monopoly right to copy certain books or classes of books. Eventually, copiers began paying authors lump sums for the right to reprint their works (for a more complete analysis, see Plant, (1934)).

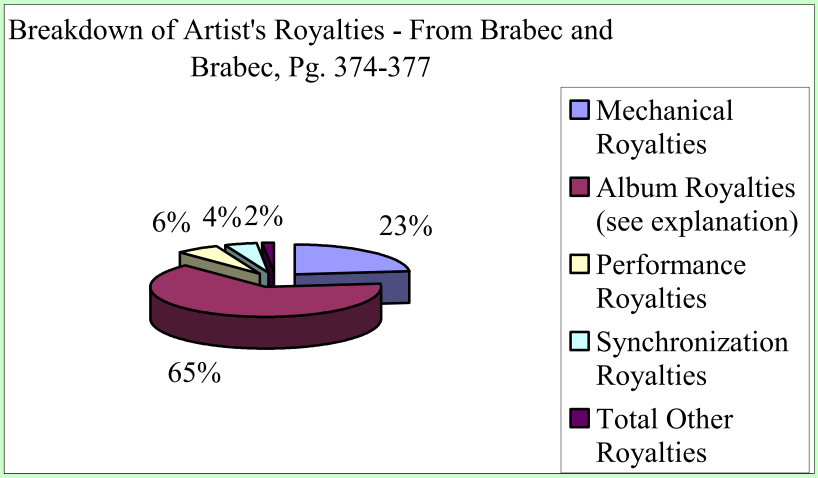
The United States Constitution, Article I, Section 8, states that "The Congress shall have Power ... To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." The first two major revisions/refinements to copyright law came in the Copyright Act of 1909 and the Copyright Act of 1976. Until the 1909 act, anyone could freely reproduce musical compositions. The Copyright Act of 1976 still forms the basis of today's copyright law. The copyright is an intangible property right which "…refers to that body of exclusive rights granted by law to authors for the protection of their writings [and] includes the exclusive right to reproduce, publish, and sell copies of the copyrighted work, to make other versions of the work, and, with certain limitations, to make recordings of and perform the work in public." (Krasilovsky & Shemel, 2000, pg. 95)

While it protects the expression of ideas rather than ideas themselves, the right is intangible in that it exists separate and apart from the physical expression. For example, when a consumer buys a *TLC* album, the physical product is owned, but the right to reproduce and sell that album still belongs to *TLC's* record label, *Arista*. With only rare exceptions, the record label is the copyright owner of all recorded performances throughout the term of a recording contract. Labels retain the copyright because nearly all recording contracts stipulate that "sound recordings are created for the company as works for-hire." (Krasilovsky & Shemel, 2000, p. 72) Section 101 of the Copyright Act of 1976 provides the following definitions for *sound recordings*, *phonorecords*, and *works for-hire*.

Sound recordings: "…works that result from the fixation of a series of musical, spoken, or other sounds, but not including the sounds accompanying a motion picture or other audiovisual work, regardless of the nature of the material objects, such as disks, tapes, or other phonorecords, in which they are embodied."

[19] Another practice that an artist has to watch carefully is one called *cross collateralization*. This practice allows the record company to, for example, withhold album and mechanical royalties from the artist to recoup video production expenses. The artist and the label usually negotiate that only a certain percentage of the royalties can be cross collateralized, but there is no set rule other than that a more established artist has more bargaining power.

Figure 3-7



Album Royalties:

$18	CD retail price
25%	Mfg./Packaging deduction %
$4.50	Dollar deduction
$13.50	Royalty base
18%	Royalty rate
$2.43	Artist royalty (per album)
3,000,000	Album Sales
$7,290,000	Artist royalties (pre-deduction)
(300,000)	Recording cost
(400,000)	Album advances
(100,000)	Touring fund
(200,000)	Promotional expenses
$6,290,000	Final Royalty Check

Adopted From Brabec & Brabec, 2000, pp. 374-377

Phonorecords: "…material objects in which sounds, other than those accompanying a motion picture or other audiovisual work, are fixed by any method now known or later developed, and from which the sounds can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device. The term 'phonorecords' includes the material object in which the sounds are first fixed…"

Works for-hire are either: "(1) A work prepared by an employee within the scope of his or her employment," or, "(2) A work specially ordered or commissioned for use as a contribution to a collective work, as part of a motion picture or other audiovisual work, as a translation, as a supplementary work, as a compilation, as an instructional text, as a test, as answer material for a

test, or as an atlas, provided that the parties expressly agree in writing that the work shall be considered a work for-hire."

Recently, the *works for-hire* provision has become somewhat controversial. Recording artist Don Henley leads a group called the *Recording Artist Coalition* (*RAC*) which is actively lobbying Congress to change the laws, and even Bertlesmann's BMI unit has come out in favor of the RAC's position. According to their statement, "BMI believes strongly in the rights of composers, songwriters, and publishers to own the copyright in their works." (Holland, 2000) While the issue is still unresolved, there is definitely an organized movement among recording artists to regain the ownership of their copyrights from past recordings *and* to keep copyright ownership of future recordings. Possible reasons for this newly organized movement will be discussed further in Section 3.4.

Similarly to the label-artist relationship, the music publisher retains the copyright to its writers' compositions. Incidentally, while the copyright notice – for example, © NJM Publishing, Inc. – is required for copies of *written* works to maintain their copyright protection, since *sound recordings* are actually not considered copies of written compositions, a copyright notice is not required to maintain protection on *sound recordings*.[20] Basically, "Two factors affect the copyright status of a sound recording: when and whether it is published." (Krasilovsky & Shemel, 2000, p. 96) According to the Copyright Act of 1976, publication is defined as "the distribution of copies of phonorecords of a work to the public by sale or other transfer of ownership, or by rental, lease or lending…." Any and all sound recordings published on or after February 15, 1972, and all those published or unpublished on or after January 1, 1978 are covered by federal copyright law. Any sound recordings published prior to February 15, 1972, and any unpublished by January 1, 1978, are covered by state common law until February 15, 2047, at which time they fall into the public domain – which is the status of any work for which copyright protection has expired. Since the passage of the 1998 Sonny Bono Copyright Term Extension Act, all federally covered works are protected for the life of the author plus 70 years after the author's death. Nonetheless, recording contracts actually give record labels a slightly longer duration of copyright protection. In the case of *works for-hire* written on or after January 1, 1978, copyright protection lasts for 95 years from the date of first publication or 100 years from creation, whichever is shorter. Since most recording contracts stipulate that sound recordings made during its term are regarded as *works for-hire*, the record label usually has this extended protection for its albums (those recorded after January 1, 1978). Infringement on the copyright falls into three distinct categories – *bootlegging*, *piracy*, and *counterfeiting*.

While each of these categories represent someone stealing someone else's property, they are slightly different. *Bootlegging* is the unauthorized recording of a live or broadcast performance. For example, *bootlegged* copies of U.S. artists' overseas performances are quite popular. *Piracy*, on the other hand, is the unauthorized duplication of the actual sound recording, and *counterfeiting* is the duplication of the entire good – the artwork, the packaging and the sound recording. Prior to Napster, which allowed users to make pirated copies of songs (in many cases), the more common understanding of piracy was when a foreign record company made an unauthorized copy of, for example, a *Rage Against the Machine* CD (copyright held by *Epic Records*) and sold copies of the record under its own name. If, however, the foreign company had copied the recording *and* the packaging, and then surreptitiously sold the CD under the *Epic*

[20] Even though failure to register the copyright does not cause the copyright holder to lose copyright protection, a copyright holder wishing to make an infringement claim cannot do so until the copyright has been registered. Still, even if the alleged infringement takes place before the copyright was registered, once registration has taken place the claim can be made.

label, it would have been guilty of counterfeiting. Due to increased bootlegging, piracy, counterfeiting and, in part, to the widespread popularity of home recording devices, there have been several recent attempts to update copyright law with new legislation.

One such attempt is the 1992 Audio Home Recording Act (AHRA). While it has been considered a failure by the music industry due to both its lack of financial returns and its failure to truly clarify the propriety of home recording,[21] this Act "…attempts to shield the consumer against copyright infringement liability for home copying for noncommercial use and protects hardware manufacturers, sellers of digital equipment, and blank-tape marketers from infringement liability…" (Krasilovsky & Shemel, 2000, p. 78) This act requires the above mentioned companies to pay a blanket license fee which is collected by means of a 3% surcharge on the transfer price of the device. The RIAA formed a non-profit organization named the Alliance of Artists and Recording Companies to collect these fees which, as of 1997, had not yet surpassed $900,000 in any given year. Next, mainly in response to the coming digital transmission of music over the Internet, the Digital Performance Right in Sound Recordings Act of 1995 was passed.

This act was an attempt to define new digital transmission technologies so that copyright protection would be preserved in the digital age. According to this act, digital transmissions fall into one of the three following categories: (1) *non-subscription* services, (2) *interactive* services, or (3) *subscription* services. A *non-subscription* service is the type of transmission which has come to be called "Internet radio" and it is not subject to a licensing fee under *this* act. This type of service allows users to log onto the Internet and listen to songs almost as if they had turned on a radio (the process is referred to as "streaming"). Next, while the service is free to the user, *interactive* services allow the user to download digital files free of charge. *Subscription* services, on the other hand, are those which allow users to download digital files for some pre-determined charge. While licenses for *interactive* services are determined solely through negotiations between the service company and the record label, with no statutory requirements, licenses for *subscription* services are subject to a statutory rate of 7.0% (for subscription services operating as of July 31, 1998, the rate of 7.25% will apply from January 1, 2004 through December 31, 2007). Of course, even in the case of *subscription* services, the parties involved are free to negotiate payment of a percentage of the statutory rate instead of the full rate. Later, after the Digital Millennium Copyright Act of 1998 (DMCA) was passed, performance license fees were required to be paid to record companies (and artists) for performances on digital radio – the *non-subscription* services referred to above. Currently, these fees are solely based on negotiations and are not subject to statutory rates. So far, fees from all three types of services have mostly been collected by the record labels themselves.

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[21] The propriety of home audio recording is largely unsettled because of the ambiguity of case law surrounding the *fair use* doctrine. This doctrine "has been applied for many years as a judicial exception to the exclusive rights of a copyright owner to print, publish, copy, and vend a copyrighted work." (Krasilovsky & Shemel, 2000, p. 109) In fact, the doctrine is even included in the Copyright Act of 1976. The problem, however, is that the language is vague and allows for interpretation by the courts. While the applicability of the doctrine depends on, among other things, the purpose of the use and its effect on the market for the copyrighted work, the current body of case law does not offer a clear guide. A further complication arises from the Sound Recording Amendment Act of 1971. During hearings for this amendment, the House Judiciary Committee went on record saying "It is not the intention of the Committee to restrain the home recording from broadcasts or from tapes or records, of recorded performances where the home recording is for private use and with no purpose of reproducing or otherwise capitalizing commercially on it." Again, this issue is largely unsettled – especially now that the Internet has become a tool in home recording.

The DMCA was actually passed by the U.S. Congress to implement two World Intellectual Property Organization (WIPO) treaties.[22] These treaties are an example of how the U.S. government is becoming more involved in the movement to legislate intellectual property laws which are enforceable throughout the world.[23] One of the more controversial provisions of the DMCA is that it outlaws the deleting or circumventing of digital encryption and/or watermarking techniques. Shortly after the passage of the DMCA, the Librarian of Congress announced the following two exemptions to this provision:

> (1) compilations consisting of lists of websites blocked by filtering software applications; and
>
> (2) literary works, including computer programs and databases, protected by access control mechanisms that fail to permit access because of malfunction, damage, or obsolescence.

Unless incorporated into the DMCA (or some other law) however, these exemptions are set to expire in the fall of 2003. The technology for which these more recent acts were passed, along with some of the controversies stirred by it, will be discussed in the next section.

3.4 Technology and The Future of the Industry

While technological advances have had major effects on the music industry, a complete discussion of all these advances is beyond the scope of this paper. For example, while recording equipment has advanced to the point where virtually anyone can purchase the tools needed to record music out of their home, a discussion of the differences in ¼ inch tape and Digital Audio Tape (DAT) specifications is not needed here. Given the complexities of making master recordings, it seems unlikely that a massive influx of home recording studios will supplant the existing studios in the near future. The most immediate technological threat to the current structure of the music industry, however, is actually a combination of two interrelated technologies – the Internet and digital downloading.

In its own right, the Internet poses a threat to traditional music distribution because it allows consumers, with very low transaction costs, to easily purchase pre-packaged CDs from nearly any label's catalog, even those of independents. For consumers, this method has another advantage over traditional mail order sales because it allows consumers to hear samples of music before purchasing it. Additionally, the cyberstore has been beneficial to independent artists who,

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[22] WIPO has been in existence since 1967 and is an intergovernmental agency based in Geneva. In December 1996, WIPO drafted two treaties with the intent of establishing minimum standards of copyright protection in the digital environment. While the U.S. is one of only 11 countries to have ratified the treaties, a minimum of 30 countries are required to sign before the treaties can be implemented by statute in all countries.

[23] The effort to protect copyrights of American works in foreign countries has mostly centered around the treaties of the *Berne Convention for the Protection of Literary and Artistic Works* – commonly called the Berne Convention. After over 50 years of squabbling, the U.S. Congress voted in 1988 to ratify the Berne Copyright Convention which actually amended the U.S. Copyright Act of 1976. According to Krasilovsky & Shemel (2000), the Berne Copyright Convention is "the world's oldest, most comprehensive…most protective…most important…reciprocal copyright treaty…" in existence. Signatories of the Berne Convention agree to treat nationals of other member countries as if they were their own nationals for purposes of copyright protection – an agreement which actually increases the rights granted to American authors in some foreign countries. As of this writing, the Convention included at least 128 countries as signatories. (Krasilovsky & Shemel, 2000, pp. 225-229 & 497-507)

historically, have had the most difficulty getting their music into stores. To facilitate sales of their CDs, many independent bands have joined sites which target fans of their type of music, regardless of where these fans live. Typically, these sites link to the band's home page and/or to commercial cyberstores where, in either "place," consumers can buy pre-packaged CDs and/or download digital copies. One of the best known sites for independent music was started in 1993 and is called the Internet Underground Music Archive (IUMA). By 1998, IUMA was receiving approximately 250,000 hits per day and claimed to be indirectly responsible for gross sales of approximately $1 million per year. (Krasilovsky & Shemel, 2000, p. 449) Interestingly, one of the main tools that IUMA uses to promote bands is the same tool that made *Napster* a household term – the music compression format known as the MP3 file.

3.4.1 The Technology

Although many are commonly referred to as MP3's, there are actually several digital music file formats currently in use, with new ones bound to surface in the future. Nonetheless, the MP3 format, which was originally intended for video, was the first of the compression formats to gain extensive use, and is really nothing more than an algorithm. MP3 is actually an abbreviation for MPEG-3, which is an acronym for *Moving Picture Experts Group, Audio Layer 3*. This group, MPEG, works under the joint direction of the International Standards Organization (ISO) and the International Electro-Technical Commission (IEC). The actual algorithm, however, was developed by a German company named Fraunhofer IIS-A in 1987, within the framework of the *EUREKA project EU147, Digital Audio Broadcasting (DAB)*, a joint project with the University of Erlangen. While the algorithm itself is not proprietary, it is clear from Fraunhofer's website that the company has used its development of MP3 to market itself as a premier software developer; the company offers a wide range of technical support and consulting services for users of the MP3 algorithm. Interestingly, Fraunhofer's website (http://www.iis.fhg.de/amm/index.html) claims that, in 1995, the company "devised one of the world's first IP protection schemes, the Multimedia Protection Protocol (MMP)." The company also remains heavily involved in developing new copy protection technologies, and was involved in the development of the recording industry's ill-fated SDMI project.

The MP3 format produces CD quality music in a compressed file which can be easily downloaded, stored and, therefore, posted on a website and transferred to others– all reasons that the "file-sharing" service *Napster* became so popular and controversial. While the MP3 still seems to be the most popular format in use, there are several other compression technologies which are currently being used on commercial websites and/or being developed.

One popular alternative to MP3 is Liquid Audio's *Liquid Music System*. This format protects the file so that only one copy can be made through the user's CD burner. Consumers can go directly to Liquid Audio's website and download songs for as little as $0.99 each and create their own custom discs.[24] AT&T has a format called *a2b*, which prevents *any* copies from being made, and Microsoft introduced *Windows Media™ Technologies 4.0*, which it claims has double the compression ratio of MP3 with equal sound quality *and* an embedded rights manager to protect encoded files. Another company, VQF, has developed a format which it claims compresses files to two-thirds the size of MP3 and offers better sound quality. Also, with the support of the five major labels, IBM has undertaken a program to test its *Electronic Music*

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[24] The cost per song does vary depending on the artist and the label. For example, the band Linkin Park, from the Warner Brothers label, sells its most recent single for $0.99, while Lenny Kravitz of Virgin Records (EMI Group) sells his most recent single for $3.49. Liquid Audio also licenses its technology to other sites.

Management System (EMMS). According to IBM, this secure format will eventually allow consumers to download a full-length CD in about three minutes. With the exception of MP3, the security measures that all of these formats employ include either one or some combination of the following three tools: (1) *encryption;* (2) *watermarking*; or (3) *the Serial Copy Management System (SCMS)*.

Watermarking is the process of embedding a digital file with data that cannot be removed without damaging the file. A digital watermark can be "…likened to a digital fingerprint and can contain copyright ownership information, customer identification, and royalty tracking information." (Krasilovsky & Shemel, 2000, p. 452) Consequently, w*atermarking* is a useful tool for tracking piracy. *Encryption*, on the other hand, involves encoding data into a file that *only* the intended recipient can understand. This technique allows an authorized user to decode the file with, for example, a password. The third tool, the *SCMS*, actually encompasses any technique specifically designed to prevent a user from making multiple copies of a protected work. These technologies, as well as those still being developed, can be used to prevent people from downloading copyrighted material and making it available to the whole world on the Internet. Many in the music industry fear that this sort of file-sharing displaces sales of sound recordings.

It stands to reason that if the masses can download all the songs they want for free, then they typically would not pay for them (this issue will be examined more completely in Section 3.5). Not only would this sort of large scale sharing be harmful to labels, but artists could also receive greatly reduced royalty payments. Still, the potential for this occurrence, even when secure formats are used, depends largely on consumers' trustworthiness. According to David Leibowitz of Aris Technologies, "Encryption is like building a better mouse-trap: what you often get is better-educated mice." (Krasilovsky & Shemel, 2000, p. 453) In fact, hackers commonly post instructions to websites so that consumers can learn how to defeat copy protection.[25] Still, if most individuals are honest and/or consider defeating copy protection technologies too burdensome, perhaps Internet piracy will remain small enough so that digital distribution will be profitable. Regardless, the potential for large-scale digital music downloading – legal or otherwise – likely depends on the pervasiveness of the Internet and, more directly, broadband connections.

The 2000 Census reports that almost half of all U.S. households are now wired to the Internet – a hefty increase from 1997 when only 18% were connected. By this count, about 50 million American *households* have an Internet connection, and about 50 million do *not*. Still, the Wall Street Journal reports that "…only about 7 million [of these households] today enjoy high-speed access." (Kahn, 2001) Furthermore, it doesn't appear that lack of access to high-speed connections is the reason for this low subscriber rate. According to an estimate by the FCC, "Anywhere from 70% to 80% of U.S. households can already sign up for high-speed Internet access if they want it." (Weber, 2002) While reading and sending email over a dial-up modem is no problem, downloading meaningful amounts of music without a broadband connection is

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[25] In the fall semester of 2000, a research team at Princeton led by Professor Edward Felten participated in a public event called the "Hack Secure Digital Music Initiative (SDMI)." SDMI was a consortia of recording industry and technology companies which sponsored this event - one which invited people to try to defeat their copy protection. Professor Felton's team found that SDMI was insecure and they planned to present a technical paper on their findings. This action invited the threat of legal action from the RIAA. Eventually, after the team filed suit seeking protection under the first amendment [Felten v. RIAA, US DC NJ Case #CV-01-2669], the RIAA withdrew its threat of legal action and the scientists presented their paper. (Gross, 2001)

painfully slow. Nevertheless, it appears that most consumers still view high-speed access, which currently costs about $20-$30 per month more than a dial-up connection, as a luxury item. Based on the above information, approximately 90 million American *households* still do not have a high-speed connection.

Even when compared to the most optimistic estimates of Napster users - the research firm Webnoize estimated there were as many as 40 million Napster *users* per month at the service's peak (Washington Post, 12/20/00) - there is clearly still room for tremendous growth in the digital music download market. A prudent view of this market potential is reflected in the following statement by Marc Geiger, CEO of online music company *Artist Direct*: "When the world goes toward digital delivery, which I believe is about ten years away, the next thing that will really happen is that you'll take the manufacturing and physical being of the CD potentially out of the picture…People think that it's right around the corner but it's not…The mail order and direct marketing revolution is the [area] to focus on for now." (Schwartz, 1998, p. 266) Nonetheless, early success stories have prompted sizeable investments by companies looking to stake out their territory on the web.

3.4.2 The Current Status of the Download Market

Aside from the IUMA, one of the best early examples of the potential for digital download sales on the Internet is David Bowie's 1996 release of the single "Telling Lies." In September of '96, Bowie's label made the song available for download, free of charge, for one week, and the song was downloaded over 450,000 times by users in 87 countries. (Krasilovsky & Shemel, 2000, p. 447) While the *potential* for sales is clear in this example, these downloads were used as a promotional tool; they were given away to promote sales of pre-packaged albums. Furthermore, as of this writing, we have been unable to produce one example of a profitable digital music store (one whose main focus is on selling digital music downloads).[26] Most recently, this section of the industry has been consolidating as the major labels have bought many of the initial providers.

One example of this trend starts with a company called *Good Noise*. In the late 90's, they entered the market and were promptly bought by *EMusic*- a firm which was also founded in the late 90's. In June of 2001, Vivendi Universal SA acquired EMusic. Then, in August of 2001, Vivendi paid $372 million in cash and stock for the company *MP3.com*, a firm which had built a reputation of being somewhat anti-establishment. One of the main reasons sited by Vivendi for acquiring MP3.com was that it wanted to use their technology to power its forthcoming site *Duet*, a joint venture with Sony for online music distribution. Additionally, this acquisition sets up Sony and Vivendi to compete directly with the other three major labels.

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[26] Two such examples include Liquid Audio and MP3.com. Liquid Audio, which not only operates a cyber store but also licenses its technology, reported total net revenues for the third quarter of '01 of $1.3 million, compared with $1.0 million for the second quarter of 2001 and with $3.4 million for the third quarter of 2000. However, they also reported a net loss for the third quarter of $6.1 million, compared sequentially with a net loss of $14.0 million, and year-over-year with a net loss of $8.9 million. In June of 2001, MP3.com reported second quarter '01 revenues of $17.5 million with a loss of $1.6 million – although the second quarter loss was not as bad as their first quarter loss of $2.2 million (on sales of $21.8 million). Offering a ray of hope, they did report positive *pro-forma* EBITDA of $662,000 for the fourth quarter of 2001. However, before these results could be borne out, they were purchased by one of the industry's big 5 - Vivendi-Universal. As a consequence, the world will never know for sure if those projections would have been met (even if they had, it still would not have been a positive *net income*).

Duet will be competing with a service called *MusicNet*, a joint venture between AOL Time Warner, Bertelsmann, and EMI.[27] In the meantime, MusicNet and MP3.com are competing by offering digital downloads for a monthly fee. Aside from differences in the catalogs of music, there are clear differences between the two services in both their flexibility and pricing structure. For instance, MP3.com, for about $3.00 per month, allows consumers to download all the songs they want and even burn *one* copy onto a CD, while MusicNet, for about $10.00 per month, allows consumers to download up to 100 songs *and* stream up to 100 songs per month without allowing *any* sort of transfer to another device (such as a CD burner). Simultaneously, Vivendi is running EMusic as if it were an independent site, one which, at first glance, seems to be competing with its MP3.com site. However, EMusic is actually quite different than MP3.com.

Not only is EMusic focusing on major artists *and* charging consumers a lower price than MP3.com, but once consumers download a file from EMusic, they are free to do whatever they wish with it – even send it to a friend.[28] One of the most recent, and, perhaps most interesting, entries into the digital download music industry is Apple Computer. On April 28, 2003, Apple launched its *iTunes* service for Macintosh users.

The iTunes service allows consumers to download songs for $0.99 each and restricts users in that it does not allow songs to be transferred online. While the service is currently available only to Macintosh users, Apple does have plans to launch a Windows version soon. Most importantly, Apple currently has all of the major labels on board. The service was launched with 200,000 songs, and Apple hopes to eventually offer millions of songs for downloads. According to Leonard (2003), Apple is paying record labels an average of $0.65 for each song that it sells. Still, to date, the only site (from those listed above) which makes its platform available to *all* independent artist, signed or unsigned, is MP3.com. Consequently, we have only been able to verify the terms offered to artists on MP3.com.

The *exact* terms offered to an artist by MP3.com, while always on a *non*exclusive basis, depend on which of the company's services are used. For instance, an artist using MP3.com can elect to choose any of the following services: (1) selling their own CDs through MP3.com (those manufactured by someone other than MP3.com); (2) allowing MP3.com to serve as the their CD manufacturing facility; (3) creating net CDs (so the consumer can download the entire CD with one click); (4) taking advantage of various sales and marketing services; or (5) using "pay for play" services for digital downloads. The CDs that MP3.com manufactures end up looking similar to those distributed by a typical record label; they are enclosed in a jewel case and they include a four page insert – for which artists can supply their own artwork. Once artists upload their files, MP3.com, on a per-order basis, manufactures and ships the CDs to the customer. To allow for maximum versatility, the CD is encoded with both the standard CD format and the MP3

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[27] The three majors are also partnered with *Napster* and *Real Networks* for this venture. In May of 2003, *Real Networks* announced it would launch its own download service to compete with Apple's *iTunes* (discussed above). For a current listing (April 2003) of downloading services and their features, see the following *Business Week* chart at
http://www.businessweek.com/technology/content/apr2003/tc20030422_0928.html

[28] The sites are very different. To begin, EMusic charges consumers between $9.99 per month (for those customers who subscribe for one year) and $14.99 per month (for those who commit to only 3 months). Also, MP3.com caters directly to the independent artists, allowing anyone to post their songs, while EMusic only works with established labels – they will not even *review* an unsigned artist's material. As a result, there are many more artists on the MP3.com site. For example, for artists whose names start with the letter 'a,' in the Alternative/Punk genre, MP3.com has approximately 2,700 artist while has only 112. Furthermore, out of this 112, only 7 artists are listed on *both* sites. MP3.com also offers its artists many services which are not available on EMusic, such as CD manufacturing and posting "Net CDs."

format. MP3.com charges a $3.99 production fee and allows artists to charge any retail price they wish - and keep 50% of the *net* revenue. This split certainly appears to be a better deal for artists than those secured under the typical recording contract. For example, by earning 15% royalties on a $16 CD, before any of the standard deductions (see Section 3.2), the artist keeps $2.40. Under the MP3.com contract, however, artists could sell their CDs for less money and keep a higher dollar amount from each sale. For example, by selling a CD for $12, the artist under contract with MP3.com would keep $4. The terms MP3.com offers to artists for digital download sales, however, do not make it clear that artists will enjoy this same sort of monetary benefit from the new technology.

To earn fees for each downloaded song, the artist has to pay MP3.com $20 per month to be in their "Premium Artist" group. By joining this club, artists earn ½ cent per qualified play (all downloads or streams lasting at least 30 seconds). Under these terms, an artist would have to sell 200 million downloads to earn $1 million, a feat which could be accomplished by selling a bit more than 400,000 albums under the terms of a typical recording contract (see Figure 3-8). MP3.com's premium artists are also allowed to purchase their own CDs at a discounted price of $3.75.

Regardless, negotiations over statutory licensing fees has been a main stumbling block for entrepreneurs wishing to open these types of cyberstores. As of this writing, none of the sites currently operating are able to offer complete catalogs from all the labels. Since consumers currently have to join several sites to find all the titles they want, this obstacle has almost surely attributed to the sluggish starts for these firms. Consequently, exactly how the licensing issues get resolved could be a key determinant in how the industry evolves with these new technologies.

Figure 3-8

Old Regime*:	
Album Royalties (per album sold)	$2.40
Albums Sold	416,667
Total:	1,000,001
New Regime**:	
Download Royalties (per qualified play)	$0.005
Downloads	200,000,000
Total:	1,000,000

* Based on 15% album royalty rate for a $16 CD, does not include any standard deductions
** Based on 1/2 cent per download or stream lasting at least 30 seconds, does not include $20 monthly fee to MP3.com

3.4.3 The Technology's Implications for the Future

In Senate hearings on April 3, 2001, the rift between the majors and their artists became quite clear. As reported in Business Week, "Musical artists represented by RAC want to be able to sell their music on the Internet without going through the bureaucracy of record labels. While many artists supported the copyright-infringement lawsuit the RIAA brought against Napster, they now want labels to aggressively award licensing deals to legitimate independent music Web sites in addition to the labels' own online services. That's something that isn't happening as fast as artists hoped….RAC says that if labels don't voluntarily license their music to independent Web sites, Congress should consider compulsory licenses." (St. Pierre, 2001) So, a noteworthy occurrence surrounding these new technologies has been that artists and labels have practically switched sides on a key issue (see Section 3.2). In fact, if the artists' switch to favoring compulsory licensing is any indication of what digital distribution will mean for the industry's future structure, the balance of power in the industry is destined to shift. It appears that digital downloading on the Internet is threatening to empower both the consumer and the artist at the labels' expense.

The new technology has already started to pay dividends for artists in terms of their ability to secure a more flexible, and perhaps more profitable, recording contract. According to Brabec and Brabec (2000), "Unlike the traditional record company contract, these new forms can take any number of forms including a sharing of all income from sales 50/50…a sharing of monies from subscription fees based on the number of downloads; an offer to owners of masters a higher percentage for downloads than would be made under a normal record company contract, etc…Many of the arrangements are non-exclusive or are exclusive for only a short period of time [and]…Practically none of these arrangements transfer ownership in the master recording or the song away from the artist or writer." (pg. 414) The following three developments in this quotation deserve careful scrutiny: (1) the better overall percentage of monies to the artist; (2) the shorter time period of exclusivity (or lack thereof); and (3) the artist retaining copyright ownership of the recordings.

As noted above, the RAC is now actively fighting to have the *works for-hire* clause removed from recording contracts *specifically* because recording artists want to retain copyright ownership of their master recordings. While it could just be a coincidence that artists are getting organized to fight this issue at the same time the potential for digital downloading is surfacing, one could easily make the argument that this confluence of events is no accident. In fact, when a main cost advantage of downloading is examined, a clearer picture begins to develop.

Aside from providing a clear advantage in terms of productive efficiency, digital downloading eliminates the costs which are *the* most severe charge against the artist's royalties – manufacturing and packaging. Downloading also eliminates the need for the traditional distribution chain, a possible benefit to the artist for several reasons. First, downloading removes respective markups at the wholesale and retail level, which means that the consumer's price should be lower. Of course, this lower price suggests that a larger quantity of records will be sold. Next, compared to the traditional distribution method, the digital method practically removes physical limitations on the quantity of music that can be "stocked" in the "store." This development should make it easier for unknown artists to get their music distributed. Of course, digital downloading benefits consumers because it lowers the price they pay, lowers their transaction costs and increases the flexibility they have when buying music. For example, on MP3.com, consumers can buy all the individual songs they want for one price (only $3.00 per month) and make custom CDs – without ever leaving their homes. While these developments certainly appear to benefit the artists and the consumer, they do not bode well for either the record

store or the record distributor. Should licensing become compulsory for subscription services, a major hindrance to digital distribution will vanish.

Consequently, by meaningfully reducing the label's control over distribution, the technology would also erode the record companies' main source of leverage in contract negotiations with the artists. The following quote from Marc Geiger illustrates the importance of this lower reliance on traditional distribution: "The Internet provides the first radical change in a distribution system since the music business started….Prior to the Internet, all [record companies], whether majors or independents, had to go through the same steps [to sell their product] – manufacture a record and try to get it into record stores; if [the stores] took it, try to get [them] to prioritize it. This meant using a 'push' economy, that is, pushing the record into the market all over the world, marketing it as best you could, and hoping the consumer would find and purchase that record…The Internet is the first medium that has allowed a radical change in that…It's potentially transitioning into a 'pull' mechanism where the consumers can find what they want whether it's in a big record store or directly from the artist or label…" (Schwartz, 1998, p. 260) Because of the technology's likely impact on distribution, the artist may finally have a credible threat in the area of distribution. Artists who do not like the terms being offered by a label could, for the first time, credibly threaten to distribute the records on their own.

Given that labels have already started offering larger shares of sales, shorter periods of exclusivity (in some cases none) and retention of the copyright to artists for digital downloads, it appears that this credible threat may already be having an effect. In fact, some are predicting that the relationship between the artist and the label may evolve into more of a partnering arrangement – one where the artist depends on the record company mainly for promotional needs. Krasilovsky & Shemel have made the following observation: "This downloading and uploading technology, coupled with the availability and low cost of high quality recording equipment, seems to minimize the need for record companies…Of course, the artist would still need promotion and marketing. However, with the increased use of the Internet, one wonders how these processes will evolve as well." (Krasilovsky & Shemel, 2000, p. 462) Still, regardless of how artists' music is distributed, they are faced with, in essence, an information problem.

For instance, before buying music, a consumer first has to be able to find a song from among hundreds of thousands of other songs. Until artists becomes popular, therefore, getting more consumers to find their music is vital to making sales. While all consumers surely will not like all the music that they hear, it is likely that most consumers will not buy music from artists without first hearing it. So, in the future, marketing should remain a key function for a label and/or an artist. At the very least, using a third party marketing specialist will always provide the artist with more time to create music. Regardless of the nature of the intermediary functions, enforceable copyrights will be essential to the success of both artists and labels. Still, in spite of the clear desire of many artists to retain copyrights in the digital age, some individuals are arguing that the new technologies make copyrights obsolete.

3.4.4 The Technology and Copyright Opponents

An understanding of this position can be taken from the writings of John P. Barlow. Mr. Barlow is a former lyricist for the Grateful Dead, the co-founder and current Vice-Chairman of the Electronic Frontier Foundation, and a Fellow at Harvard Law School's Berkman Center for Internet and Society. His discourse, quoted below, has appeared in The Atlantic Monthly's website (www.theatlantic.com) over the last few years. Barlow posits that copyrights are no longer necessary because "A new means of distributing creative spirit has arisen that does not require its being embedded into objects." More pointedly, he says that copyrights "…are

designed almost entirely to perpetuate the moribund publishing and distribution industries, which are desperately seeking to preserve by law what they can no longer sustain by necessity…Through an amplifying cascade of mouse clicks [ideas] reproduce until they have reached sufficient mind-share to change politics." Apparently opposed to both the U.S. Constitution and the body of case law (not to mention laws in other countries) which support the existence of the copyright, Mr. Barlow acts as though the copyright is meant to protect the idea itself, not the expression of the idea.

Indeed, as has been clearly demonstrated in Section 3.3, the copyright itself only depends on the work being "embedded into objects" for its legal definition; the intent of the right is much more expansive. Still, even if one were to accept Mr. Barlow's conclusions at face value, the notion that the Internet allows ideas to be transferred apart from any physical means is untrue. The computer hardware and the miles of cable (or tons of wireless equipment) needed to transmit information over the Internet are no less physical objects than books. Even though the Internet can greatly enhance the dissemination of ideas, the ideas themselves do not travel between two individuals' crania without first being expressed through at least one type of physical object. Unless those investing in this equipment are reasonably assured of earning a return on their capital, the equipment will, eventually, cease to exist.

Furthermore, as was demonstrated in Section 3.4, the current publishing and distribution structures may very well be altered because of changes brought on by the technology itself, not by the copyright being ignored. Barlow's type of argument also ignores the fact that he, just like any other person, is completely free to forgo the copyright and, rather than sell, give away the expression of his ideas. While it is true that artists under contract with record labels do not have this type of freedom, nearly all of these artists freely chose to enter into those agreements. For any artists who did sign their contracts under duress, the legal system offers them a way to remedy that situation. While the Internet offers artists an enhanced means with which to disseminate their music, the technology itself is neutral toward the copyright; it is equally capable of benefiting artists who want copyright protection as it is artists who wish to forgo it.

A main reason businesses are investing in these technologies is that they allow consumers to find what they are looking for with much lower transaction costs, not that the investment will make them rich at the expense of consumers. Therefore, to argue that large record and publishing companies want to use copyrights in the digital age to "preserve by law what they can no longer sustain by necessity," is a misstatement. Additionally, Barlow's argument overlooks that the technology enhances artists' freedom to choose whether they want copyright protection. In fact, many artists already understand that they will never become a top-selling artist and they create music for enjoyment – irrespective of a copyright. One independent artist on IUMA posted the following message: "…many bands are not main stream, and will never get 'commercial success' (and may not even be looking for it!). I post my music on the Internet, not to be the next big 'band', but because I like to make music…Most likely out of the 100,000 plus independent artists with music on the net, most of us will never go anywhere with our music. This does not make me unhappy, because most of the music I like best (on the Internet), (or off the net) is the non-commercial stuff." If Barlow and like-minded individuals do not want to take advantage of copyright protection, they do not have to. But in choosing to forgo this right, they should not also infringe on the rights of other individuals to utilize this protection. While it may be impossible to determine how many artists would still create music in the absence of copyrights, history has proven that many artists, as well as those investing in them, do want this protection.

3.5 The Industry's Consumers

No discussion of the music industry would be complete without analyzing what sustains the industry – its consumers. As Figure 3-9 shows, since 1993 consumers in the U.S. have spent over $10 billion per year on sound recordings, with CDs being the overwhelmingly favored format since 1992 (since 1999, CDs have accounted for over 80% of all formats sold each year). In fact, since 1991, with the exceptions of a 2.37% decrease from '96-'97 and a 1.8% decrease from '00-'01, consumers have spent more on sound recordings each year. While nearly all formats other than the full-length CD have fallen out of favor since 1997, the fall of the CD single has added to the controversy stirred by Napster. The RIAA points to the 38.8% drop in CD singles sold from '99-'00 as evidence that record sales have been displaced by file sharing on the Internet. However, based on several key trends, this complaint seems to oversimplify the situation. To begin, from '99-'00, the number of full length CD units sold actually rose by just under 1%, and the number of *full-length* cassettes sold fell by nearly the same percentage as CD *singles* (about 38%). Additionally, throughout the 90's, the CD single has never reached the same popularity as the cassette *single*; more than 80 million cassette singles were sold *each* year from '92-'94, while the highest ever annual total for CD singles was 66.7 million in '97. Therefore, following the RIAA's logic of a *direct* correlation between the drop in CD singles and the proliferation of Internet file sharing seems a bit questionable. These trends could simply show that consumers have never become endeared to the single in the *CD format*. Regardless of favoring the full-length CD format, evidence seems to suggest that the consumers of the independents' music and of the majors' music possess some very different characteristics.

In fact, many consumers of independent music seem to eschew commercial radio and the popular music charts. To demonstrate these differences, the following two quotes have been taken from chat rooms of IUMA:

> (1) "Distant Sun has a new experimental industrial/dance track called "Blinding Sun", download at http://distantsun.iuma.com "

> (2) "I've [been] looking for true Lo-fi musicians for a long time. By that I mean recorded on a 4-track, limited equipment and money, etc. I don't want to hear perfect little songs that all sound the same. I want to listen to songs with character, emotion and mistakes. YES, mistakes - we are not perfect so why should our music be. Help me bring back human characteristics in the monotonous world today. http://www.joshwilton.com"

The genre referred to in the first quote, for example, does not even warrant a listing on the popular music charts. Most popular music fans do not also listen to "experimental industrial/dance" music. In many cases similar to this one, independent music serves only niche markets for which, by definition, smaller numbers of consumers exist than for popular music. As for the second quotation, while many independent fans may enjoy it, sales data clearly show that *most* music fans do not want to hear "songs with mistakes." If most consumers did enjoy music with mistakes, it seems unlikely that the majors would have been able to garner an 83% market share by selling music *without* mistakes – especially given that consumers typically pay $4 to $9 more for majors' CDs than independents'. While the majors' large market share can be partially attributed to their control throughout the distribution chain (see Section 2.3), a key reason for their impressive market share is because they sell music that most people want to hear. Still, while a great deal of independent music has a smaller audience, the market does have a way of "finding" independent artists with mass appeal.

Bands such as "The Dave Matthews Band" and "R.E.M." are just two examples of artists who started out with independents and ended up signing with majors. Because none of the majors thought they had a wide enough audience, these bands initially had no choice but to play college campus concerts and secure air time on college radio. However, since these artists were able to use these venues to prove their music appealed to *many* consumers rather than to a very narrow audience, they were eventually able to sign with major labels. While the majors are serving as intermediaries for the artists to reach a wide audience, large investments by labels would not be necessary without such mass appeal. It seems likely that one of the reasons judging this appeal is difficult is that consumers' tastes change. Even though many of the genres on the IUMA charts are not even listed in the study, the RIAA Consumer Profile, available in its entirety at www.riaa.org, provides data which supports this idea.[29]

While consumers' most preferred genre over the last decade has been *Rock*, its share of total sales has been slipping (see Figure 3-10). In 2000, the *Rock* genre represented just under 25% of all music sales – considerably lower than its decade high in 1994 of 35%. The second most popular genre in 2000 was *Rap/Hip Hop*, which captured just under 13% of total sales. Since 1991, the genres *Rap/Hip Hop*, *Pop* and *Country* have each bounced back and forth as the second most popular genre. *Country* rose from a 9.6% share in 1990 to a high of 18.7% in 1993, and ended the decade with a 10.8% share. *Pop*, on the other hand, had steadily declined from a high of 13.7% in 1990 to 9.3% in 1996 only to rise successively over the last few years of the decade to claim 10.3% share. Exhibiting even more volatility, the *Rap/Hip Hop* genre has alternated between increasing and decreasing its market share in almost every year of the '90's. The next tier of the genres includes three groups, *Religious*, *Jazz*, and *Classical*, with a 4.8%, 2.9%, and 2.7% share, respectively. While *Religious* music's slightly higher share seems to be a phenomenon of the second half of the decade, the share captured by *Jazz* and *Classical* has fluctuated around 3% to 4% for the entire decade. Nonetheless, the trends among consumers' gender and age do exhibit some stability.

Across genres, there has been a fairly even split between male and female purchasers for, at least, the last five years. As for age groups, younger people have accounted for most of the purchases for all of the last decade. For instance, in 2000 almost half of all purchases (44.9%) were made by consumers between the ages of 10 and 29, with the heaviest percentage of that group being in the 15 to 24 year old range (see www.riaa.org). The heavy buying from these younger age groups is one of the reasons that the industry has been so concerned about the effects file sharing is having on their sales.[30]

Even though the Napster-like services garner most of the publicity, there is actually more than one type of "copying" that has the music industry worried. To begin, copying can be done directly by "burning" a CD to a blank CD-R, from either a legitimately purchased CD or from a copied version of that CD. Another form of copying is know as "ripping." This process entails

[29] Some examples of genres on the IUMA charts which do not appear on the RIAA study (not even in the "other" category) are as follows: Progressive Rock, Funk, Surf, Thrash, Rockabilly, and Bluegrass.

[30] It is widely held that students on college campuses are heavy users of the Internet and were the principal group of Napster users – so much so that much of the statistical evidence in the Napster case involves studies of music retailers near college campuses. Also, a study by CyberAtlas shows that the 67% of Internet users are between the ages of 18 and 44. This study can be found at: http://cyberatlas.Internet.com/.

copying tracks from legitimately purchased CDs onto the user's hard drive. From there, the files can be converted to the MP3 format and used in several ways. Finally, there are the Napster-like services where Internet users can download copies of songs directly to their hard drives (for a more expansive discussion of copying, see Appendix A).

The direct copying of CDs seems very similar to the once popular act of "dubbing" legitimately purchased audio cassette tapes onto blank cassette tapes. This form of copying, when it became widespread in the 70's/80's, also resulted in the music industry crying foul. However, in addition to this form of home copying being deemed legal under the "fair-use" doctrine, the music industry continued to prosper as this form of copying became widespread. It seems likely, therefore, that this form of direct copying – in either its earlier, cassette tape version or its newer, CD version – is not harmful to record companies. In fact, the "indirect appropriability" explanation, put forth by Liebowitz (1981), suggests that this form of copying actually benefits record companies because it allows them to charge a higher price to those consumers actually buying the goods (the high valuation consumers). Many of the consumers performing direct copying, according to this hypothesis, are likely to have been (or still are) low valuation consumers who were not going to buy the CDs (or tapes) in the first place. This reasoning shows why it may be difficult to prove/disprove the effect of sharing services on record sales – many of the individuals sharing on these services may be those not buying CDs in the first place.

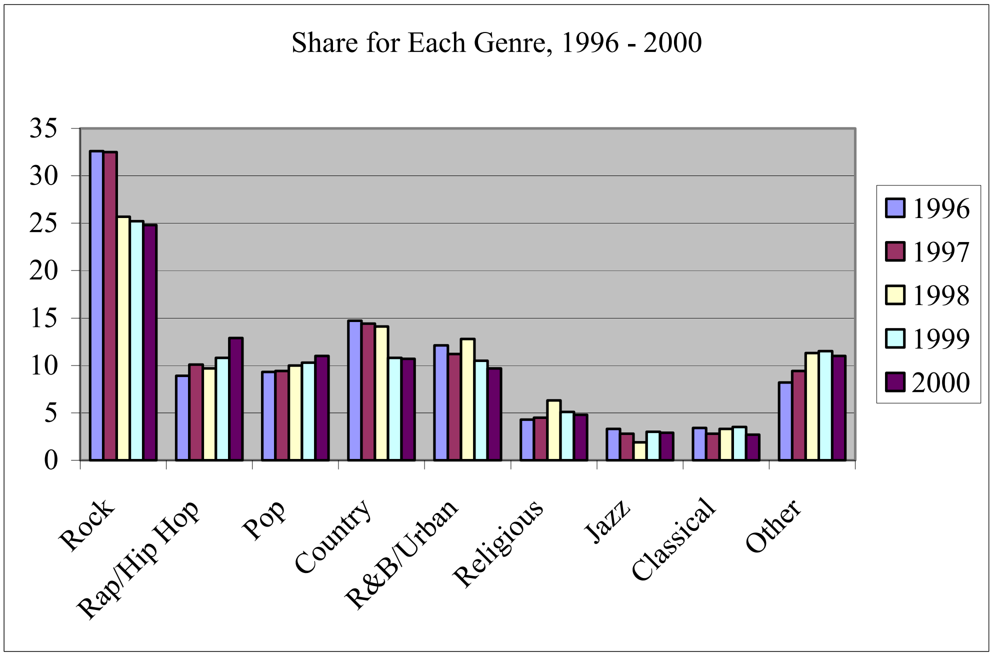
The act of "ripping" also seems to be somewhat innocuous, provided the ripped files are not uploaded and shared on the Internet. By ripping files, consumers can take single tracks from legitimately purchased CDs, convert them into the MP3 format, and use them in a variety of ways. For example, the converted files can be used for any of the following reasons: (1) to create custom CDs (with *only* the user's favorite songs) on a CD burner; (2) to be used as a sort of PC jukebox; or (3) to be used in an MP3 player. While these other forms of copying have received added attention lately, the lion's share of the publicity is still given to Internet file sharing.

Figure 3-9

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total Dollar Value:	7,834	9,024	10,047	12,068	12,320	12,534	12,237	13,724	14,585	14,323
in millions (net of returns)										
Formats (%):										
Full Length CD	38.9	46.5	51.1	58.4	65	68.4	70.2	74.8	83.2	89.3
F.L. Cassettes	49.8	43.6	38	32.1	25.1	19.3	18.2	14.8	8	4.9
Singles (all types)	8.8	7.5	9.2	7.4	7.5	9.3	9.3	6.8	5.4	2.5
Total Units Shipped										
in millions (net of returns)										
CD	333.3	407.5	495.4	662.1	722.9	778.9	753.1	847	938.9	942.5
CD Single	5.7	7.3	7.8	9.3	21.5	43.2	66.7	56	55.9	34.2
Cassette	360.1	366.4	339.5	345.4	272.6	225.3	172.6	158.5	123.6	76
Cassette Single	69	84.6	85.6	81.1	70.7	59.9	42.2	26.4	14.2	1.3

From RIAA 2000 Consumer Profile

Figure 3-10



Adopted from the 2000 RIAA Consumer Profile

3.5.1 Consumers and Internet File Sharing

File sharing on the Internet has stirred controversy throughout the world and, in many cases, embittered people against "the music industry." When I told one of my junior-level students that I was working on digital copyrights in the music industry, his response was something akin to "Yeah! Napster rules! Metallica is a bunch of sellouts!" Metallica is the band which named, in a lawsuit, over 335,000 Napster users as illegally copying their songs. Many individuals argue that file sharing services such as Napster are just a more efficient method for sharing music than what existed previously. There is no difference, they argue, between using an Internet sharing service and making copies of friends' cassette tapes and CDs. These sharing proponents are overlooking a major difference, however, because the Internet allows anonymous sharing with, theoretically, an unlimited number of people. The labels argue that allowing consumers to share digital files on such a large scale is piracy which negatively affects their sales of albums. Sharing proponents counter by saying that file sharing actually promotes the sales of albums because it is tantamount to providing free samples. These samples, it is argued, allow artists to sell more music at higher prices because consumers have more information about the music. In economic terms, the demand curve shifts outward, resulting in both a higher equilibrium quantity and price. While this argument may seem plausible at first, it loses much of its credibility when examined more closely.

To begin, the fact that a *potential* consumer is able to preview the music on an album does not guarantee that it will be bought. In fact, the ability to preview the album may result in the opposite outcome. If, for example, a large number of consumers do not like the samples they hear, the demand curve for the album could shift dramatically inward, resulting in a lower equilibrium price and quantity. Consequently, the mere threat of this occurrence could cause more resources to be used when creating an album to ensure a "better" finished product, causing

the label's supply curve to shift inward (a lower equilibrium quantity and a higher equilibrium price). Given the recent trends in consumer buying habits, it is unlikely that a higher equilibrium price is an outcome that most record labels and/or artists would welcome. Still, even if the sharing results in a higher price caused by a demand shift (as is normally argued by sharing proponents), depending on the degree of substitutability between the shared and the pre-packaged goods, the artist may not benefit from the higher price of the pre-packaged good.

If users of file sharing services could *only* download one or two songs from any given album (or clips from songs) before deciding whether to purchase it, perhaps sharing proponents would have a solid argument. In reality, however, users of these services can download each song from an album and copy all of them onto a CD – with nearly identical sound quality as the pre-packaged CD. While some music fans would surely want the pre-packaged version of the CD as a collectible good, *most* consumers would probably consider the "home-made" version to be a near-perfect substitute. This situation is analogous to that of hardback vs. paperback books; far fewer hardback versions of books are even printed by publishers because of the lower demand for the higher priced hardback versions.[31] Similarly, it seems unlikely that most individuals downloading all the songs from an album would *also* buy the pre-packaged CD. Once technology advances to the point where most people have broadband connections *and* can download entire albums in only a few minutes, it seems likely that most people would opt for a free copy of an album before buying it, especially when the market price for the album is near $20. Similarly, it seems highly unlikely, at best, that individuals would download one digital copy of a song for free and then pay for another digital copy of the same song; these two goods may be the best example ever of perfect substitutes. While countless websites have surfaced vilifying bands like Metallica and professing the legitimacy of Napster and its successors, I have not found any which strengthen their case by directly addressing this issue of substitutability.

In fact, even the pro-Napster site www.verticalgerbil.com lists arguments which *weaken* its position. In one section, after pointing out how restrictive record labels' recording contracts are, the website says that well known rap artist Chuck D "…believes that Napster can help an artist bypass this all, and he calls it direct-to-consumer marketing. There are no hassles of record company contracts or fees for marketing, and artists can share their music directly with the public at their own discretion." While the Internet certainly seems to be on the cusp of providing this sort of freedom to artists, these quotations clearly show that not even Chuck D is advocating that artists should not be able to sell their music. Chuck D's support of Napster-like services is based on the technology giving artists more control over their careers. In fact, a careful read of Chuck D's argument shows that he believes artists should be allowed to share *at their own discretion*. However, since Napster and its successors do not give artists any choice in the matter, bands should not be vilified for choosing against sharing their music. Furthermore, none of these arguments offer any suggestions as to why consumers would pay for a digital copy of a song that they could also get for free. Regardless, the idea that top-selling artists would whole-heartedly embrace a technology which would prevent them from ever selling their music seems somewhat dubious. Indeed, even some of the artists in IUMA's chat rooms, where one is likely to find anti-industry rhetoric, profess that unknown artists do not shun the opportunity to make money. For example, one independent artist posted the following comment on IUMA:

> "I guess the goal of many independent music artists is to do both, make money, and keep their artistic integrity. There are many successful artists that do this. These artists may not be making a million dollars a year, but they do make a living."

[31] Madden (2000).

By proliferating free digital copies of artists' songs, sharing services could, if digital distribution becomes widespread, prevent artists from making a living selling their music. The implication of this sort of market, where both free and market priced copies of the same goods exist, is that copyrights are unnecessary.

While pro-Napster artists surely would like to have more control over their careers, they are not rushing to abolish copyrights. In fact, as described in Section 3.4.3, artists are actually trying to regain control of their copyrights from the labels. A very important question to be answered, then, is at what price would consumers buy music once digital downloading becomes the preferred method of purchase (assuming that it does). Before this new system's pricing structure can be estimated, however, a complete understanding of why file sharing is so popular is needed. While these issues will be studied further in another chapter of this thesis, one reason that so many consumers have openly embraced file sharing appears to be because of high CD prices.

Modern consumers are cost conscious; they understand that blank CDs cost less than $0.50 each, and they find it hard to believe that record companies need to sell CDs for as much as $15 to $18. Incidentally, one of the main benefits to consumers using the online sharing services is that they avoid paying these high prices – a factor which has not received much attention in academic journals.[32] This price factor is not, however, overlooked by the entrepreneurs starting sharing services. For example, the CEO of FastTrack, the parent company of one of Napster's successors (KaZaA), leaves no doubt about why he thinks these services are so popular. In a recent Wall Street Journal article, he says that "Consumers are making a statement that paying $18 for a CD is not the right price. But the record companies aren't giving them any alternative." (Weber, 2001) Even those consumers who purchase pre-packaged CDs seem to be making some sort of statement about high prices. As discussed in Section 3.1, the total percentage of CD sales in *record* stores has been declining over the last ten years, while the portion sold in *other* stores has been steadily increasing. This category of *other* stores, interestingly, includes mainly large retailers such as Circuit City and Wal-Mart, stores which sell CDs at lower prices than record stores. These retailers frequently use CDs as loss leaders and, in some cases, sell popular CDs for just under $10.00. In fact, the major labels recently suffered a publicity setback after the Federal Trade Commission (FTC) completed its investigation into how the labels tried to discourage such pricing.

In response to the lower CD prices at the large retailers, it was alleged, major labels pressured *record* stores to keep prices on certain CDs above a set minimum – thus overcharging consumers. Specifically, the FTC found that the majors threatened to withhold advertising dollars from the *record* stores if they refused to comply with the minimum advertised price policies.[33] While they admitted no wrongdoing in the settlement, the majors agreed to stop the practice. Regardless, the negative publicity from this FTC investigation surely added to the

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[32] Instead of formally examining the reasons for the popularity of sharing, nearly all scholarly articles focus on whether sharing will benefit or harm the public and/or the company that holds the copyright. Incidentally, many of the articles find that *small scale* sharing could benefit the copyright holders and the public. These articles are discussed in Chapter 2 of this thesis.

[33] The practice of withholding advertising dollars, in and of itself, is not illegal. Had the record labels also refused to allow record stores to carry CDs as a punishment for non-compliance, however, then they would have been committing an anti-trust violation. Not only was this sort of refusal never alleged by the FTC, but the majors did not admit any wrongdoing in their settlement with the government. Instead, they agreed to stop the practice.

public perception that the major labels were "overcharging" for CDs. Furthermore, the fact that the industry itself claims to be very inefficient certainly does not help to alleviate this negative view of the majors. For example, according to Cary Sherman, general counsel for RIAA, "It's the rare successes that finance the 90% that fail to make it. Having the ability to capitalize on the catalog of survivors…is what makes the system continue to work." (Harris, 2002) While I have found very little data to support claims like these, they appear to be widely accepted by industry professionals.[34] This sort of inefficiency, most likely, adds to the perception that labels are charging "artificially" high prices on popular CDs.

While it is difficult to use one figure to represent the price of "a CD," an examination of Figure 3-11 reveals that average prices for full-length CDs have been on a fairly steady upward trend over the last ten years; since a small decline in 1996 (to just over $11.00), the average CD price has risen annually through year 2000 (to $13.57). Still, there are several caveats that should be adhered to when examining these figures. For example, while different genres are priced differently and different stores price their CDs differently, these averages consist of all CDs shipped to all types of stores. Nonetheless, the widespread popularity of sharing services, as well as the increased number of purchases made in discount retail stores, certainly seems to suggest that consumers would like to pay less for CDs. The implications of these developments for the music industry's *future* pricing structure will be examined in a separate chapter to this thesis.

Figure 3-11

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total Dollar Value (All) *millions (net of returns)*	7,834	9,024	10,047	12,068	12,320	12,534	12,237	13,724	14,585	14,323
% of Full Length CDs	38.90%	46.50%	51.10%	58.40%	65.00%	68.40%	70.20%	74.80%	83.20%	89.30%
Dollar Value of FL CDs	3047.5	4196.16	5133.81	7047.71	8008.2	8573.1	8590.2	10265	12134.3	12790.4
CDs Shipped (net)	333.3	407.5	495.4	662.1	722.9	778.9	753.1	847	938.9	942.5
Average CD Price	**$9.14**	**$10.30**	**$10.36**	**$10.64**	**$11.08**	**$11.01**	**$11.41**	**$12.12**	**$12.92**	**$13.57**

Source: RIAA 2000 Consumer Profile

3.6 Conclusions

The current structure of the music industry is a combination of the oligopoly and monopolistic competition models. The industry consists of five major labels and thousands of independent labels (known as independents). While both the majors and the independents offer the same intermediary functions to artists, the majors have a clear advantage over the independents in the following two areas: (1) national/international distribution; and (2) national promotion on commercial radio. While these advantages may contribute to a higher degree of monopoly power for the majors than the independents, the situation is much more complex. For

[34] An example of the acceptance of this idea is found in the Krasilovsky & Shemel, 2000, p. 81: "…85% of recordings released in the U.S. annually that, according to the RIAA, fail to make a profit." While they do not site any data, they also accept that this is a reasonable proposition. The context of Krasilovsky & Shemel's use was in reference to counterfeiters not having to carry the burden of 85% of the records that fail to make a profit. This same sort of sentiment is even seen in the chat room postings of websites like IUMA. Also, Billboard Magazine's Market Watch reports do, occasionally, list annual sales by "current, catalog, and deep catalog," but the data is solely based on Soundscan data and is not available (from Billboard) as an historical data set.

instance, since nationwide distribution requires more resources than local distribution, it should be expected that nationally distributed CDs cost more than locally distributed CDs. Furthermore, national distribution is inherently riskier than local distribution; all of the companies in the distribution chain are investing more funds because they are betting that many more consumers will find *and* buy the CDs.

Since this larger risk requires a greater return for all of the companies involved, nationally distributed CDs should be priced higher than locally distributed CDs. In fact, while a more complete analysis is needed, it appears that CD prices are quite similar for both top-selling independent artists and top-selling major artists. This evidence would also support the idea that how much consumers “like” the music, measured (ex-post) by how many albums are sold, is an important factor in determining the price that can be charged for a CD. Another factor which cannot be ignored is that most niche markets in the music industry are served by independent labels. Since fewer consumers buy these CDs in the first place, it is not surprising that many of these CDs sell for less. In addition to the copyright, the economic factors discussed above are key contributors to the pricing structure of CDs. Still, contrary to what some have argued, the technological changes the industry faces make the copyright an essential tool for this market to continue functioning properly.

If, as predicted, digital downloading on the Internet does become the preferred method of distribution, it appears unlikely that artists would be able to sell their music in the absence of enforceable copyrights. Since digital copies of songs on sharing services and digital copies offered for sale by artists and/or record labels are near perfect substitutes, enforceable copyrights could be necessary for this market to exist. Furthermore, given that consumers have continued to buy larger numbers of CDs year after year (goods which are not considered necessities), it seems clear that there is a thriving market for sound recordings. In the year 2000, for example, consumers spent over $13 billion on nearly 1 billion CDs. Therefore, it is specious to argue either of the following positions: (1) the copyright has harmed music consumers; or (2) copyrights cannot benefit artists. If artists selling digital copies of their own music do not wish to use copyright protection, then they do not have to. However, if they expect any third party to invest in their music, then it is essential that they use copyright protection in the digital environment.

Two additional important copyright issues for the future of the industry are as follows: (1) whether artists will be able to retain the copyright for their works; and (2) whether record labels will be forced to license digital copies of their current catalogs to independent websites. Evidence suggests that the new technologies are already allowing artists to retain their copyrights, and artist groups are already pressuring Congress to implement compulsory licensing for digital download services. Compulsory licensing, along with the proliferation of high-speed Internet connections, appear to be two of the most important factors in how quickly the digital distribution method will overtake the traditional method. Provided that secure formats for digital downloads can be utilized, it appears that the tremendous gains in productive efficiency from switching to digital distribution all but ensure that this change in methods will, eventually, take place. Incidentally, as long as laws against illegal copying are strictly enforced and/or copying is made bothersome for the average consumer, utilizing secure formats may not be an insurmountable hurdle for the new distribution method.

It is certainly possible, therefore, that these technologies could dramatically change the structure of the music industry. Since practically anyone, even the artists themselves, would be able to distribute their music directly to consumers, the future structure of the industry will probably shift to a more competitive one. As a result, neither the independents nor the majors

would have an inherent advantage by being able to offer an artist nationwide distribution; artists could distribute nationwide on their own.

Consequently, one possible scenario for the future is that record companies will form more of a partner-type relationship with artists, focusing mainly on the marketing and promotional aspects of the artists' careers. While the Internet may yet prove to be an important tool for self promotion by artists, it appears that helping consumers "find" artists' music will remain a significant task for the record company of the future. Still, as long as secure formats for digital copies can be utilized, it appears that the artists and the consumers will reap most of the benefits of the new technologies. Artists will benefit by gaining more control over how their recordings get distributed and, therefore, a larger share of sales revenues. Consumers will benefit by paying lower prices and being able to purchase only the songs they like. Figure 3-12 summarizes the major conclusions of this analysis.

Figure 3-12

Current Market Structure

Five major labels and thousands of
Majors have advantage in nationwide distribution and commercial
Price differences between top-selling independent and major artists
Financial risk and other economic factors account for the pricing

Most Significant Effects of Digital Download Technology

Majors' distribution advantage will disappear
Artists gain more control over their careers
Consumers gain the ability to purchase only the songs they li

Resulting Likely Future Market Structure

Less concentration in the industry; artists may distribute on their own
Record companies serve as promotional intermediaries
Retail music prices should fall as industry becomes less concentrated

Keys to the Realization of This Future Market Structure

Compulsory licensing for digital downloads
Enforceable copyrights
Secure music file formats
Proliferation of broadband Internet connections

Chapter 4, Consumer Demand and Firm Profit Maximization

4.0 Introduction to Model and Basic Assumptions

The derivation of the model is divided into two chapters (Ch. 4 and 5). Chapter 4 focuses on the relationship between the consumer and the label, and chapter 5 examines the interactions between the label and the artist. Accordingly, the revenue-sharing arrangement between the firm and the artist is taken as exogenously given in Chapter 4, and then endogenized in Chapter 5.

4.1 The Firm

The firm in this model is assumed to be a major label, and the product supplied to consumers is viewed as "music," a homogenous product without any references to a particular genre. Not only do both independent and major labels carry out the various functions of the label in a similar fashion, but independents are comparable to the majors' individual labels in that they both sell music in a fairly small number of genres.[1] By assuming the firm sells a homogenous product, we are implying that consumers of each music genre typically buy only from within that genre. Consequently, this assumption implies that changes in the prices of other types of music do not affect the demand for this particular type of music. Since most consumers of a particular style of music do tend to buy from within that particular genre, we take this to be a reasonable simplifying assumption.[2]

The firm is taken to be a profit maximizing monopolist. Given the current structure of the music industry, treating the firm as a monopolist may seem like an oversimplification. However, since we are examining one firm which sells one type of music to a set of consumers, this monopoly assumption is reasonable.[3]

The firm's cost structure consists of fixed costs (recording and promotional costs) and variable costs (managing, manufacturing, and distributing costs). Given the demand curve for music CDs, denoted by $y(p)$, the firm is assumed to choose the price p (of a CD) so as to maximize the following profit expression.

$$\pi = (1-\mu_A)(py(p)) - cy(p) - F \tag{1}$$

In (1), μ_A denotes the *artist's* negotiated share of album sales (taken exogenously in (1)), p is the price of the CD, y is the quantity of CDs sold, c represents the manufacturing, managing and

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[1] While there are minor differences across genres, these differences are quite similar whether a major or an independent is producing the music (see Chapter 3).
[2] Furthermore, most consumers purchase music in the same format, the CD. Since the "single" in the CD format has never really gained widespread acceptance in the market, and is basically being phased out, the product sold to consumers in this model is assumed to be in the format of the full-length CD.
[3] Regardless of the industry's structure, each label, through copyrights, always has a monopoly on, at the very least, a particular version of a song/album. This idea is generalized in the model such that the firm has a monopoly on the homogenous product "music."

distribution expenses per unit produced, and F represents the promotional and recording expenses.

The firm is faced with a given copy technology: instead of purchasing music as CDs supplied by the firm, a fraction of the market may copy instead. Some individuals may also choose neither to buy or copy – this will be examined further below.

4.2 The Consumer

Consumers are able to satisfy their taste for music through both purchasing CDs and obtaining copies. While there are several forms of copying (see Appendix A), all of these are assumed to fall into one category of "copying," with copyright compliance costs treated as part of transaction costs.[4] This assumption is reasonable because the consumer's choice to buy or copy will depend on the value that the consumer places on the CD and the transaction costs incurred by making the copy. Regardless of which form of copying takes place, the higher the price of the CD relative to a consumer's transaction costs, the more likely that consumer is to copy, and vice versa. In our model, transaction costs include all marginal opportunity costs associated with copying.[5] For instance, the transaction costs for copying include both the opportunity cost of time for making the copy and of learning about the copy technology.[6]

Based on the above assumptions, a Hotelling-type model of spatial differentiation is used to illustrate the consumer's choice and to derive demand functions. In this model, consumers are distributed uniformly along a line segment of length one, with each consumer identified by the consumer's *cost type*, $x \in [0,1]$. At the extremes, the consumer of type $x = 0$ is one who has no ability to grasp the copy technology, while a consumer of type $x = 1$ is one who grasps the technology perfectly.[7] Consumers can buy music as CDs at price p or they may copy at transaction cost $t(1\text{-}x)$ (>0), which reflects the "distance" of the consumer of type x from those who grasp the copying technology perfectly ($x = 1$)[8]. Additionally, a *taste parameter*, θ, is used to show that consumers with high preferences for music will consume large quantities of music, and those with low preferences for music will consume relatively smaller quantities. The parameter θ is distributed uniformly between zero and one.

The parameters q^{CD} and q^{COPY} are introduced to denote the *quality* of the CD and the copy, respectively. Both q^{CD} and q^{COPY} are assumed to be along the interval from zero to one. In the case of q^{CD}, quality represents any set of characteristics which *only* the firm can include with the CD, with a value of one being the highest quality and a value of zero being the lowest

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[4] As will be seen below, this assumption works well in the current state of the music market but becomes troublesome when digital copying on the Internet is the dominant mode of copying.

[5] Since adding a fixed component to the transaction cost of copying does not change any of the implications of the model, they are taken to be zero to make the model more tractable. Appendix B demonstrates that the alternate model, with these fixed costs included, results in identical implications.

[6] Naturally, these costs would vary across consumers. E.g., a freshman in college would have a much lower opportunity cost of time than an executive.

[7] In reality, we could expect these numbers to be very close to zero or one, but not exactly equal to either of the "perfect" categories. For example, even a consumer with "perfect" knowledge of the copy technology will still have a small opportunity cost associated with making the copy.

[8] Baake and Oechssler (1997) show that equilibrium solutions in Hotelling-type models may not exist even when consumers have quadratic transaction costs. The issue of quadratic transaction costs of copying is addressed further in Appendix C.

quality.[9] In the case of q^{COPY}, quality represents the degree of substitutability between the original and the copy. For this parameter, a value of one represents a perfect substitute for a CD (a "high" quality copy) and a value of zero represents a poor substitute for a CD (a "low" quality copy). Additionally, the parameter q will be used (without superscripts) to denote the difference in the quality between the CD and the copy, i.e., $q = (q^{CD} - q^{COPY})$, with $q > 0$.[10] It is assumed that all consumers would place a lower value on a "bad" copy (one that hisses, for example) and all place a higher value on a "good" copy. Quality thus serves to vertically differentiate CD's from copies and "good" copies from "bad" copies.

Given the above assumptions, the consumer's utility function from choosing to buy, copy, or stay out of the market is taken to be of the form[11]

$$U_x = \begin{cases} \theta_x q^{CD} - p & \text{if the consumer buys the CD,} \\ \theta_x q^{COPY} - t(1-x) & \text{if the consumer copies,} \\ 0 & \text{if the consumer does neither} \end{cases} \tag{2}$$

In the first case, the consumer whose cost type and taste parameter are x and θ_x pays the price p for any CD purchased. By purchasing the CD, the consumer obtains the surplus utility $\theta_x q^{CD} - p$, which is affected by the quality of the CD, q^{CD}. If $q^{CD} = 1$, then the consumer's utility is only reduced by the price of the CD. In the case of the consumer who copies, the consumer incurs the cost $t(1-x)$, which depends on the consumer's cost type. When x approaches one the consumer's copying costs shrink, and when x approaches zero they rise.[12] The consumer's utility when copying is reduced by any lack of quality of the copy, with $q^{COPY} = 1$ when the copy is a perfect substitute for the CD and $q^{COPY} = 0$ when the two are completely different.

When the consumer maximizes the utility function (2) so as to decide whether to purchase a CD or copy the music, the choice will depend on the price of the CD, p (taken exogenously by the consumer), and the (exogenous) parameters $t(1-x)$, θ_x , q^{CD}, and q^{COPY}, representing the level of transaction costs incurred when copying, the consumer's taste for music, the quality of the CD and the quality of the copy, respectively.[13]

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[9] E.g., the firm can include the original artwork of the artists and, perhaps, include dual formats on the original CD. While omitting dual formats or using "bad" artwork would give the CD lower quality, we would not expect the CD quality to be zero. In fact, the assumption is made (see above) that $q^{CD} > q^{COPY}$.

[10] If $q = 0$, the two goods are perfect substitutes. However, even in the case of two identical digital goods, one offered by the firm and one obtained through copying, we could expect some small, positive difference, perhaps from some nominal feeling of guilt from consuming an illegal copy. Since both q^{CD} and q^{COPY} are between zero and one, and since we are restricting q to being positive, we are also requiring that $q^{CD} > q^{COPY}$.

[11] The utility function in (2) is a modified version of the one found in the basic vertical differentiation model of Tirole (2001), p. 96. Analogous versions of this utility function are also discussed in Shy (1995), pp. 150-163.

[12] This notion is analogous to distance in the original Hotelling (1929) model. Instead of representing the distance from a store, x now represents the cost type of the consumer, with x=0 representing someone who cannot grasp the copy technology, and x=1 representing someone who grasps it perfectly.

[13] All variables and parameters represent a per unit cost distance from zero or one.

If the quality difference between the CD and the copy, q, is close to zero (the CD and the copy are very close substitutes), then the consumer's choice will depend largely on which cost, p or $t(1\text{-}x)$, is smaller. This notion corresponds to the standard interpretation of the (linear) Hotelling model in which the consumer buys from the least cost supplier of a (homogenous) product. In this case, those consumers whose cost type is close to zero are likely to buy, and those whose cost type is close to one are likely to copy.

When $q^{COPY} = 0$ (the goods are completely different) the utility from copying is negative, and the consumer buys a CD instead of copying. The copy would not, in this case, supply the consumer with the "music" that the consumer wishes to consume. We can also expect that some consumers will neither buy nor copy; these cases will be fully explored below.

4.3 Critical values of θ and x

By setting the utilities of the buying and copying consumers equal, the following critical value of the taste parameter, θ, is obtained for a given x,

$$\hat{\theta}_x = \frac{p - t(1-x)}{q} \tag{3}$$

where $q = q^{CD} - q^{COPY}$ ($q > 0$). All consumers of type x whose taste parameter is larger than this critical value will buy a CD, and those whose θ is smaller than $\hat{\theta}_x$ but larger than $t(1\text{-}x)/q^{COPY}$ will copy. That is, consumers will not copy if their taste parameter is less than the quality adjusted cost of copying; for these consumers, music is not worth even the cost of acquiring the copy.

If the critical value $\hat{\theta}_x$ increases, more consumers of type x have a taste parameter less than $\hat{\theta}_x$, so more will choose to copy and fewer will buy CDs. An examination of equation (3) reveals that $\hat{\theta}_x$ will increase if the price of the CD (p) increases, the cost of copying (t) decreases, or the difference in the CD and copy quality (q) decreases.[14] Alternatively, if the critical value $\hat{\theta}_x$ decreases, more consumers have a taste parameter greater than $\hat{\theta}_x$, and CD buying will increase. When the price of the CD (p) decreases, the cost of copying (t) increases, or the difference in the CD and copy quality (q) increases, $\hat{\theta}_x$ will decrease. This suggests that, in order to increase the number of consumers who will buy CDs across consumer types, the firm should attempt to reduce the critical taste parameter, $\hat{\theta}_x$, by either reducing the price of the CD, increasing the cost of copying (perhaps by altering its copy protection techniques), or increasing the difference in the quality of the CD and the copy.

Similarly, the utilities of the copying and buying consumers can be set equal to each other so as to solve for a critical value of x, the cost type of the consumer, given the taste parameter θ. The resulting point of indifference, x^*, is as follows

$$x^* = \frac{\theta_x q - p + t}{t} \tag{4}$$

[14] All partial derivates not in the main text are included in a derivation section, Appendix D.

where $q = q^{CD} - q^{COPY}$. All consumers whose cost type exceeds x^* will copy, and those whose cost type parameter is smaller than x^* will buy (x^* represents the cost type where the utility from buying a CD is equal to the utility from copying). Therefore, as x^* decreases, more consumers will have a cost type greater than x^*, so more will copy. On the other hand, when x^* increases, more consumers will have a cost type less than x^*, so more will buy CDs. An examination of equation (4) shows that, for a given θ, *copying will increase* if the price of the CD increases or if the quality difference between the CD and the copy, q, decreases. Also, if there is no difference in the quality of the CD and the copy ($q = 0$), x^* increases as the transaction cost of copying (t) is increased; consumers will then buy more and copy less. This point of indifference is represented graphically in Figure 4-1A.

Figure 4-1A

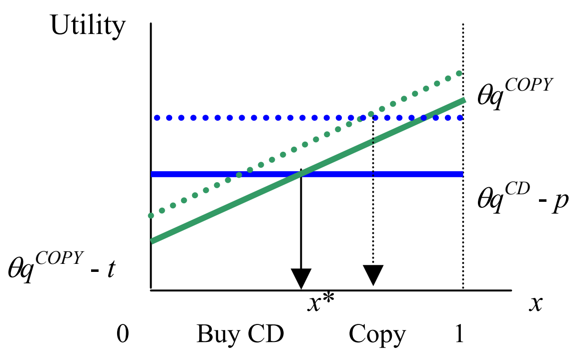


Figure 4-1A illustrates the choice of consumers whose taste parameter is equal to a given θ. The vertical axis represents utility and the horizontal axis represents the cost type $x \in [0,1]$. The solid horizontal line shows the utility surplus that a consumer of type x receives from buying a CD, given by $\theta q^{CD} - p$. The solid upward sloping line shows the utility surplus a consumer of type x receives from copying. This line has an intercept of $\theta q^{COPY} - t$ when $x = 0$, and of θq^{COPY} when $x = 1$. In other words, consumers completely unable to grasp the copy technology have their surplus from copying reduced by the full transaction cots, t, and those able to perfectly grasp the copy technology are able to enjoy the full surplus of the copy, θq^{COPY}. All consumers whose cost type x is smaller than the critical value x^* receive more surplus from buying than copying, and those whose cost type x is larger than x^* receive more surplus from copying than buying.

The effect of an increase in the taste parameter θ is illustrated by the dotted lines in Figure 4-1A. When θ increases, both of the lines depicting the consumer surplus shift upward. These upward shifts reflect the increase in consumer surplus from both buying and copying when consumers' taste for music rises. However, given the assumption that the quality of the CD remains higher than the quality of the copy, i.e., $q^{CD} > q^{COPY}$, the utility from buying a CD will increase more than the utility from copying, which means that the intersection of the dotted lines, defining the new critical value x^*, will be higher, indicating that more CDs would be bought when θ is higher.[15]

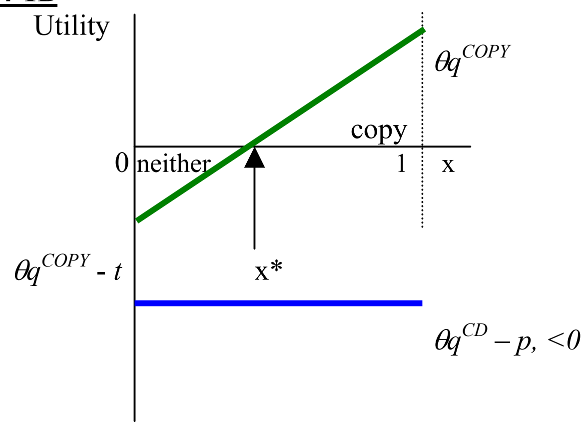
[15] Thus, we would expect that the firm would try to increase the taste parameter by, perhaps, increasing its amount of advertising and promoting or finding better artists.

However, if the taste parameter, θ, is low enough, the horizontal line (representing the *buy* utility, $\theta q^{CD} - p$) lies below the horizontal axis. In this case, consumers choose between not consuming music at all and copying. Here, by setting the utility of copying equal to zero (the utility from the choice of neither buying nor copying), a new critical value for the taste parameter, θ, is found to be

$$\hat{\theta}_x = \frac{t(1-x)}{q^{COPY}}. \quad (5)$$

This new critical value, $\hat{\theta}_x$, splits the consumers into those who neither buy nor copy and those who copy (for a given cost type, x). Those consumers of a given cost type, x, whose taste parameter, θ, exceeds this critical value (5) will copy, and those with θ less than this critical value (5) will neither buy nor copy. Equation (5) is positively related to the transaction cost of copying, t, and negatively related to the quality of the copy, q^{COPY}. So, as either the transaction cost of copying rises or the quality of the copy falls, the critical taste parameter (5) will rise, indicating that fewer consumers will copy and more will stay out of the market altogether. We can figuratively express consumers' choices with this lower θ value in Figure 4-1B, a modified version of Figure 4-1A.

Figure 4-1B



In Figure 4-1B, the copy utility (represented by θq^{COPY} - t when x =0 and θq^{COPY} when x =1) is expressed as an upward sloping line and the utility from buying a CD (represented by $\theta q^{CD} - p$) is the horizontal line below the x axis (the utility from buying a CD is negative). The new point of indifference, x^*, is found by setting the utility of the copying consumers equal to the utility of those choosing to neither buy nor copy, i.e., θq^{COPY} - $t(1\text{-}x) = 0$. Therefore, this point of indifference represents the consumers who are indifferent toward copying and staying completely out of the market (for a given θ) and is represented by the following expression.

$$x^* = \frac{t - \theta q^{COPY}}{t} \quad (6)$$

Consumers whose cost type, x, exceeds this critical value will copy, and those whose cost type is less than x^* will stay out of the market completely. This point of indifference (6) is positively related to the transaction cost of copying, t, and negatively related to the quality of the copy, q^{COPY}. Therefore, if the transaction cost of copying rises, x^* will increase, indicating that

fewer consumers will copy. Alternatively, if the quality of the copy rises, x^* will decrease, indicating that more consumers will copy.

4.4 Illustration of Market Demands

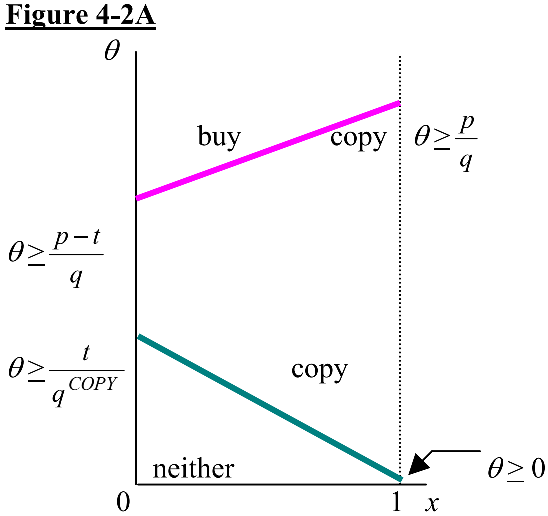
We can use the utility expressions of the three groups of consumers (those who buy, those who copy, and those who do neither) to illustrate the market demands for CDs and copying for all pairs of taste parameter, θ, and cost type, x. Figure 4-2A shows the regions of CD purchasing, copying, and no consumption of music in any form, corresponding to Figures 4-1A and 4-1B.

The upward sloping line in Figure 4-2A is obtained by setting the utility of buying and copying equal to each other (equation (3)); this line separates the choices of buying and copying music from each other for the complete range of cost types, x. When the taste parameter θ is greater than the critical value identified by the upward sloping line, for any cost type x, the consumer will buy the CD rather than copy. On the other hand, below this line, consumers will choose to copy, unless their taste for music is so low that they forgo consumption altogether.

By setting the utility of copying equal to zero (the utility of neither buying nor copying), as in equation (5), we obtain the downward sloping line in Figure 4-2A. This line divides the consumers, for any cost type x, into those who will copy music (located above the downward sloping line) and those will not consume music at all (below the line).

As is clear from Figure 4-2A, the size of the regions in which consumers buy or copy music or do not consume music at all depends on the magnitude of the ratios t / q^{COPY} and $(p - t) / q$. These magnitudes determine the intercepts of the two lines on the vertical axis. This observation indicates that the demand for copying depends on the quality adjusted cost of copying, t / q^{COPY}, i.e., whether this quality adjusted cost of copying is greater than, equal to, or less than the quality adjusted cost difference of buying over copying, $(p-t)/q$. Figure 4-2A is drawn assuming that t / q^{COPY} is less than $(p-t)/q$.

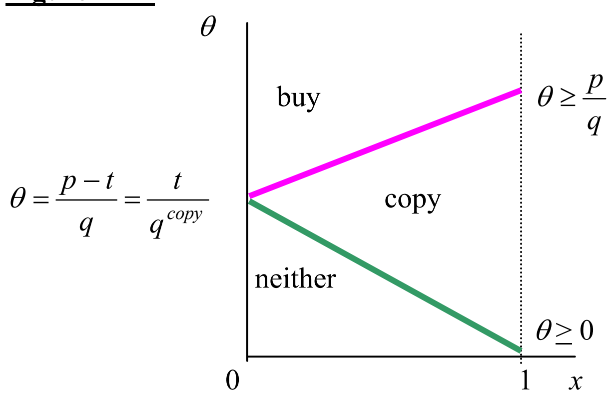
<u>Figure 4-2A</u>



4.4.1 Market Demand When $t/q^{COPY} = (p-t)/q$

When $t/q^{COPY} = (p-t)/q$, the two lines in Figure 4-2A cut each other on the (vertical) θ axis. This means that a consumer of cost type $x = 0$ is indifferent between buying, copying, and doing neither. Figure 4-2B illustrates the resulting demand pattern.

Figure 4-2B



2.4.2 Market Demand When $t/q^{COPY} > (p-t)/q$

If $t/q^{COPY} > (p-t)/q$ the difference in the quality of the CD and the copy is such that consumers get so much less quality (per cost unit) from copying that they will either buy or stay out of the market all together.

This case seems rather unrealistic because for it to occur the quality of copies (per cost unit) must be grossly inferior to the quality of CDs, a condition which is no longer present in the market today. One of the main reasons that copying has become so popular is that music of nearly identical quality to originally produced CDs can be obtained for a much lower cost than the originals.[16]

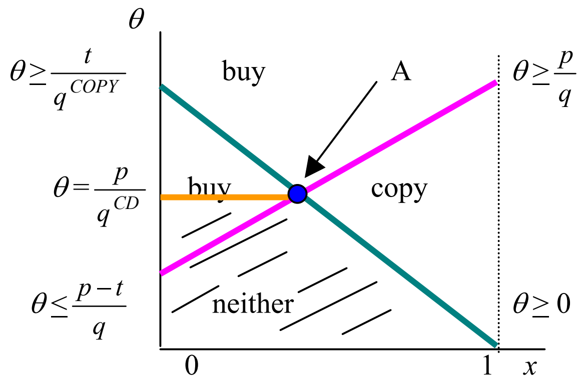
Therefore, it seems plausible that many consumers copying music files on the internet in recent years may have been from the group of consumers in the "neither buy or copy" region. The drastic improvement in copying technology may have been sufficiently large to bring these consumers into the market as copiers, but their taste for music may not have been high enough for them to become music buyers. Nonetheless, for the sake of completeness, Figure 4-2C illustrates the case where $t/q^{COPY} > (p-t)/q$.

In Figure 4-2C the point of indifference (point A) is such that consumers are indifferent between buying, copying, and doing neither; i.e., the utility from each choice is zero. Since the lines representing the *buy* and *copy* utilities cross at some cost type between 0 and 1, there is an additional demand region to examine (the triangle adjacent to the θ axis). By setting the buy utility equal to zero, we find that this region is separated by a horizontal line equal to p/q^{CD}. In

[16] Some may even argue that the quality of the copies is greater than that of the original because the copy can be used to create new CDs with individual songs specifically picked by the consumer.

this region, consumers with a taste parameter, θ, above this horizontal line will buy CDs, and those with a taste parameter below the line will choose to stay out of the market.

Figure 4-2C



By using the information in Figures 4-2A and 4-2B, the market demands for music CD's and copying can be derived (we will not consider the case in Figure 4-2C).

4.5 Formal Equations for Demand for CDs

Since any consumer with a cost type below the critical value x^* defined in equation (4) will buy a CD rather than copy, equation (4) represents the proportion of consumers that will buy a CD for a given price, p, quality difference, q, transaction cost, t, and taste parameter, θ (as long as $\theta \geq (p - t) / q$).[17] Therefore, we obtain the following individual demand function for buying CDs, given θ:

$$\text{Demand for CDs} = \frac{t - p + \theta\, q}{t}. \tag{7}$$

An examination of equation (7) shows that the demand for CDs is negatively related to the price of the CD, p, positively related to the difference in quality of the CD and the copy, q, and, as long as q= 0, positively related to the transaction cost of copying, t.

Since θ is a random variable uniformly distributed from zero to one, in order to obtain *the market demand for CDs*, equation (7) must be integrated with respect to θ. It has already been shown that consumers with a very low θ will not buy music at all. Therefore, the lower integration limit for equation (7) is found from the requirement that the demand for CDs is nonnegative (i.e., the taste parameter, θ, must be at least as large as$(p - t) / q$). Thus, the following market demand function for CDs is obtained.

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[17] When the buy utility and copy utility in equation (2) are set equal to each other and solved for a critical taste parameter, θ, we learn that the minimum value for θ is p-t/q (by setting x=0) instead of zero. If the value of θ were less than p-t/q, the demand for CDs would be negative.

$$\text{Market Demand for CDs} = \int_{\frac{p-t}{q}}^{1} \frac{t-p+\theta q}{t} d\theta = \frac{1}{2qt}(q-p+t)^2 \equiv y^{CD} \qquad (8)$$

Since the upper integration limit for equation (8) is one, we now have the restriction that the quality adjusted difference between the price and the transaction cost is less than one, i.e., $p - t/q < 1$. Stated differently, this restriction says that the difference between the price and the transaction cost is less than or equal to the difference in quality between the CD and the copy, i.e., $p - t \leq q$.[18] Equation (8) is represented graphically in Figures 4-2A and 4-2B, and equation (8) sums up all of the individual demands for buying CDs.

4.6 Market Demand for Copies

Since any consumer with a cost type above the critical value x^* derived from Figure 4-1B will copy rather than stay out of the market, the complement of equation (6) represents the proportion of consumers that will copy for a given copy quality, q^{COPY}, transaction cost, t, and taste parameter, θ. So, for a given θ, the following individual demand is obtained for those who choose copying over staying out of the market.

$$\text{Demand for copies} = 1 - \frac{t - \theta q^{COPY}}{t} \qquad (9)$$

In the cases illustrated on Figures 4-2A and 4-2B, demand for copies results from those values of the taste parameter, θ, between the two straight lines (whose intersection with the vertical axis depends on the magnitudes of t / q^{COPY} and $(p - t) / q$). There are thus multiple regions to consider when summing the individual demands.

First, so as to separate those who choose copying over staying out of the market, we integrate the lowest region from zero to t / q^{COPY}. Then, we have to account for θ values between t / q^{COPY} and $(p-t)/q$, as well as those between $(p-t)/q$ and one. Integrating all these regions, we obtain the following market demand function.

$$\text{Market Demand for copies} = \int_{0}^{\frac{t}{q^{COPY}}} \left[1 - \frac{t-\theta q^{COPY}}{t}\right] d\theta + \int_{\frac{t}{q^{COPY}}}^{\frac{p-t}{q}} 1 d\theta + \int_{\frac{p-t}{q}}^{1} \left[1 - \frac{t-p+\theta q}{t}\right] d\theta =$$

$$-\frac{1}{2}\left[\frac{t}{q^{COPY}} - \frac{2p-q}{t} - \frac{t^2-p^2}{qt}\right] - \frac{t-p}{q} \equiv y^{COPY} \qquad (10)$$

However, we still have to consider the case illustrated in Figure 4-2B, where the quality adjusted cost of the copy is equal to the quality adjusted cost difference between buying and

[18] In the model, the variable for price, p, and the parameters for transaction costs of copying, t, and quality difference between the CD and the copy, q, each represent a per unit cost distance from 1, the cost type (location) of a consumer who perfectly understands the copy technology. Therefore, this restriction does not detract from the model's usefulness.

copying; i.e., $t/q^{COPY} = (p-t)/q$. Again, we start by separating those who choose copying over staying out of the market by integrating the lowest region from zero to t/q^{COPY}. Now, however, we can account for all other copying consumers by integrating from t/q^{COPY} to one (since $t/q^{COPY} = (p-t)/q$). Therefore, the following market demand function is obtained

$$\text{Market Demand for copies} = \int_0^{\frac{t}{q^{COPY}}} \left[1-\frac{t-\theta q^{COPY}}{t}\right]d\theta + \int_{\frac{t}{q^{COPY}}}^{1} \left[1-\frac{t-p+\theta q}{t}\right]d\theta =$$

$$\frac{1}{2}\left[\frac{1}{q^{COPY}}\left(t+\frac{qt-2pq^{COPY}}{q^{COPY}}\right)+\frac{2p-q}{t}\right] \equiv y^{COPY} \qquad (11)$$

4.7 Partial Derivatives of the Demand Functions

The demand for CDs given in equation (8) responds negatively to a change in the price of the CD, p, positively to a change in the quality difference of the copy and the CD, q, and positively to a change in the transaction cost of copying, t (assuming that $q > 0$ and $p - t \leq q$). These changes can be seen below in equations (12), (13) and (14), respectively.

$$\frac{\partial y^{CD}}{\partial p} = \frac{1}{qt}(p-t-q), \leq 0 \qquad (12)$$

$$\frac{\partial y^{CD}}{\partial q} = \frac{(q-p+t)}{qt}\left[\frac{q-p+t}{-2q}+1\right], \geq 0 \qquad (13)$$

$$\frac{\partial y^{CD}}{\partial t} = \frac{(q-p+t)}{qt}\left[\frac{q-p+t}{-2t}+1\right], \geq 0 \qquad (14)$$

The negative relationship between the price of CDs, p, and the demand for CDs, y^{CD}, corresponds with the standard relationship between the price of a good and its quantity demanded. Given the assumption that the quality of the CD remains higher than the quality of the copy, i.e., $q^{CD} > q^{COPY}$, the positive relationship between the quality difference of the copy and the CD, q , and the demand for CDs, y^{CD}, is as expected. As the quality difference, q, rises, the goods become less substitutable because the quality of the CD improves relative to the quality of the copy, and vice versa. Given the additional assumption that the difference between the price and the transaction cost is less than the difference in quality between the CD and the copy ($p - t \leq q$), equation (14) exhibits a positive relationship between the transaction cost of copying, t, and the demand for CDs, y^{CD}.

While the same inferences can be drawn from the copy demands in both equations (10) and (11), when t/q^{COPY} is either less than or equal to $(p-t)/q$, respectively, the partial derivatives for both cases are derived. First, equations (15), (16), (17) and (18) show the partial derivatives of the demand for copies, y^{COPY}, from equation (10), when $t/q^{COPY} < (p-t)/q$. Assuming that $p - t \leq q$, these equations show that the demand for copies, y^{COPY}, is positively

related to the price of the CD, p, and the quality of the copy, q^{COPY}, and negatively related to the quality difference of the CD and the copy, q and the transaction cost of copying, t.

$$\frac{\partial y^{COPY}}{\partial p} = \frac{1}{t}\left[1-\frac{p}{q}\right]-\frac{t-p}{q}, \geq 0 \quad (15)$$

$$\frac{\partial y^{COPY}}{\partial q^{COPY}} = \frac{t}{2(q^{COPY})^2}-\frac{t-p}{q}, \geq 0 \quad (16)$$

$$\frac{\partial y^{COPY}}{\partial q} = \frac{-1}{2t}\left[1+\frac{(t^2-p^2)}{q^2}\right]-\frac{t-p}{q}, \leq 0 \quad (17)$$

$$\frac{\partial y^{COPY}}{\partial t} = \frac{-1}{2}\left[\frac{1}{q^{COPY}}+\frac{2p-q}{t^2}+\frac{t^2-p^2}{qt^2}\right]+\frac{1}{q}(1-t-p), \leq 0 \quad (18)$$

Equation (15) shows that the demand for copies, y^{COPY}, is positively related to the price of the CD, p, and equation (18) demonstrates that the demand for copies, y^{COPY}, is negatively related to the transaction cost of copying, t. Since the CD and the copy serve as substitute goods, the positive relationship between the price of the CD, p, and the demand for copies, y^{COPY}, is as expected. Likewise, since the transaction cost of copying, t, represents the "price" of a copy, the negative relationship between t and the demand for copies, y^{COPY}, is as expected.

Equation (16) shows the positive relationship between the demand for copies, y^{COPY}, and the quality of the copy, q^{COPY}, and equation (17) gives the negative relationship between the demand for copies and the quality difference of the copy and the CD, q. These relationships are also as expected since an increase in the quality of the copy, q^{COPY}, would make the copy a better substitute for the CD, and an increase in the quality difference of the copy and the CD, q, means that the CD has a higher quality relative to the copy.

Next, equations (19), (20), (21) and (22) show the partial derivatives of the demand for copies, y^{COPY}, from equation (11), when $t / q^{COPY} = (p-t)/q$. Assuming that $0 \leq t/q^{COPY} \leq 1$, these equations show that the demand for copies, y^{COPY}, is positively related to the price of the CD, p, and the quality of the copy, q^{COPY}, and negatively related to the quality difference of the CD and the copy, q and the transaction cost of copying, t.

$$\frac{\partial y^{COPY}}{\partial p} = \frac{1}{t}-\frac{1}{q}, \geq 0 \quad (19)$$

$$\frac{\partial y^{COPY}}{\partial q^{COPY}} = \frac{1}{(q^{COPY})^2}\left[\frac{-t}{2}-p-\frac{(qt-2pq^{COPY})}{q^{COPY}}\right], \geq 0 \quad (20)$$

$$\frac{\partial y^{COPY}}{\partial q} = \frac{-1}{2}\left[\frac{1}{t}-\frac{t}{(q^{COPY})^2}\right], \leq 0 \quad (21)$$

$$\frac{\partial y^{COPY}}{\partial t} = \frac{1}{2}\left[\frac{1}{q^{COPY}}\left(1+\frac{q}{q^{COPY}}\right)-\frac{2p-q}{t^2}\right], \leq 0 \quad (22)$$

Equation (19) shows that the demand for copies, y^{COPY}, is positively related to the price of the CD, p, and equation (22) demonstrates that the demand for copies, y^{COPY}, is negatively related to the transaction cost of copying, t. Again, since the CD and the copy serve as substitute goods,

and since the transaction cost of copying, t, represents the "price" of a copy, these relationships are as expected.

Equation (20) shows the positive relationship between the demand for copies, y^{COPY}, and the quality of the copy, q^{COPY}, and equation (21) demonstrates the negative relationship between the demand for copies and the quality difference of the copy and the CD, q. Just as in equations (16) and (17), since an increase in the quality of the copy, q^{COPY}, would make the copy a better substitute for the CD, and since an increase in the quality difference of the copy and the CD, q, means that the CD has a higher quality relative to the copy, these relationships are as expected. All of the key assumptions used to derive the demand equations are listed below in Table 4-1. We will now use the demand for CDs in (8) to derive the firm's profit maximizing condition.

Table 4-1 Key Assumptions

General:

- $q^{CD} > q^{COPY}$, i.e., $q > 0$
- To buy CDs $\theta \geq \frac{p-t}{q}$
- $p - t \leq q$

Case Specific:

Demand for copies when $\frac{t}{q^{COPY}} = \frac{p-t}{q}$, we require $0 \leq \frac{t}{q^{COPY}} \leq 1$

4.8 The Firm's Choice of p

The label observes the demand for CDs, y^{CD}, derived in equation (8), and chooses the price of CDs so as to maximize the profit expression

$$\pi = (1-\mu_A)(py^{CD}(p)) - cy^{CD}(p) - F \tag{23}$$

where μ_A is the *artist's* negotiated share of album sales (taken exogenously), p is the price of the CD, y^{CD} is the demand for CDs, c is the variable cost (manufacturing, managing and distribution expenses) per unit, and F is the fixed cost (promotional and recording expenses). Substituting equation (8) into (23) and maximizing with respect to price p results in the following two solutions for the optimal price.[19]

[19]We maximized with respect to price rather than quantity because the music industry is better described this way. For example, record labels regularly price CDs differently across genres *and* within genres based on the record sales they project for the artist. Furthermore, since consumers are comparing the price of the CD to the "price" of the copy, this approach seems reasonable. The calculations are provided in Appendix D.

$$p_1* = \frac{1}{3}\left[q + t + \frac{2c}{1-\mu_A}\right] = \frac{1}{3}\left[q^{CD} - q^{COPY} + t + \frac{2c}{1-\mu_A}\right] \quad (24)$$

$$p_2* = q + t = q^{CD} - q^{COPY} + t \quad (25)$$

Which of the two price solutions is actually profit maximizing depends on the values of model parameters, and this has interesting implications for firm behavior. It turns out that when $q + t$ is less than $c/(1-\mu_A)$, solution (25) is the true maximum, i.e., the label chooses the price $p_2* = q + t$. This pricing rule does not respond to changes in either the marginal cost, c, or the artist's share of album sales, μ_A. On the other hand, when $q + t$ is larger than $c/(1-\mu_A)$, solution (24) is the maximum. In this case, labels' pricing decisions are responsive to marginal costs and to the share paid to artists.

These two observations imply that *as the transaction cost of copying (t) and the quality difference between copies and CDs decline (q + t declines), the firm's pricing policy (i.e., p*) becomes less responsive to the firm's variable costs and the artist's compensation*. This apparently counterintuitive conclusion can be explained by observing that the reductions in copying costs and quality differences are likely to coincide with a significant increase in actual copying of music, thereby forcing the firm to price its product lower, irrespective of its cost factors c and μ_A. The comparative statics for the pricing equations are as follows.

Starting with the optimal price (24), optimal price p_1* responds positively to changes in the artist's negotiated share of album sales, μ_A, the transaction costs of copying, t, and the quality difference between the CD and the copy, q. Additionally, we show the comparative statics on the expanded version of equation (24), where the quality difference between the CD and the copy, q, is decomposed into its two parts – the quality of the CD, q^{CD}, and the quality of the copy, q^{COPY}. These comparative statics are given below.

$$\frac{\partial p*}{\partial \mu_A} = \frac{2}{3}\left[\frac{c}{(1-\mu_A)^2}\right], \geq 0 \quad (26)$$

$$\frac{\partial p*}{\partial t} = \frac{1}{3}, \geq 0 \quad (27)$$

$$\frac{\partial p*}{\partial q} = \frac{1}{3}, \geq 0 \quad (28)$$

$$\frac{\partial p*}{\partial c} = \frac{2}{3(1-\mu)}, \geq 0 \quad (29)$$

$$\frac{\partial p*}{\partial q^{CD}} = \frac{1}{3}, \geq 0 \quad (30)$$

$$\frac{\partial p*}{\partial q^{COPY}} = -\frac{1}{3}, \leq 0 \quad (31)$$

Equation (26) shows that the optimal price (24), is positively related to the artist's negotiated share of album sales, μ_A. That is, the larger the share of album sales given to the artist, the higher the optimal price. The positive relationships between the optimal price, $p*$, and both

the transaction cost of copying, t, as well as the quality difference of the CD and the copy, q, as seen in equations (27) and (28), respectively, are as expected. The more difficult it is for consumers to obtain a copy due to higher transaction costs, the more the profit maximizing monopolist should charge.

Likewise, the greater the difference in quality between the CD and the copy, assuming $q^{CD} > q^{COPY}$, the higher the optimal price the firm should charge. Equation (29) shows that the optimal price (24) is positively related to the monopolists' marginal cost – the typical relationship for a monopolist. Then, equations (30) and (31) show that the optimal price (24) is positively related to the quality of the CD, q^{CD}, and negatively related to the quality of the copy, q^{COPY}, respectively.

The comparative statics on the optimal price (25) are as follows.

$$\frac{\partial p^*}{\partial t} = 1, \geq 0 \tag{32}$$

$$\frac{\partial p^*}{\partial q} = 1, \geq 0 \tag{33}$$

$$\frac{\partial p^*}{\partial q^{CD}} = 1, \geq 0 \tag{34}$$

$$\frac{\partial p^*}{\partial q^{COPY}} = -1, \leq 0 \tag{35}$$

Equations (32) and (33) show that the optimal price (25) responds positively to changes in the transaction costs of copying, t, and the quality difference between the CD and the copy, q, respectively. Finally, equations (34) and (35) show that the optimal price is positively related to the quality of the CD and negatively related to the quality of the copy, respectively. So, using either solution (24) or (25), the firm's optimal price is negatively related to the quality of the copy, q^{COPY}, and positively related to the difference in the quality of the CD and copy, q. However, it is clear that the optimal price (25) implies labels' pricing decisions are not responsive to either their marginal cost or the share of sales they pay to artists, an implication that does not hold for the optimal price (24).

4.9 Copyright Assumptions

In the previous sections, all forms of copying were assumed to be included in one general type of "copying," and any copyright compliance costs were included in the transaction costs of copying, t. In the current state of the market for CDs, the above model and its implications hold up well under this assumption. For instance, consumers can currently choose between various methods of purchasing music (traditional stores, on-line mail order, etc.) and copying music (borrowing from a friend, on-line sharing, etc.).

As such, copying by consumers under the "fair-use" aspects of copyright law easily fit into the framework of the above model.[20] Based on the price of the CD, p, the transaction costs of copying, t, taste, θ, how well they grasp the copy technology, x, and the substitutability of the CD and the copy, q, consumers will either buy, copy, or stay out of the market. Furthermore, as has been shown by Besen and Kirby (1989) and Liebowitz (1985), such copying can lead to both

[20] For more on the specifics of copyright law, see Chapter 3.

higher profits for firms and increased consumer welfare. In general, firms are able to extract more surplus from some consumers by raising prices (knowing that some copying will take place), while the copying consumers have a higher surplus because they do not pay the sales price.

The impact of copying on profits, therefore, depends on how much the label can raise the price of the CD relative to how the number of copies sold decreases. For example, when the label is unable to raise its price to compensate for lost sales, total surplus does not rise. Therefore, our model implies that when digital copying on the Internet is the dominant mode of copying, and digital delivery on the Internet is the dominant mode of distribution for the label, total surplus would not rise from copying unless copyrights can be enforced.[21] An examination of the determinants of demand for CDs and copies in this digital environment illustrates this point.

The only portion of the marginal transaction costs, t, remaining would be those arising from copyright compliance costs. The learning portion of the marginal transaction costs, as well as any opportunity costs, would be identical whether purchasing from the label or copying from a sharing platform. Similarly, for the label to rely on digital distribution, the cost type of consumers, x, would have to be quite uniform (and low).[22] More importantly, in this environment, the label's digital music files are perfect substitutes (or as close as possible) for the digital copies being "shared" on the Internet. In other words, the difference in quality of the original and the copy, q, is very close to 0. Naturally, these factors, especially the degree of substitutability, have important implications for the price of the originals, p.

In the absence of copyright compliance costs, consumers of all tastes, θ, would choose between buying and copying perfect substitutes. Since the "price" of the copy in this case is effectively zero, it follows that labels would not be able to charge very much for their digital files. The long-term implications of this effect can be clearly seen by re-examining equation (23), the label's profit expression.

When the price of the original, p, is effectively zero, the label's revenue collapses to zero. In this case, there is no reason for the label to expend any fixed costs, F, to record and promote artists. Just as important, even if artists forgo the intermediary services of the label, they will face the same problem as the label: they will not be able to recover any of their costs. While some artists would surely still record music for their own enjoyment, it is clear that there would be no incentive for anyone to invest in the resources needed for a market to exist.

This problem is the familiar fallacy of composition. When most consumers can copy music for free, the music that they hope to copy in the future will, eventually, cease to exist. One possible way to ensure the existence of the market is to have a selectively enforceable copyright. In other words, while labels and artists should not be overly concerned with consumers who give copies to one or two friends, they should invoke copyright law to prevent large-scale sharing on the Internet. In a sense, the Internet sharing platform replaces the distribution function of the label, but is unsustainable in the long run because artists will not be able to charge for their music.

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[21] As will be explained shortly, this does not suggest that no copying can take place.

[22] This cost type scenario does not seem unreasonable. For example, when college students of 2000 reach retirement age, it is quite reasonable to assume that most consumers will easily grasp the copy/download technology.

4.10 Conclusions and Implications

We assume the most important determinants of the demand for CDs and for copies are the consumers' tastes and transaction costs of copying (including their understanding of the copy technology), the price of the CDs, and the degree of substitutability between the CDs and the copies. Depending on the combination of these factors, consumers will choose to either buy CDs, copy music or stay out of the market completely.

Our model formalizes the notion that, as the transaction costs of copying fall and the quality of the copy rises relative to the quality of the CD, more consumers will enter the market (through copying) who, formerly, stayed out of the market completely. The model suggests that this group of consumers' taste for music, given the relative costs and quality of CDs and copies, was lower than that of the consumers buying CDs. It also shows that consumers with a low enough taste parameter will choose to either copy or stay out of the market based on their costs of copying relative to the quality of the copy.

Given the dramatic increase in copy quality and reduction in the transaction costs of copying, the model suggests that some of the increased copying on the Internet in recent years was undertaken by consumers who were previously staying out of the market. The drastic improvement in copy technology and reduction in cost was enough to bring these consumers into the market to copy, but their taste for music was not high enough to induce them to buy CDs at the market prices. Still, the same implications hold true for consumers previously buying CDs. The model suggests that some of these consumers, given the lower quality difference between the copy and the CD as well as the lower relative cost of the copy, decided to copy rather than buy.

While we have taken the bargaining solution between the artist and the label as exogenous, the pricing rules derived above still provide several implications as to the firm's strategy. For instance, the model predicts that we should see labels becoming *less* sensitive to the share they pay artists as copying becomes more widespread, and vice versa. To increase the sales of CDs, the model shows that the firm should try to increase consumers' taste for music by either reducing the price of the CD, increasing the cost of copying (perhaps by altering its copy protection techniques or increasing litigation), or increasing the difference in the quality of the CD and the copy. Given the current state of copying technology, however, the firm may not be able to increase the quality difference between the CD and the copy. Therefore, the firm may have to focus on either increasing the cost of copying and/or lowering the prices of CDs.[23]

The model demonstrates that the optimal price charged for CDs is positively related to the quality of the CD and negatively related to the quality of the copy. Furthermore, the model formally shows that the optimal price for CDs is positively related to the *difference* between the quality of the CD and the copy. These factors suggest that labels should charge a lower price for CDs relative to the price they charged before this quality difference decreased.

The model also has a key implication for copyright law in a market where both originals and copies are distributed (predominantly) digitally over the Internet. Since the degree of substitutability between originals and copies is becoming ever higher, and since the other factors of demand may equalize for both copies and originals, the only way to ensure a viable market for

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[23] In September 2003, Vivendi Universal SA's Universal Music Group cut the suggested retail price of nearly all its CDs to $12.98, a decrease of as much as 32 percent. The decision was pitched as part of a broad strategy that included aggressive legal action against online piracy. (Smith, (2003))

music may be to have selectively enforceable copyrights. Thus, the copyright should be used to prevent large-scale sharing on the Internet.

Chapter 5, Endogenous Artist-Label Bargaining

5.0 Introduction

In Chapter 4, the bargaining agreement between the firm and the artist was exogenously given, with μ_A representing the artist's negotiated share of album sales. We now examine this relationship further by endogenizing the bargaining agreement between the firm and the artist. After presenting a brief analysis of the typical bargaining arrangement by artists and labels, we incorporate these ideas into a theoretical framework using the Nash cooperative bargaining model to obtain the profit sharing solution (see Nash (1950) and Muthoo (1999)).

5.1 Discussion of Artist-Label Bargaining

As in chapter 4, the firm in this model is assumed to be a major label which functions similarly to independent labels. As a result, the arrangement discussed here is typical of most recording contracts offered to artists. While independent labels may offer a less standardized contract to artists, both the majors and the independents do offer similar contracts in that the label's expenses are recouped before the artist receives royalties on album sales. For simplification, the artist in this chapter is taken to be a recording artist who is paid a royalty rate on album sales.[1]

While the exact percentage of the album royalty rate is negotiable, depending mostly on the stature of the artist, most new artists can expect to receive (gross) between 10% and 12% of the retail price of the album, while the most successful artists can receive as much as 17% to 25%.[2] The net royalty rate the artist receives, however, can be significantly smaller than the negotiated gross rate.

The typical recording contract is designed so that nearly all of the label's expenses (called recoupable expenses) are deducted from the artist's royalties.[3] For example, all new artists in a particular genre are allocated a similar amount for recording expenses, usually in the form of an advance. These costs, representing a portion of the label's fixed costs, are then fully recouped from the artist's gross royalties before the artist receives any net royalties.

The label's other fixed costs (mainly promotional expenses) and variable costs (managing, manufacturing, and distributing) are all typically treated as recoupable expenses.

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[1] This simplification does not harm our analysis. As discussed in chapter 3, there are differences in the royalties recording artists, songwriters and recording artist/songwriters receive. For example, a recording artist /songwriter would be entitled to different types of royalties than a recording artist or a songwriter, and so on. For more details on the different royalties available to each type of artist, see chapter 3.

[2] Alternatively, the record label will issue royalty payments on the wholesale price of the album and, since the wholesale price is roughly half of the retail list price, double the artist's royalty percentage.

[3] In addition to recoupable expenses, many record labels only pay royalties on 90% of the albums sold *and* hold a portion of the artist's royalties in reserve to guard against excessive returns. For more details on these types of contract features, see chapter 3.

Basically, the label finances the development of the artist and, provided the artist is successful, recoups its investment before the artist is paid. So, while a royalty rate on album sales is negotiated, the artist actually receives a share of the profit, provided there is any. Therefore, the bargaining arrangement is really about sharing profits, not revenues. Unfortunately, for those who may dislike this arrangement, artists enter contract negotiations with very little bargaining power.

Aside from the fact that there are many more aspiring artists than well-established labels, the label's have several key advantages which increase their bargaining power.[4] Historically, the most significant of these have been in the areas of promotion and distribution. Because of the significant investment needed to promote and distribute an artist's material nationwide, labels have been able to provide these intermediary services to artists. Without such help, artists have had very little hope of ever being nationally (or even regionally) recognized.

One of the interesting paradoxes of digital downloading on the Internet is that the technology both threatens to eliminate the distributional advantage held by the labels and to make selling music less profitable for artists.[5] Regardless, artists currently have to win the attention and respect of a label through a great deal of hard work, and enter the negotiating process with very little bargaining power. Of course, both parties usually have attorneys to actually negotiate the contract.[6] The following excerpt from Brabec & Brabec (2000) illustrates a typical exchange between lawyers representing the respective parties:

> Record Label Attorney: Hello ________. As you know, our A&R people are very interested in signing your client to a recording artist agreement. Before I send you a summary deal memo of our proposal, I'd like to go over the main points of the offer so we know whether or not we have a deal.
>
> Artist's Attorney: That sounds good to me. The more issues and areas we can define and agree to before you draft a deal memo, the better for everyone.
>
> Record Label Attorney: We'd like to sign the artist for 1 album, and we need to have options for 6 more albums after the first. We'd also like to have the right to issue a "greatest hits" album over and above the option albums. The royalty rate will be 15% of retail for albums and 14% for singles. We'll pay on 90% of all recordings sold and will reduce the artist royalties by 50% for sales outside the U.S. There will be a guarantee that one video will be produced per album, the cost of which will be cross-collateralized with both the artist's audiovisual royalties and audio, CD, and tape income. We'll advance your client $150,000 on signing the agreement, with an escalating advance payable for each new album that is recorded and released. The amount of each option album advance will be based on $66^{2/3}$% of the earnings from the most recent past album. As your client is a songwriter, there will also be a 75% of statutory mechanical rate, with a 10-song cap payable as songwriter and publisher royalties for sales of each album released, and with a 2-song cap on singles. The mechanical rate will be the one in effect when the artist starts to record the album. Those are the basic terms, what do you think?
>
> Artist's Attorney: I'll discuss the offer with my client and get back to you

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[4] It is true that all aspiring artists' products vary considerably in quality. Therefore, it could be argued that all aspiring artists should not be counted in the supply of artists. This possibility will be considered in future research which looks more closely at the supply of artists.
[5] For more on this issue, see Chapter 3.
[6] For more specifics on this issue, and on how artists attract the attention of labels, see Chapter 3.

> with our counterproposal. I do want you to know that, in its present form, the proposal is unacceptable. However, if we can get a 16% album rate with percentage escalators based on the achievement of sales plateaus as well as option years, increased royalties in at least the major foreign territories, a release guarantee for each album in not only the U.S. and Canada but also in the United Kingdom, an understanding that only 50% of the video costs will be recouped from the artist's audio recording royalties, guaranteed tour support, minimum guarantees as to album advances regardless of the earnings from the most recently released album, either a 12-times-statutory mechanical rate cap or, in the alternative, a 13-song-times75% rate cap for albums and an effective mechanical rate determined by the U.S. release date of each album, we'll at least have something to talk about.

After a certain degree of haggling, the artist will either opt to sign with the label or walk away from the negotiations. By the time a label makes an offer to an artist, the label is fairly satisfied that the artist's potential is sufficient to make a profit. As a result, the typical artist-label contract is on an exclusive basis for a given number of albums. Usually, this arrangement consists of the label having the option to pick up three to seven albums based on the success of the first album. The artist, however, does not have the option to choose against recording those additional albums. While there are exceptions, most artists and labels settle on fairly similar contracts and do not renege.

5.2 Justification for using the Nash bargaining solution

In general, a bargaining solution is a formula that determines a unique outcome for each situation in a given class of bargaining situations. The Nash bargaining solution (Nash (1950)) has been widely used because it can be easily applied to many bargaining problems. As long as a clear theoretical justification exists for doing so, using the Nash solution makes studying these situations more tractable. To see how the Nash solution can be justified for the artist-label arrangement, we first provide a brief discussion of the Rubinstein *alternating offers game* (see Rubinstein (1982)). The Rubinstein model can provide a very realistic representation of real-life negotiations, and its solution coincides with that of the Nash model.

5.2.1 The Rubinstein alternating offers game

The Rubinstein alternating offers game is a realistic representation of a bargaining process for several reasons. To begin, as its name suggests, the model allows players to offer and counteroffer until an agreement is reached. Further, the model accounts for friction in negotiations by introducing an element of time. In many bargaining situations, prolonging the negotiations imposes real costs on both sides – perhaps disproportionately. Since it addresses these issues, the alternating offers game appears a fairly good stylized description of the actual artist-label negotiations.

In the Rubinstein game, two players, A and B, bargain over the partition of a surplus of size π, where $\pi > 0$. At discrete points in time, the players propose to each other shares of the surplus. For example, at time zero, player A proposes to player B that they share the surplus in a seventy-thirty ratio. Player B may accept this offer at time $\Delta > 0$, at which time an agreement would be reached and the surplus divided in this ratio. Alternatively, at time $\Delta > 0$, player B could make a counteroffer to share the surplus, for example, in a fifty-fifty ratio. If player A does

not accept this counteroffer, player A makes a new counteroffer at time 2 Δ, and so on until an agreement is reached.

If the players reach agreement at time $t\Delta$, t = 0,1,2…, on a partition that gives player i, i = A,B, a share x_i $(0 \leq x_i \leq \pi)$ of the surplus, then player i's payoff is $x_i \exp(-r_i t\Delta)$, where $r_i > 0$ is player i's discount rate. In other words, each players' payoff is discounted for the time that elapses between the start of the bargaining process and the final agreement. In the event that the players perpetually disagree, each player's payoff is taken to be zero; the negotiation never ends and neither player receives a share of the surplus. If both parties are allowed to haggle indefinitely at no cost ($r_A = 0$ and $r_B = 0$), the solution to the alternating offers game is indeterminate, however unlikely this may be.

In the Rubinstein model, the players' discount rates, $r_i > 0$, and the time lag parameter, Δ, represent friction in the bargaining process. For example, when a player decides to counter-offer, rather than accepting an offer, then that player has to wait Δ time units. Further, the cost of waiting Δ time units is increasing in a player's discount rate, $r_i > 0$. The player's discount rate can be thought of as the rate at which the surplus shrinks during the negotiating, thus capturing the magnitude of the friction in the bargaining process. Naturally, rational players would make counter-offers immediately after rejecting an opponent's offer, thus minimizing the cost of waiting.

This observation suggests that using very small values of Δ provides the most realistic representation of a bargaining process, thus implying the need for a limiting condition, where $\Delta \to 0$. Incidentally, this observation also provides a connection to using the Nash solution as a shortcut to the alternating offers game. To fully describe this link to the Nash solution, it is helpful to review the key reason for the widespread use of the Rubinstein alternating offers game, namely that it provides a unique solution to the bargaining problem.

In the unique subgame perfect equilibrium outcome of this game, agreement is reached at time zero and the partitioning of the surplus is Pareto efficient when $r_A > 0$ and $r_B > 0$. In the limit, as $\Delta \to 0$, the shares obtained by players A and B, respectively, converge to $\eta_A\pi$ and $\eta_B\pi$, where $\eta_A = r_B / r_A + r_B$ and $\eta_B = r_A / r_A + r_B$. In the limit, as $\Delta \to 0$, the equilibrium share of each player depends on the ratio of r_A/r_B, not the absolute magnitude of the players' discount rates. Thus, each player's payoff is decreasing in his own discount rate, and increasing in the opponent's discount rate. In other words, the smaller a player's discount rate (the more patient the player is), the lower the player's cost of haggling and, therefore, the greater the player's bargaining power.

The link between the Rubinstein and Nash model is that, under certain conditions, the subgame perfect equilibrium payoff shares of the Rubinstein model, $\eta_A\pi$ and $\eta_B\pi$, are identical to the payoff shares derived when using the asymmetric (or weighted) Nash bargaining solution that accounts for players' unequal bargaining powers.[7] In his original framework, Nash (1950) treated both players as having the same bargaining power. However, the weighted Nash solution is a more general version which coincides with the symmetric solution when both players have the same bargaining power.

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[7] These conditions will be fully discussed below. For a formal proof that, in the limit, as $\Delta \to 0$, the unique subgame perfect equilibrium payoff in the Rubinstein model converges to the asymmetric Nash solution, see Muthoo (1999), p. 66. For more on the relationship between the Nash and Rubinstein models, see Binmore (1994), pp. 122-135.

The bargaining powers do not represent the players' negotiation skills. As Nash (1953) pointed out, any perfectly rational player can be expected to bargain just as skillfully as any other perfectly rational player.[8] Instead, the bargaining powers in the weighted Nash solution are used to account for external factors which could affect the outcome of negotiations. In general, the bargaining powers represent each player's position of bargaining strength as determined by the circumstances under which the negotiations occur. For example, if a struggling artist has been hoping to sign with a label for many years, a well-established label will have greater bargaining power in any negotiations between the two; the label will be bargaining from a stronger position than the artist. Since the artist and the label typically have different levels of bargaining power, it appears natural to apply the weighted Nash solution to their bargaining problem.

5.2.2 The Nash Bargaining Solution

The Nash bargaining arrangement is defined by specifying the players, a set of possible agreements (the bargaining set) and a status quo point (also known as the disagreement or threat point).[9] The disagreement point represents one of Nash's key innovations in that it allows agreements to be affected depending on what would happen if negotiations were to fail. So, in addition to a set of possible agreements, X, the Nash solution requires that a status quo point, ε, inside of X be specified. The status quo point, ε, is the pair of payoffs the players will receive if they are unable to reach an agreement. The following is a brief description of the Nash bargaining solution.

Two players, A and B, negotiate to divide a surplus of size π, where $\pi > 0$. The set of the players' possible agreements is $X = \{(x_A, x_B) : 0 \leq x_A \leq \pi, x_B = \pi - x_A\}$, where x_i is the share of the surplus to player i ($i = A, B$) and $x_i \in [0, \pi]$. The set X includes the players' disagreement points and, by definition, both players will receive some positive share x_i of the surplus. For each share x_i of the surplus, $U_i(x_i)$ is player i's utility from obtaining a share x_i of the surplus, and player i's utility function $U_i : [0, \pi] \rightarrow \Re$ is strictly increasing and concave in x_i. The strictly increasing and concave utility function ensures that each player will be risk averse and each player will be better off the larger the share of the surplus they receive.

When the players cannot reach an agreement, each player obtains a payoff with at least as much utility as would be derived from receiving none of the surplus. Formally, when an agreement cannot be reached, player i obtains a utility of d_i, where $d_i \leq U_i(x_i)$. Nash ensures that a mutually beneficial agreement exists by theorizing that each player has a level of utility from some share of the surplus which is greater than the utility from their disagreement payoffs. Formally, $x_i \in X$: $U_A(x_A) > d_A$ and $U_B(x_B) > d_B$. The utility pair $d = (d_A, d_B)$ is the utility associated with Nash's status quo point, ε. We now define the set Ω of possible utility pairs obtainable through agreement, utility pairs which represent each player's utility from their respective shares of the surplus. Formally defined, $\Omega = \{(u_A, u_B) : \exists\, x \in X : U_A(x_A) = u_A, U_B(x_B) = u_B\}$.

[8] This reference to Nash (1953) is pointed out in Binmore (1994), p. 78.

[9] As will be discussed below, the players' deadlock and breakdown points have to be the same to justify generalizing the problem with a disagreement point. Binmore (1994) provides a detailed explanation of this issue.

We can now define the Nash bargaining solution. The Nash bargaining solution for the above scenario is the unique pair of utilities, $\left(u_A^N, u_B^N\right)$, that solves the following maximization problem

$$\max_{(u_A,u_B)\in\Theta} \left(u_A - d_A\right)^{\alpha_A}\left(u_B - d_B\right)^{\alpha_B},$$

where $\Theta \equiv \{(u_A, u_B) \in \Omega : u_A \geq d_A, u_B \geq d_B\}$, and α_A and α_B represent the bargaining powers of the respective players, $\alpha_A \geq 0$ and $\alpha_B \geq 0$. The term $\left(u_A - d_A\right)^{\alpha_A}\left(u_B - d_B\right)^{\alpha_B}$ is referred to as the Nash product; the terms of the product represent each player's net utility from agreeing to a share of the surplus (the utility from a share x_i of the surplus, $U_i(x_i) = u_i$, less the utility from the disagreement payoff, d_i). The maximization problem has a unique solution because the Nash product, $\left(u_A - d_A\right)^{\alpha_A}\left(u_B - d_B\right)^{\alpha_B}$, is continuous and strictly quasiconcave, and the set Θ is non-empty.

The Θ symbol is used to denote the set of utility pairs because of the importance of the Nash disagreement points. We maximize with respect to each player's utility contained in the set Ω, but we also account for the condition that, for each player, there is some share of the surplus with a utility at least as large as the utility from their disagreement point. Consequently, since a mutually beneficial agreement can only exist when $u_A > d_A$ and $u_B > d_B$, each player's utility in the Nash solution must be greater than the utility from their disagreement point, i.e., $u_A^N > d_A$ and $u_B^N > d_B$. Regardless, the players' bargaining powers are a key to the solution of the bargaining problem.

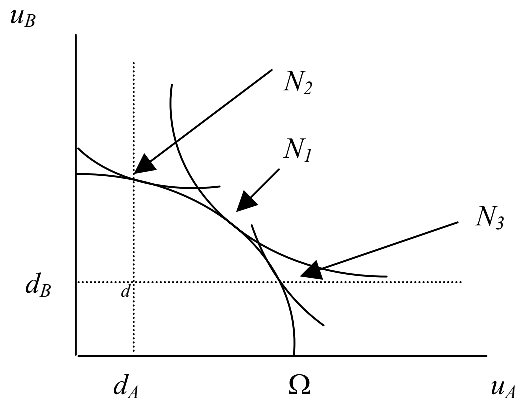
The relative bargaining powers determine the position of the equilibrium shares of the surplus within the Pareto efficient bargaining set. Thus, for example, when $\alpha_A = 0$, player *A* has no bargaining power and receives only the utility from the status quo payoff, d_A. If, on the other hand, $\alpha_B = 0$, player *B* has no bargaining power and receives only the utility from the status quo payoff, d_B. Alternatively, when each player's bargaining power is the same ($\alpha_A / \alpha_B = 1$), the weighted Nash solution coincides with the symmetric Nash solution, and the Nash product simplifies to the expression $\left(u_A - d_A\right)\left(u_B - d_B\right)$.[10] A graphical representation of the Nash solution can be seen on Figure 5-1.

5.2.3 Graphical Representation of the Nash Solution

The following is a graphical depiction of the Nash bargaining solution.

[10] See Binmore (1994) and Muthoo (1999).

Figure 5-1



In Figure 5-1, the intersection of the dashed lines, d_B and d_A, represents the utility pair d (the status quo point). The status quo point is contained within the set of all possible utility pairs, Ω, which is depicted by the concave set Ω in Figure 5-1. The three convex arcs in Figure 5-1, labeled N_1, N_2, N_3, represent level curves of the Nash product, $(u_A - d_A)^{\alpha_A}(u_B - d_B)^{\alpha_B}$, and correspond to different relative values of the bargaining power parameters, α_A and α_B.

The point of tangency represented by curve N_1 represents the utility pairs in the Nash bargaining solution, $(u_A^N, u_B^N) = u^N$, when the players' bargaining powers, α_A and α_B, are the same. When the players' bargaining powers are not the same, the position of the Nash solution's utility pair, u^N, shifts along the frontier of the set of all possible utility pairs, Ω. For instance, when $\alpha_A = 0$, player *A* has no bargaining power and receives only the status quo payoff, d_A, resulting in the point of tangency represented by curve N_2. If, on the other hand, $\alpha_B = 0$, player *B* has no bargaining power and receives only the status quo payoff, d_B, resulting in the point of tangency represented by curve N_3.

Alternatively, if player *B*'s bargaining power, α_B, is slightly above zero, and player *A*'s bargaining power, α_A, is slightly higher than player *B*'s, a point of tangency to the set of possible utility pairs would occur somewhere between N_1 and N_3. Thus, for the weighted Nash solution, the location of the point of tangency (the utility pairs in the Nash bargaining solution) depends only on the ratio of the weights, α_A and α_B. The utility pair u^N, therefore, represents the maximum obtainable utility for both players given their disagreement points (subject to $x_i \geq d_i$, $i = A, B$) and relative bargaining powers, α_A and α_B. Still, before applying the Nash solution, the bargaining situation's characteristics should be checked against several axioms.

Specifically, there are several axioms that characterize the Nash product which, if satisfied, allow us to use the maximization of the Nash product to determine the bargaining solution. Only after demonstrating that the axioms hold for a particular bargaining situation can it be argued that the agents will act as if they are maximizing the Nash product. The next section describes each of these axioms.

5.2.4 Axioms for the Nash Solution

The axioms that need to be satisfied before applying the weighted Nash solution are as follows:[11]

- Independence of utility calibration
- Independence of irrelevant alternatives
- Pareto efficiency

The independence of utility calibration axiom states that the players' preferences determine the real outcome of the bargaining solution, not the particular utility functions used to represent these preferences. In particular, it is assumed that the outcome of the bargaining arrangement will not change if the players' utility functions are replaced by increasing, linear transforms of the functions. As such, applying the Nash solution to the same bargaining problem, using two different utility scales, would result in the same real outcome because the players' preferences would be unaffected. The independence of irrelevant alternatives axiom is less straightforward.

This axiom ensures that increasing the risk aversion of one player will be strategically advantageous to the other player. The players may perceive, for example, there is a risk that negotiations will break down. The idea is generally expressed as a requirement that if the players sometimes agree on *s* when *t* is feasible, then they will never agree on *t* when *s* is feasible. More formally, the idea is expressed as a sort of opposite to an individual monotonicity axiom which violates the above risk aversion idea. (Binmore (1994)) If this axiom were violated, increasing a player's risk aversion would never make that player worse off, a situation which would be implausible.

The Pareto efficiency axiom requires that the solution for the bargaining problem be Pareto efficient. In other words, there can be no other utility pair that makes both players better off without making at least one player less well-off. In terms of the Nash solution's graphical representation in Figure 5-1, the optimal utility pair, u^N, never lies below the set of possible utility pairs, Ω, such that no mutual gains are left unexploited. The applicability of these axioms to the artist-label arrangement will be discussed more fully below.

5.2.5 Applicability of the Nash Solution to the Artist-Label Arrangement

When the actual bargaining environment approximates a non-cooperative game, such as the Rubinstein *alternating offers game*, using the weighted Nash bargaining solution is justified as a "shortcut" to the non-cooperative solution. (Binmore (1994)) This shortcut can be used because, when certain conditions are met, *any* outcome of the alternating offers game corresponds to the Nash bargaining solution of the appropriately defined Nash bargaining problem. Since the actual bargaining between the artist and the label can be regarded as an alternating offers game (the label makes an offer, the artist's attorney makes a counter offer, and so on), applying the Nash bargaining solution to the artist-label arrangement does pass the first test.

Another aspect of the artist-label arrangement which needs further justification for using the Nash solution deals with the status quo point. Binmore (1994) shows that Nash's original

[11] The symmetric Nash bargaining problem requires a symmetry axiom, which states that the set of feasible agreements, X, and the status quo, ε, look exactly the same to both sides. (See Binmore (1994), p. 91) Since we are implementing the weighted Nash solution, this axiom is omitted from the above discussion.

formulation of the status quo point will not necessarily hold in all cases. In particular, the *deadlock point* and the *breakdown point* have to be the same to justify generalizing the problem with a *disagreement point*.

The deadlock point is the payoff pair that would result if the players were to negotiate indefinitely without ever reaching an agreement. The breakdown point is the payoff pair that would result if the negotiations were broken off at the outset. In the case of the label-artist relationship, the breakdown and deadlock points coincide. In either situation, the artist would be left with only the payoff attainable without signing with a label, and the label would be left with only the payoff attainable without signing the artist. Therefore, in our case, the use of only a disagreement point is justified. Still, before we can be completely justified in using the weighted Nash solution, the artist-label bargaining arrangement must be checked against several axioms (as stated above).

The independence of utility calibration axiom states that using linear transformations of the players' utility functions will not alter the *real* outcome of the bargaining solution. A linear shift in the utility scale would require only that the solution be rewritten using new "utils" and, therefore, that the label and the artist would be in the same economic position as before the change. For example, whether we describe utility using dollars or millions of dollars, the actual wealth of the artist and the label will be the same because their preferences will remain unchanged. There is no reason to believe that this axiom will not hold for the artist-label bargaining problem. The most vital axiom for the Nash bargaining problem is the independence of irrelevant alternatives axiom. This axiom ensures that increasing the risk aversion of one player will be strategically advantageous to the other player.

In the artist-label relationship, it is plausible to suggest that increasing the risk aversion of the artist, who clearly has less bargaining power than the label, would make the label better off. If artists are afraid that negotiations will break down, for example, they will be more risk averse to any strategy which prolongs negotiations and, therefore, more likely to reach a less favorable agreement if one can be reached quickly. It is true that some artists may feel they have nothing to lose by taking more chances, perhaps by holding out for a higher royalty rate, but this strategy does not appear likely to always improve the outcome for the artist. In most cases, the label would likely break off negotiations and move on to the next artist. In our model, increasing the risk aversion of the artist will increase the strategic advantage of the label. The one remaining Nash axiom, the requirement that the bargaining solution be Pareto-efficient, is somewhat irrelevant. (Binmore (1994))

Given the assumption that a share of the surplus exists such that each player is at least as well off as receiving their status quo utility, bargaining solutions lie in the Pareto efficient bargaining set.[12] The Pareto-efficiency axiom requires that the bargaining solution be one which makes one player strictly better off without making the other player worse off. While it is possible that some sort of unusual contract could be agreed upon which would violate the Pareto-efficient axiom, this does not appear to be the typical case. Artists currently have a wealth of resources available to help ensure that they do not sign contracts that will harm them, and labels

[12] Binmore (1994) makes the point that the requirement is actually *weak* Pareto-efficiency, but that most authors have replaced this requirement with Pareto-efficiency. However, Binmore argues that this issue is of no great importance and that it is acceptable to follow convention and use the requirement of Pareto-efficiency.

are careful to structure deals so that album sales will pay for their costs.[13] After an agreement is reached, if the artist's music is well-received by its audience (an expectation of both the artist and the label), both parties are better off. Furthermore, experience shows that both parties are willing to risk their respective resources in the hope that higher album sales will make them better off. The last aspect of the arrangement to be discussed is the relative bargaining power of the artist and the label.

In the artist-label relationship, the label currently appears to have a relatively stronger bargaining position (more bargaining power). Historically speaking, the most significant source of the labels' higher bargaining power has been in the areas of promotion and distribution. Because of the significant investment needed to promote and distribute an artist's material nationwide, labels offer a service which artists cannot easily provide on their own. Since both parties have full knowledge of this issue, the artist enters the bargaining process at a relatively weaker position (the label is offering the chance to sell many more albums than would be possible without its services). Furthermore, since distributing music through digital downloading threatens to change the artists' bargaining position, modeling the bargaining process with the weighted Nash solution allows us to more fully explore these implications. We can now present the bargaining model for the artist-label relationship.

5.3 The Bargaining Model

We now formulate the first stage of our three stage game. Chapter 4 formalized the second and the third stages, where the label chooses an optimal price, p^*, to maximize its profits given the consumer demand as a function of the optimal price, $y(p^*)$. The consumer demand, $y(p^*)$, is solved in the third stage, and the optimal price, p^*, is solved in the second stage. In the second stage (Ch. 4), we saw that, depending on model parameters, the label actually chooses between the following two optimal price solutions.

$$p^* = \frac{1}{3}\left[q + t + \frac{2c}{1-\mu_A}\right] \tag{24}$$

$$p^* = q + t \tag{25}$$

When the label chooses the optimal price (25), the price does not respond to either the marginal cost or to changes in the share the firm pays to artists. So, while the label's profit *share* depends on the share it pays to artists (μ_A), the label's *gross profit* will not respond to a change in μ_A because the label's price will not respond to a change in μ_A. In other words, choosing the optimal price (25) requires that the artist and label bargain over a fixed profit. Incidentally, even when the optimal price (24) is chosen, the label and artist could, in theory, bargain over a fixed profit by "ignoring" the effect that either the artist's share or marginal cost has on future profits.

Since the choice of either optimal price (24) or (25) would not change the bargaining outcome when bargaining over a fixed profit, and since the choice of (25) requires that the two parties bargain over a fixed profit, we formulate each player's payoffs by using expression (25) for the optimal price, given consumer demand. We then use these payoff functions to obtain the

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[13] In practice, both sides use attorneys to iron out the details. Since all rational agents would hire experienced attorneys, and since failing to reach agreement would leave both sides with their status quo payoff, the Pareto-efficiency axiom would typically not be violated by the agreement reached by the two sides.

shares of profit that each party will obtain from the bargaining process. First, we derive the payoff functions and profit shares for the case where bargaining is done over a fixed profit, and we then relax this assumption to examine the effect that negotiating over a variable profit has on the bargaining solution. The next step, therefore, is to substitute the optimal price, p^*, and the consumer demand, $y(p^*)$, into the expression for the label's profit. These substitutions yield the following profit expression

$$\pi(\mu_A) = \left(\frac{2k^3}{qt(\mu_A - 1)^2}\right) - F \tag{36}$$

where $k = z(1\text{-}\mu_A) - c$, $z = \frac{1}{3}[q + t + (2c/1 - \mu_A)]$, and $\partial\pi / \partial\mu_A < 0$. An explanation for these substitutions, as well as the first and second derivatives for this expression, are in part 1 of Appendix E.

For simplicity, we formulate the bargaining model in terms of the actual money payoffs of the artist and label, x_A and x_L, where x_A and x_L sum to $\pi(\mu)$.[14] After solving for the optimal money payoff, x^*, solving for the artist's optimal share of album sales, μ^*, is straightforward. After deriving solutions and comparative statics for this scenario, where the surplus is fixed, we illustrate the effect that allowing the surplus to vary would have on the bargaining outcome.

To implement the Nash bargaining solution, we specify the payoff functions of both the artist, A, and the label, L. The set of possible agreements in terms of the money payoffs is expressed as follows,

$$M = \{(x_A, x_L): x_L = \pi(\mu) - x_A,\ 0 \le x_A \le \pi(\mu)\}$$

where x_A and x_L represent the nonnegative money payoffs for the artist and label, respectively. In terms of the players' profit payoffs, $x_A = \mu \cdot \pi(\mu)$ and $x_L = (1 - \mu) \cdot \pi(\mu)$. For each x_i, $U_i(x_i)$ is participant *i's* utility from obtaining a payoff x_i of profit, $\pi(\mu)$. The following utility functions represent the artist's and label's payoff functions. The label is viewed as risk-neutral and has a utility function, U_L, expressed as

$$U_L = x_L\ , \tag{37}$$

and the artist is viewed as risk-averse and has a utility function, U_A, of the following form:

$$U_A(x_A) = x_A^{\gamma},\ 0 < \gamma < 1. \tag{38}$$

The γ parameter represents the artist's level of risk aversion, with the artist becoming less risk averse as γ approaches one, and more risk averse as γ approaches zero.

The next step in implementing the Nash solution is defining the disagreement point of the bargaining arrangement, $d = (d_L, d_A)$, which ensures a mutually beneficial agreement in partitioning the profit, $\pi(\mu)$. Incidentally, there is no reason to believe that the artist's disagreement point could not vary. For example, the advances in digital technology have already made it easier for artists to take on some of the label's functions, and it is easy to see how digital

[14] For ease of exposition, we refer to the artist's share of album sales, μ_A, as simply μ.

downloading over the Internet could allow artists to distribute their music without as much help from a label.

These types of technological advances could increase an artist's expected net wealth from producing music without a label contract, thus requiring a larger share of album sales to entice the artist to sign.[15] The artist's disagreement point represents some level of expected net wealth from *not* signing with a label. In other words, the artist's outside option is the expected wealth from not signing with the label. If the artist's expected wealth from not signing exceeds the expected wealth from signing, the artist will not sign. Some artists may believe that the amount of money they can make without signing a record-label contract is not worth the effort of producing a product.[16] Hence, for these artists, the disagreement point equals zero. Otherwise, the artist would have a positive disagreement point.

The label's disagreement point represents its level of expected wealth from not signing the artist. One reasonable point of view is that the label will not sign an artist unless it thinks it could break even on its investment. For example, the label would walk away from negotiations if the artist was trying to get too high of a share (from the label's perspective) of the profits. If the label would only sign an artist when it expects its share of profits to be positive, its disagreement point would equal zero. If, on the other hand, the label views the sales from a given artist as part of a larger surplus from a group of its signed artists, it would have a positive disagreement point. Therefore, in general, we can say that the disagreement points of the artist and the label are as follows:

$$d_A \geq 0 \tag{39}$$

$$d_L \geq 0 \tag{40}$$

where d_A is the artist's disagreement point and d_L is the label's disagreement point. Below, we examine the case where both the artist's and label's disagreement points equal zero, and we then relax this assumption for the artist, allowing us to examine the implications of a nonzero disagreement point.

Provided we meet a concavity condition, we can now use the Nash solution to examine the artist-label arrangement. Given that meeting the concavity condition is straightforward (as discussed below) when the bargaining is done over the payoffs, and because finding a solution to the bargaining problem is simplified by this method, we assume that the bargaining takes place over the money payoffs. Since we are formulating the bargaining over the actual money payoffs that the artist and label will obtain, the utility functions need only be concave in the money payoffs. Specifically, U_A must be concave in x_A, and U_L must be concave in x_L.

Since the label's utility, U_L, is linear in the label's money payoff, it is clearly concave in the label's money payoff. In the case of the artist, since γ is less than one, the artist's utility, U_A, is concave in the artist's money payoff. Therefore, we can apply the Nash solution over the money payoffs and then use the results to solve for the artist's optimal share of album sales, μ^*.

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[15] This increase in expected net wealth could also lead to higher bargaining power for the artist, an issue which will be explored more fully below.

[16] The term "producing" is used here in generic sense, as in "supplying a product."

Using this method, the Nash bargaining solution (NBS) of the artist-label negotiation is the unique pair of money payoffs, $\left(x_L^N, x_A^N\right)$, that solves the following maximization problem

$$\max_{(x_A, x_L)} \left((x_A)^{\gamma} - d_A\right)^{\alpha_A} \left(x_L - d_L\right)^{\alpha_L} \tag{45}$$

where x_A and x_L sum to $\pi(\mu)$, α_A and α_L represent the bargaining powers of the artist and the label, respectively, and where $\alpha_A \geq 0$, and $\alpha_L \geq 0$. Maximizing equation (45) with respect to, and then solving for, the artist's and label's money payoffs, x_A and x_L, provides the money payoffs that will be agreed upon during the bargaining. Once we have solved (45) for the optimal money payoffs, we can obtain a solution for the artist's optimal share of album sales, μ^*. Solving for the optimal μ is achieved by substituting the definition of x_A (or x_L) into the expression for the optimal x_A (or x_L) and solving for μ.

5.4 Bargaining With Fixed Profit

In this section, we derive the optimal payoffs for each player when their bargaining powers differ, the asymmetric bargaining case. To simplify, we hold the players' disagreement points equal to zero and treat the profit as fixed, assumptions that will be relaxed later. By relaxing the fixed profit assumption, we allow the players to exhibit forward-looking behavior with regard to the expected surplus, a technique that allows us to more effectively examine the impact that bargaining over a variable profit has on the optimal share, price and quantity solutions. For the asymmetric case, we can rewrite the Nash product (45) as follows,

$$N = \left(x_A^{\gamma}\right)^{\alpha} \left(\pi(\mu) - x_A\right)^{1-\alpha} \tag{46}$$

where α_A and α_L sum to one (i.e., $\alpha_L = 1 - \alpha_A$), d_L and d_A are equal to zero, and the "A" subscript for the artist's bargaining power, α_A, is dropped for ease of exposition.[17] Maximizing (46) with respect to x_A and solving for x_A results in the following optimal money payoff for the artist

$$x_A^* = \frac{\alpha\gamma\pi(\mu)}{1-\alpha(1-\gamma)} \tag{47}$$

Given that the label's money payoff, x_L, is simply $\pi(\mu) - x_A$, the corresponding solution in terms of the label's payoff is as follows

$$x_L^* = \frac{\pi(\mu)(1-\alpha)}{1-\alpha(1-\gamma)} \tag{48}$$

We can now use the definition of the artist's (or label's) money payoff to solve for the artist's optimal share of album sales. By substituting the definition of the artist's money share, $x_A = \mu\pi(\mu)$, into (47), we obtain the following optimal share of album sales,

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[17] See part 2 of Appendix E for the derivation of the Nash product (46), the optimal payoffs, their corresponding comparative statics, and the derivation of the optimal share of album sales (49).

$$\mu^* = \frac{\alpha\gamma}{1-\alpha(1-\gamma)} \tag{49}$$

which shows that the optimal share depends on the artist's level of risk aversion and bargaining power. It can be seen from (49) that when γ equals one, μ^* is equal to α. In other words, when γ equals one, the solution depends only on the artist's relative bargaining power indicator, α. Taking the comparative statics of (49) with respect to α and γ, respectively, results in the following expressions,

$$\frac{\partial\mu^*}{\partial\alpha} = \frac{\gamma}{(1-\alpha(1-\gamma))^2} > 0 \tag{50}$$

$$\frac{\partial\mu^*}{\partial\gamma} = \frac{\alpha(1-\alpha)}{(1-\alpha(1-\gamma))^2} > 0 \tag{51}$$

which show that the artist's optimal share of album sales is positively related to both γ and α.[18] The optimal share is, therefore, positively related to the artist's bargaining power and negatively related to the artist's level of risk aversion. As the artist's bargaining power increases, the artist's optimal share increases. As γ increases, the artist becomes less risk averse and the artist's optimal share rises. For example, if an artist were afraid that negotiations would break down, thus leaving the parties without an agreement, the more risk averse artist may adopt a strategy to speed up negotiations. Consequently, the artist may be more likely to reach a less favorable agreement (a lower share of album sales) in the interest of agreeing quickly.

Also, since the label's share is simply 1-μ^*, we can see from equations (49) through (51) that the label's optimal share would be negatively related to the artist's bargaining power, α, and positively related to the artist's level of risk aversion. It follows that the artist's optimal share is negatively related to the label's bargaining power and vice versa. It is also clear that as the artist becomes more risk averse (γ decreases), the label's optimal share will rise. For the sake of completeness, we briefly discuss a special case of (46), where the bargaining powers of both players are equal.

In this scenario, referred to as symmetric bargaining, we restate the Nash product (46) as follows,

$$N = (x_A{}^{\gamma})(\pi(\mu) - x_A) \tag{52}$$

where α_A and α_L are both equal to one, and d_L and d_A are equal to zero. Maximizing (52) with respect to x_A and using the definition of x_A to solve for μ results in the following expression for the artist's optimal share of album sales.

$$\mu^* = \frac{\gamma}{\gamma+1} \tag{53}$$

[18] See part 3 of Appendix E for the derivations of comparative statics on the optimal shares derived in section 5.4.

The optimal share (53) shows that, in the symmetric case, the optimal share depends only on the artist's level of risk aversion.[19] It can be seen from (53) that when γ equals one, μ* is equal to one half. In other words, when the two players see the bargaining situation symmetrically, the solution is that both players obtain an equal share.

Taking the comparative static of (53) with respect to γ gives the following expression,

$$\frac{\partial \mu^*}{\partial \gamma} = \frac{1}{\gamma + 1} > 0 \tag{54}$$

which shows that the artist's optimal share of album sales is positively related to γ and, therefore, negatively related to the artist's level of risk aversion. Just as in the asymmetric case, as γ increases, the artist becomes less risk averse and the artist's optimal share rises.

Also, since the label's share is simply 1-μ*, we can see from equations (53) and (54) that the label's optimal share would be negatively related to γ. As the artist becomes less risk averse (γ increases), the label's share of album sales will fall. By the above reasoning, an artist with a lower level of risk aversion is more likely to negotiate for a larger share of album sales, thus decreasing the label's share. Next, we examine the relationships between the optimal share solution and the optimal price and demand solutions derived in chapter 4.

5.5 Optimal Price and Consumer Demand With Endogenous μ-share

In stage two of the three-stage game, while holding the artist's share exogenous, we found that the label chooses between the following two optimal price solutions,

$$p^* = \frac{1}{3}\left[q + t + \frac{2c}{1 - \mu_A} \right] \tag{24}$$

$$p^* = q + t \tag{25}$$

where μ_A represented the artist's exogenous share of album sales, depending on whether $q + t$ is greater than *or* less than $c/(1 - \mu_A)$. As seen in Chapter 4, the label chooses optimal price (25) when the cost of copying (t) is very low and the difference between the copy and CD quality (q) is close to zero. Conversely, the label chooses optimal price (24) when the transaction cost of copying (t) and the copy/CD quality difference (q) is significant. Since the optimal price solution (25) does not depend on the artist's share of album sales, we now substitute the newly derived endogenous artist's share (49) into expression (24) to examine the effect the bargaining process has on the optimal price (24). This substitution yields the following expression for the optimal price,

[19] The complete derivation and the comparative statics for the optimal money payoffs in the symmetric case are presented in Appendix E.

$$p^* = \frac{1}{3}\left[q + t + 2c\left[\frac{1-\alpha(1-\gamma)}{1-\alpha}\right]\right] \tag{55}$$

where the expression for μ^* (49) is substituted for μ_A.[20]

Endogenizing the bargaining agreement allows us to examine the relationship between the optimal price and the artist's risk aversion and bargaining power, respectively. Aside from calculating comparative statics on the new optimal price expression (55), we can see that the bargaining power and risk aversion parameters work through a multiplier effect on the marginal cost parameter, *c*. In (55), the label's marginal cost is multiplied by the term $1-\alpha(1-\gamma)/1-\alpha$, which is increasing in both α and γ.

For instance, if the artist's bargaining power, α, increases, the marginal cost multiplier increases and the label perceives the marginal cost as more important. The greater the increase in the artist's bargaining power, therefore, the greater the price increase expected from the label. Similarly, as the artist's risk aversion decreases (the γ parameter increases), the artist is more likely to extract a larger share of album sales, whereby the label would be expected to institute a greater price increase because of the marginal cost multiplier. We can also examine the effects of the bargaining power and risk aversion parameters on the optimal price with the following two comparative statics.

$$\frac{\partial p^*}{\partial \alpha} = \frac{2c}{3}\left[\frac{\frac{\partial \mu^*}{\partial \alpha}}{(1-\mu^*)^2}\right] \equiv \frac{2c}{3}\frac{\gamma}{(1-\alpha)^2} > 0 \tag{56}$$

$$\frac{\partial p^*}{\partial \gamma} = \frac{2c}{3}\left[\frac{\frac{\partial \mu^*}{\partial \gamma}}{(1-\mu^*)^2}\right] \equiv \frac{2c}{3}\frac{\alpha(1-\alpha)}{(1-\alpha)^2} > 0 \tag{57}$$

The comparative static (56) suggests that the effect the artist's bargaining power has on the optimal price is magnified by the artist's level of risk aversion. In other words, as the artist becomes less risk averse (γ increases) the magnitude of (56) increases. On the other hand, as the artist becomes more risk averse (γ decreases), the improved bargaining power has a smaller effect on the price. Likewise, the comparative static (57) demonstrates that that the effect of the artist's risk aversion on the optimal price is magnified as the artist's bargaining power increases (α increases).

More generally, equation (56) shows that there is a positive relationship between the artist's bargaining power and the optimal price, and equation (57) shows that there is a negative relationship between the artist's risk aversion and the optimal price (as γ increases, the optimal price rises because the artist becomes less risk averse). For example, the comparative static in (56) shows that as artists obtain more bargaining power and, thus, demand a larger share of album

[20] From the comparative static derived in Chapter 4 (equation (26)), we know that the optimal price is positively related to μ_A. The derivation of equation (55) and the corresponding comparative statics are in part 3 of Appendix E.

sales, the optimal response by the label is to increase the price of the CD. Since there is a positive relationship between the artist's share and the optimal price, it follows that any parameter that increases this share would increase the label's optimal price.

Consequently, since there is a positive relationship between the γ parameter and the artist's optimal share (which represents a negative relationship between the artist's level of risk aversion and the optimal share), it follows that increasing γ leads to an increase in the optimal price, p^*. For instance, (57) shows that as the artist becomes more risk averse and, thus, demands a smaller share of album sales, the optimal response by the label is to lower the price for the CD. Next, we examine the effect that the endogenous bargaining arrangement has on the consumer demand equations derived in Chapter 4.

In the third stage of the three stage game, we found that, given an exogenous price, the utility maximizing consumer was faced with the following demand for CDs,

$$y^{CD} \equiv \frac{1}{2qt}(q-p+t)^2$$

which was presented as equation (8) in Chapter 4. Substituting the newly derived optimal price (55) into (8) results in the following consumer demand expression,

$$y^{CD} \equiv \frac{1}{2qt}\left(\frac{2}{3}\left[q+t-c\left(\frac{1-\alpha(1-\gamma)}{1-\alpha}\right)\right]\right)^2 \tag{58}$$

where the expression for p^* (55) is substituted for p.[21] Before discussing the comparative statics, we can see that the same marginal cost multiplier, $1-\alpha(1-\gamma)/1-\alpha$, in the optimal price expression (55) is present in the new consumer demand expression (58). Thus, as the artist's bargaining power, α, increases, the marginal cost multiplier increases and the label perceives the marginal cost as more important. Through the higher CD price, therefore, the artist's increased bargaining power would have a more negative impact on the demand for the CD. Likewise, if the artist's risk aversion decreases (the γ parameter increases), the corresponding higher price will have a more negative impact on the demand for the CD. We can also examine the following comparative statics.

$$\frac{\partial y^{CD}}{\partial \alpha} = \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{\partial p^*}{\partial \alpha}\right) \equiv \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{2c}{3}\frac{\gamma}{(1-\alpha)^2}\right) \leq 0 \tag{59}$$

$$\frac{\partial y^{CD}}{\partial \gamma} = \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{\partial p^*}{\partial \gamma}\right) \equiv \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{2c}{3}\frac{\alpha}{(1-\alpha)}\right) \leq 0 \tag{60}$$

Equations (59) and (60) show that the demand for CDs is negatively related to the artist's bargaining power (a negative relationship with α) and positively related to the artist's level of risk aversion (a negative relationship with γ). As seen in equation (56), the artist's bargaining power,

[21] From the partial derivative taken in Chapter 4 (equation (12)), we know that consumer demand for CDs is negatively related to the price of the CD. The derivation of equation (58) and the corresponding comparative statics are in part 3 of Appendix E.

α, is positively related to the optimal price, p^*. Since any parameter that is positively (negatively) related to the optimal price would be negatively (positively) related to the demand for CDs, an increase (decrease) in the artist's bargaining power, α, would decrease (increase) the quantity of CDs demanded, y^{CD}. The magnitude of this impact, as seen from equations (56) and (57), will be greater depending on the α and γ parameters.

Additionally, equation (57) demonstrates that the γ parameter is positively related to the optimal price, p^*. As γ increases (the artist becomes less risk averse), the label's optimal response is to increase the CD price. Therefore, an increase in γ would lead to a decrease in the demand for CDs. For instance, when the artist becomes more risk averse (γ decreases) and, thus, demands a smaller share of album sales, the model predicts that the label's response will be to lower the price of the CD. This lower price, in turn, leads to an increase in the quantity of CDs demanded (the impact of which, again, will be greater or smaller depending on the α and γ parameters). This same logic can be applied to the demand for copies and the profit expression derived in Chapter 4.

The demand for copies was derived for two different cases. The first case (equation (10)) represented the demand for copies when the quality adjusted transaction cost was less than the quality adjusted difference between the price of the CD and the transaction cost. The second case (equation (11)) represented the demand for copies when the quality adjusted transaction cost was equal to the quality adjusted difference between the price of the CD and the transaction cost. Since both cases showed a positive relationship to p (the partial derivatives (15) and (19)), substituting the newly derived p^* would yield the same sign.

Consequently, any parameter that is positively (negatively) related to the optimal price, p^*, would be positively (negatively) related to the demand for copies. For instance, the artist's bargaining power, which is positively related to the optimal price, would be positively related to the demand for copies. Additionally, the artist's level of risk aversion would be negatively related to the demand for copies. When the artist becomes less risk averse (γ increases) and, thus, demands a larger share of sales, we can predict that the label's response will be to raise the price of the CD, leading to a decrease in the demand for CDs and a corresponding increase in the demand for copies. Another variable from Chapter 4 that can now be reexamined with endogenous bargaining is the label's profit expression (still assuming that optimal price (24) is chosen).

The comparative statics on equation (36) show that the label's profit is negatively related to the artist's optimal share of album sales (see Appendix E). For any given level of profit, a higher share of sales going to the artist corresponds to a lower amount for the label. It follows that any parameter which increases the artist's optimal share, μ^*, decreases the label's profit. Therefore, the label's profit is negatively related to the artist's bargaining power and positively related to the artist's level of risk aversion.

For example, when the artist becomes less risk averse and successfully bargains for a larger share of album sales, the label's profit will decrease. Of course, the model predicts that the label's response to paying out the higher share will be to raise the price of the CD, leading to an increase in the profit from selling these CDs. Similarly, when the artist's bargaining power, α, increases, resulting in a higher share being paid out to the artist, the label's profit will decrease. Again, the model predicts that the firm's optimal response will be to raise the price of the CD, thus increasing the profit from selling these CDs. In the next section, we examine the effect of the artist having a nonzero disagreement point.

5.6 The Optimal Shares With Asymmetric Bargaining and a Nonzero d_A

In section 5.4, we derived the optimal shares for the asymmetric and symmetric cases while holding both the artist's and label's disagreement points to zero. In this section, we examine the symmetric case when the zero disagreement point assumption is relaxed. We now allow the artist's disagreement point, d_A, to be positive while continuing to restrict the label's disagreement point, d_L, to be zero. Given the nonzero disagreement point, we can now rewrite the Nash product (equation (46)) in terms of the artist's money payoff as follows,

$$N = (x_A{}^{\gamma} - d_A)(\pi(\mu) - x_A) \tag{61}$$

where α_A and α_L are both equal to one, $d_L = 0$, and $x_L = (\pi(\mu) - x_A)$.[22] Maximizing equation (61) with respect to x_A leaves us with the following first order condition

$$\frac{\partial N}{\partial x_A} = \gamma x_A^{\gamma-1}(\pi(\mu) - x_A) - x_A^{\gamma} + d_A = 0 \tag{62}$$

By attempting to solve (62) for x_A , we find that a closed form solution can be found only when γ is equal to one. This difficulty can be seen from the following derivation.

$$\gamma x_A^{\gamma-1}\pi(\mu) - \gamma x_A^{\gamma} - x_A^{\gamma} + d_A = 0$$
$$(\gamma + 1)x_A^{\gamma} - \gamma\pi(\mu)x_A^{\gamma-1} = d_A$$

As can be seen from the last line of the derivation, given a nonzero disagreement point, d_A , there is no closed form solution for x_A unless γ equals one.

While we cannot derive an optimal money payoff in this case, we can use the implicit function theorem to examine the impact of a nonzero disagreement point, d_A, on the respective money shares, x_A and x_L. By applying the implicit function theorem to the first order condition (62) and taking the partial derivative with respect to x_A, we have the following expression,

$$\frac{\partial x_A}{\partial d_A} = -\frac{F_{d_A}}{F_{x_A}} = -\frac{1}{\gamma x_A^{\gamma-2}\pi(\mu)(\gamma - 1) - \gamma x_A^{\gamma-1}(\gamma + 1)} > 0 \tag{63}$$

where, since F_{x_A} is less than zero, $\partial x_A / \partial d_A$ must be greater than zero. Therefore, the artist's disagreement point, d_A, is positively related to the artist's optimal money payoff and, since x_L is simply $\pi(\mu) - x_A$, negatively related to the label's optimal money payoff. If, for instance, the artist's expected net wealth from not signing with a label increased, we would expect the artist to bargain for a larger payoff. In the next section, we discuss the effect that bargaining over a variable profit has on the bargaining outcome.

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[22] The complete derivation of (61) and the corresponding comparative statics are in part 2 of Appendix E.

5.7 Optimal Shares With Variable Profit

The optimal shares discussed in sections 5.3 through 5.6 were derived under the assumption that the artist and label would bargain over a fixed profit. In this section, we examine the most general and interesting case, where a "follow-up" game is allowed to impact the bargaining. Specifically, we now examine the effect that bargaining over a variable surplus has on the optimal shares by comparing the new results to those derived previously, where the players bargained over a fixed profit. To illustrate these effects, we re-formulate the asymmetric Nash product (46) in terms of the profit shares as follows,

$$\max_{(\mu)} \left((\mu\pi(\mu))^{\gamma}\right)^{\alpha} \left((1-\mu)\pi(\mu)\right)^{1-\alpha} \tag{64}$$

where $\gamma < 1$, α_A and α_L sum to one (i.e., $\alpha_L = 1 - \alpha_A$), d_L and d_A are equal to zero, the "A" subscript for the artist's bargaining power, α_A, is dropped for ease of exposition, and where the expression for profit as a function of the artist's share, $\pi(\mu)$, is as derived in equation (36).[23] Taking the log of (64) results in the following expression for the Nash product.[24]

$$\max_{(\mu)} \ \alpha\gamma \log\mu + \alpha\gamma \log\pi(\mu) + (1-\alpha)\log(1-\mu) + (1-\alpha)\log\pi(\mu) \tag{65}$$

Since the profit is no longer fixed, maximizing (65) results in the following first order condition.

$$\frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} - (\alpha\gamma + (1-\alpha))\frac{\pi'(\mu)}{\pi(\mu)} = 0 \tag{66}$$

Using parameters defined in section 5.3, the first order condition (66) can be expressed as follows:

$$\frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} - \frac{1-\alpha(1-\gamma)2z}{k} = 0 \tag{67}$$

where $k = z(1-\mu) - c$, $z = \frac{1}{3}[q + t + (2c/1 - \mu_A)]$, and, for simplicity, the label's fixed cost is equal to zero.[25] Since no tractable solution can be derived from (67), we illustrate the solution by graphing two curves – the first and second terms of (67) as one curve, and the last term of (67) as the second curve – whose intersection indicates the optimal share solution. To illustrate the effect the last term of the first order condition (67) has on the bargaining solution, we define the following functions

$$g(\mu) = \frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} \tag{68}$$

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[23] For simplicity, we have also dropped the "A" subscript from the artist's share, denoting profit as $\pi(\mu)$.

[24] All derivations for this section are in part 4 of Appendix E.

[25] Since bargaining over a variable profit coincides with the label choosing the optimal price (24), we substituted this optimal price solution, given consumer demand, into the profit expression. The expressions for z and k are presented in section 3.3, and their derivations are in part 1 of Appendix E.

$$f(\mu) = 2\left[\frac{z}{z(1-\mu)-c}\right] \quad (69)$$

where $g(\mu)$ and $f(\mu)$ are identically equal to the first two terms and the last term (without the multiplier) of the first order condition (67), respectively. The $g(\mu)$ expression (68) represents the first order condition when the players bargain over a fixed profit, and solving the expression for μ would result in the optimal share derived in section 5.4 (this result will be shown below).

Taking the derivative of (69) with respect to (1-μ) results in the following expression,

$$f'(\mu) = -2\frac{mx(mx+4c)-2c^2}{[x(mx-c)]^2} \leq 0 \quad (70)$$

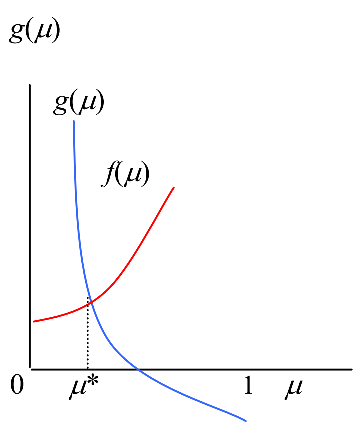
where, for simplicity, $x = (1-\mu)$, and $m = q + t$.[26] Since (70) is decreasing in (1-μ), it is increasing in μ. Additionally, if we evaluate (69) at zero, we find that

$$f(0) = 2\frac{m+2c}{m-c} \quad (71)$$

where, for simplicity, $m = q + t$. As long as the label's marginal costs are low, as they have been for some time, the expression in (71) is positive. We can now use a graphical representation of the $g(\mu)$ and the $f(\mu)$ functions to examine the effect bargaining over a variable profit has on the solution for the artist's optimal share.

The resulting graph, Figure 5-2, plots the $g(\mu)$ function (68) on the vertical axis and the artist's share, μ, on the horizontal axis (where $0 < \mu < 1$). The downward sloping curve in Figure 5-2 represents the $g(\mu)$ function (the first two terms of the first order condition (67)), and the upward sloping curve represents the $f(\mu)$ function (the last term in the first order condition (67)).

Figure 5-2



[26] As long as the label's marginal costs are relatively low, as they have been in the industry for some time, the derivative is increasing in μ. The derivation of this derivative is in part 4 of Appendix E.

The solution for the artist's share, μ *, is found where the two curves intersect. By examining how the curves in Figure 5-2 change as the parameters in the $g(\mu)$ and $f(\mu)$ functions change, we can study how these changes, as well as how bargaining over a variable profit, cause the solution for the artist's share to change.

To begin, if we assumed that both the risk aversion parameter and the bargaining powers of *both* players were equal to one, the first two terms in the first order condition (67) would have numerators equal to one. With both numerators equal to one, the downward sloping curve in Figure 5-2 would shift upward. Therefore, the less bargaining power the artist has (the smaller α is), and the more risk averse the artist is (the smaller γ is), the lower the position of the downward sloping curve and, therefore, the lower the optimal share of sales for the artist.

While the exact location of the μ* solution would depend on the precise position of the $f(\mu)$ curve, we can examine how changing the parameters in the $f(\mu)$ function would affect the μ* solution. To see how the $f(\mu)$ function (69) interacts with the artist's optimal share, we can take its derivatives with respect to *m* and *c*. First, we restate (69) as follows

$$f(\mu) = 2\left[\frac{z}{z(1-\mu)-c}\right] \equiv \frac{2mx+4c}{x(mx-c)} \tag{72}$$

where, for simplicity, $x = (1\text{-}\mu)$, and $m = q + t$. We then take the following partial derivatives.

$$\frac{\partial f(\mu)}{\partial m} \equiv -\frac{6cx^2}{(x[mx-c])^2} < 0 \tag{73}$$

$$\frac{\partial f(\mu)}{\partial c} \equiv \frac{6mx^2}{(x[mx-c])^2} > 0 \tag{74}$$

The derivative (73) shows that as the sum of the CD/copy quality difference and the transaction costs of copying rise, the $f(\mu)$ function decreases. Thus, as *m* increases, the upward sloping curve in Figure 5-2 shifts downward. We can see that, as *m* increases, the artist's optimal share would increase. These directional changes coincide with those derived for the fixed profit cases, where an increase in either *q* or *t* would increase the artist's payoff.

Similarly, the implications from the derivative (74) coincide with those derived for the label's marginal cost, *c*, when profit is fixed. The positive relationship between the $f(\mu)$ function and *c* imply that an increase in the label's marginal cost would cause the upward sloping curve in Figure 5-2 to shift up, resulting in a decrease in the artist's optimal share. This result is intuitive given that we would expect the label to respond to higher marginal costs by reducing the share it offers to the artist. Another key implication that can be seen from Figure 5-2 is that, for any given set of parameters, the μ* solution from bargaining over a variable profit would be less than that obtained from bargaining over a fixed profit.

To see that the artist's share would be smaller when the profit is allowed to vary, we can reexamine the log of the Nash product (65) and its corresponding first order condition (66). If the bargaining were over a fixed profit, rather than a variable profit, then the first order condition (66) would be expressed as follows,

$$\frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} = 0 \tag{75}$$

where the expression is identical to the first two terms in (66), the first order condition with variable profit. When (75) is solved for μ, we find that μ^* is equal to $\alpha\gamma / 1-\alpha(1-\gamma)$, an expression that is identically equal to the μ^* solution derived in section 5.4, when the players bargained over a fixed profit. In the first order condition for the variable profit case (66), however, there is a third term subtracted from the first two.

Therefore, for any given set of parameters, when the profit is allowed to vary, the optimal μ is less than when the artist and label bargain over a fixed profit. In terms of Figure 5-2, we can see that removing the third term of the first order condition, i.e., holding the profit fixed, allows us to remove the upward sloping line from the graph. Removing the upward sloping line results in an optimal μ solution where the downward sloping line intersects the horizontal axis (rather than where the two curves intersect).

As long as the $f(\mu)$ function is positive, which the model predicts, the two curves will intersect at a point to the left of where the downward sloping curve intersects the horizontal axis, ensuring that the optimal μ in the variable profit case is less than the optimal μ when the profit is fixed. Given the positive relationship between the optimal μ and the CD price, the model predicts that bargaining over a variable profit will lead to a lower optimal price than in the fixed profit case. Similarly, since there is a negative relationship between the optimal μ and the demand for CDs, the model predicts that bargaining over a variable profit will lead to a higher quantity of CDs demanded than in the fixed profit scenario.

5.8 Conclusions and Ideas for Future Research

In this chapter, we endogenized the artist-label bargaining agreement by incorporating it into a theoretical framework using the Nash cooperative bargaining solution. The model, which accounted for the artist's bargaining power and risk aversion, was used to solve for the optimal share of album sales, μ^*, and the corresponding optimal price, p^*, and demand for CDs, y^{CD}. These results were as follows:

$$\mu^* = \frac{\alpha\gamma}{1-\alpha(1-\gamma)} \tag{49}$$

$$p^* = \frac{1}{3}\left[q + t + 2c\left[\frac{1-\alpha(1-\gamma)}{1-\alpha}\right]\right] \tag{55}$$

$$y^{CD} \equiv \frac{1}{2qt}\left(\frac{2}{3}\left[q + t - c\left(\frac{1-\alpha(1-\gamma)}{1-\alpha}\right)\right]\right)^2 \tag{58}$$

Table 5-1 lists the signs of the comparative statics for these endogenous variables with respect to the exogenous parameters of the model, α, γ, t, q, c, and F, as well as the implied relationships between the demand for copies and the exogenous parameters.

Endogenizing the bargaining arrangement allows us to predict a positive relationship between the artist's optimal share of album sales and the artist's bargaining power, as well as a

negative relationship between the artist's optimal share and level of risk aversion. The endogenous bargaining framework also predicts that the artist's optimal share is positively related to the artist's disagreement point.

Combined, these results suggest that building a relatively large fan base and selling many albums as an independent artist, as well as being able to patiently negotiate with the label, should result in a higher share for the artist. Not only would building a large fan base increase the number of labels interested in the artist, but it would legitimately improve the artist's "fall back" position, thus bolstering the artist's overall bargaining position.

Therefore, the model predicts that artists with relatively higher album sales and tour income as an independent would be more likely to sign a contract awarding a higher share of album sales. While a more direct test of this hypothesis is desirable, we do know that artists' ability to build a solid fan-base and sell albums as an independent has long been an important factor used by major labels as a predictor of success.

Table 5-1 Summary of Key Results

Key Relationships for μ*

Relationship With:	Sign
Artist's bargaining power, α	+
Risk aversion coefficient, γ	+

Key Relationships for p*

Relationship With:	Sign
Artist's bargaining power, α	+
Risk aversion coefficient, γ	+
Transaction cost of copying, t	+
Degree of substitutability, q	+
Marginal cost of CD, c	+

Key Relationships for y^{CD}

Relationship With:	Sign
Artist's bargaining power, α	-
Risk aversion coefficient, γ	-
Transaction cost of copying, t	+
Degree of substitutability, q	+

Key Relationships for y^{COPY}

Relationship With:	Sign
Optimal price of CD, $p*$	+
Artist's bargaining power, α	+
Risk aversion coefficient, γ	+
Transaction cost of copying, t	-
Degree of substitutability, q	-

By improving artists' ability to increase their fan base and sell their own music, the Internet and digital downloading could strengthen artists' bargaining position and thus allow them to rely less on the label for distribution. Lowering their reliance on labels for distribution would greatly increase artists' bargaining power. Therefore, our model predicts that artists' share of profits should increase as legitimate digital distribution on the internet gains prominence.

Although the model predicts an improved bargaining position would increase the artist's optimal share of album sales, it is not entirely clear that the artist (or the label) would have a larger absolute payoff if digital downloading were the dominant form of distribution. One reason for this ambiguity is that the new technology seems to be moving toward a different preferred format, where the single song, or "track," is sold for less than/equal to its proportional share on a pre-packaged CD.

Nonetheless, for a given method of distribution, an improved bargaining position for the artist is predicted to lead to a higher price for music. For example, the model predicts that a label will respond to paying out a higher share of album sales by raising the price charged for the artist's CDs. The elasticity of demand for CDs is an important factor though, since there is a negative relationship between the demand for CDs and p^*, α and γ. If the demand for CDs is inelastic, labels could realize higher total revenue and artists could realize higher royalties by charging higher prices. However, in the case of digital downloading, where firms are currently selling individual songs for \$1 each, a considerably higher level of sales will be needed for the label and the artist to obtain the same absolute payoff that they receive under traditional distribution methods. Still, if the price elasticity of demand for music proves to be rather elastic in the digital downloading environment, lowering the price for downloads could increase the revenue that both parties receive. Another benefit of a lower price would be the reduced demand for copying.

In fact, the model predicts a positive relationship between the demand for *copies* and p^*, α and γ, as well as a negative relationship between the label's profit and μ^*, α and γ. Combined, these relationships suggest that the label would have less incentive to sign an artist with higher bargaining power because it would then have to relinquish a larger share of album sales. Consequently, the model predicts that labels will sign very few artists to contracts which give away a particularly high share of album sales. Though a direct test of this hypothesis is needed, evidence suggests that only the "best" artists sign for a noticeably higher share of album sales, and contracts are usually structured such that artists' can increase their share of album sales based on performance. There are also several model results that have not changed from the second to the third stage.

To begin, there is a positive relationship between the optimal price, p^*, and the transaction cost of copying, t, and the quality difference of the copy and CD, q. As such, the model predicts that labels' optimal response to a decrease in either t or q will be to lower prices. Yet, for very low values of these parameters, the model predicts that labels' CD prices will not be very responsive to changes in either its marginal cost or in the share of album sales it pays out to artists. For example, while one would normally expect labels to charge higher prices for artists' albums when it pays them a higher share, the model suggests that labels may not have responded this way in recent years.

In recent years, both conditions –lower transaction cost and lower quality difference– have been present that would have lead the model to predict both lower and less responsive (less

responsive to a higher payout to artists and changes in marginal cost) CD prices, a testable hypothesis. The technical innovations of the internet, digital file compression techniques, read-write CD devices and portable digital players have dramatically lowered copy transaction costs and increased the degree of substitutability between copies and pre-packaged CDs.[27]

Other than lowering CD prices, the model predicts that the label could respond to lower copy costs and higher substitutability by increasing the transaction cost of copying by, for example, increasing efforts to protect its copyright. While more direct testing is desirable, at least one major label has recently announced decreases in suggested retail prices, and the labels have been engaged in a campaign to increase the transaction cost of copying since the launch of Napster.[28] Labels have been experimenting with various forms of electronic copy protection techniques and have increased efforts to enforce copyright laws on file-traders through the court system.

Not surprisingly, if the label can increase copy protection and raise CD prices, the model predicts that the label could obtain higher profits. Since consumers vary in their taste for music, some are likely to pay the higher prices for CDs. Of course, at some point, the higher prices will lead to a smaller concentration of "high valuation" consumers, thus leading to an overall reduction in sales. An empirical study, one with pricing data *from different types of stores*, is needed to examine whether such price increases may have contributed to past CD sales declines. In the next chapter of this dissertation, we empirically test the hypothesis that much of the file-sharing since 1999 has been done by low valuation consumers. Still, there are many other topics that future research can address, both through theoretical and empirical work.

For example, instead of using the Nash bargaining framework, applying incentive contract theory to the artist-label relationship may be useful to more fully examine the relationships between the artist and the label. Very little work has been done to jointly examine the relationships between the artist, label and consumer, and adding to the theory would greatly benefit any future empirical work. Additionally, there are some specific aspects of the typical artist-label relationship that seem to warrant further study.

The artist-label contract is typically on an exclusive basis for a given number of albums and usually gives the label the option to pick up several more albums based on the success of the first album(s). This arrangement suggests that the label is making a long-term investment in an asset (the artist), and that it seeks to earn returns over time. The arrangement could also suggest that the label has revealed information by signing an artist. Specifically, by signing an artist, the label could be revealing that the artist has the ability to consistently sell a large number of albums over an extended period of time. Another aspect of these relationships deals with the supply of artists.

In this chapter, we assumed that the supply of artists by far outweighed the number of labels. However, it could be the case that many individuals calling themselves artists should not be considered "true" artists. A thorough examination of the supply of artists and artists' characteristics would be indispensable to researching the music industry. Another innovation that may prove useful would be to explicitly include a parameter for government regulation, enabling a better examination of the effects of copyright protection.

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[27] Given the format of the file-sharing platforms, it appears that any reduction in sales should be most pronounced in the market for CD singles. However, as seen in Chapter 3, the market for CD singles had been falling before 1999.

[28] See Chapter 3.

Chapter 6, An Empirical Examination of Consumer Expenditures

6.0 Introduction

The demand equations for CDs and copies derived in Chapter 4 showed that, depending on factors such as price, the substitutability of copies and CDs, taste for music and understanding of technology, consumers will choose to buy, copy or stay out of the market completely. One of the main hypotheses from our model is that, due to the recent decrease in copy transaction costs and CD/copy substitutability, some of the consumers using Internet file-sharing services were those previously not in the market. One way to test this hypothesis is to examine consumers' CD expenditures before and after the launch of file-sharing services, such as Napster, in 1999. If, for example, average CD expenditures did not decrease in a predictable manner, we would be unable to reject our hypothesis. Since a necessary condition for our hypothesis is that significant differences exist among consumers' taste for music, finding empirical evidence of such heterogeneity across consumers is needed to support our hypothesis. After briefly discussing what we view as the "ideal" data for studying our hypothesis, we present detailed descriptions of our data sets, the tests that we perform and our results.

6.1 Ideal data

In a perfect world, we would be able to directly test changes in artists' income and consumers' CD expenditures using longitudinal data that spans, at least, 1998 through 2001. Having such data would allow us to test for patterns in consumers' entertainment expenditures to see, for example, if popular trends are more important than factors such as price and CD/copy substitutability. We would also be able to directly test how these factors affect artists' income and consumers' expenditures, as well as how sensitive aggregate CD sales are to the sales of various types of artists' music. Of course, we would want these data to include control characteristics, such as the types of music each consumer purchases, as well as standard consumer demographic characteristics, such as age, family size and income. Unfortunately, most of the available data sources only contain a few of these desired properties.

For instance, the Bureau of Labor and Statistics (BLS) publishes the annual National Compensation Survey which includes aggregate earnings for the category "musicians and composers." However, the BLS does not release the micro data from the survey, making any comparison of individual artists' income impossible. Similarly, the BLS publishes the annual Consumer Expenditure Survey (CEX), whereby various categories of aggregate expenditures can be studied for different groups of consumers. Although the CEX micro data can be purchased, the data are not longitudinal, rendering a study of year-to-year changes in individual consumers' expenditures impossible. Nonetheless, the CEX data files do contain a wealth of demographic information on consumers. So, given the absence of the ideal data to study year-to-year changes in the same artists' income and the same consumers' expenditures, we attempt to study our hypothesis using the best – in terms of the above characteristics – available data that we could find.

We use a confidential data set from the U.S. Treasury's Statistics on Income (SOI) division, and we use the CEX micro data files (available for purchase from the BLS). Since both the SOI and CEX files consist of data for the years 1998 through 2001, using these data allows us to compare artists' income and consumers' expenditures for the year prior to the launch of any file sharing service to comparable income and expenditures in years after the launch of these services.[1] If the bulk of the file-sharing has been done by consumers formerly not in the market, then artists' income and consumers' CD expenditures should not have decreased in a predictable manner after 1998. Alternatively, if a large number of consumers previously in the market for buying CDs were responsible for the increased file-sharing, artists' income and consumers' CD expenditures should have decreased in a predictable manner after 1998. Unfortunately, the SOI data set contains artists' income from many types of artists other than those we are interested in, and there is no way to partition the sample on the types of artists. Therefore, we report our findings on the SOI data in Appendix F. In the main body of the text, we focus on our findings from studying the CEX data. The next section provides a detailed description of the CEX data and the tests we performed.

6.2 Consumer Expenditure Survey Aggregate Data

In this section, we examine data from the aggregate level Consumer Expenditure Survey (CEX) published by the Bureau of Labor and Statistics (BLS).[2] Using the micro-level survey data, the BLS compiles these annual aggregate mean expenditure estimates for select categories. As of this writing, the BLS has published annual aggregate means from 1984 to 2001. One disadvantage of using these data is that we cannot examine specific categories of expenditures, such as CDs and movie tickets. Another disadvantage of using the CEX data (at both the aggregate and micro-level) is that the unit of measure is the *consumer unit* (CU), which is not necessarily an individual consumer. According to the BLS, the CU is comprised of either:

> (1) all members of a particular household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who pool their income to make joint expenditure decisions. Financial independence is determined by the three major expense categories: Housing, food, and other living expenses. To be considered financially independent, at least two of the three major expense categories have to be provided by the respondent.[3]

Nonetheless, using the aggregate CEX data allows us to readily examine a time series of mean expenditure changes from 1984 to 2001 for various groups of consumers on different types of entertainment goods.

6.2.1 Methodology for Aggregate Consumer Expenditure Survey data

The aggregate expenditure categories that we examine are as follows: (1) *fees and admissions,* (2) *televisions*, *radios and sound equipment*, and (3) *other entertainment supplies, equipment and services*. Since the BLS does not publish the CPI for recreation items prior to 1993, we adjust the aggregates to 2001 dollars using (1) the CPI for all items less food and energy, and (2) the GDP deflator. We also control for age differences by examining the

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[1] The first of such services, Napster, was launched in May of 1999.

[2] The aggregate data is available for years 1984 to 2001 at http://www.bls.gov/cex/csxstnd.htm#2001 .

[3] The definition is available at http://www.bls.gov/bls/glossary.htm#C.

aggregates for the following three groups of consumers: (1) *all consumer units*, (2) *all with reference person age 25 to 34*, and (3) *all with reference age person 55 to 64*.[4]

Using the aggregate CEX data, we run the following ordinary least squares (OLS)[5] regression model for the three entertainment expenditure categories,

$$\Delta ENT\,exp_t = \hat{\beta}_1 + \hat{\beta}_2 \Delta y_t + \hat{\beta}_3 ENT\,exp_{t-1} \tag{76}$$

where $\Delta ENTexp_t$ represents the first difference of the aggregate mean expenditure for a given category, Δy_t represents the first difference in the aggregate mean of before tax income, and $ENTexp_{t-1}$ represents the one-period lagged aggregate mean of the expenditure for the given category.[6] Model (76) was run separately for each consumer groups' distinct expenditure categories using both nominal and 2001 dollars. To check for autocorrelation in the error term, we saved the residuals from each OLS regression using model (76), lagged them one period, and then regressed the residual on its lagged value and all independent variables ($\hat{e}_t = \hat{\rho}\,\hat{e}_{t-1} + \hat{\beta}_1 + \hat{\beta}_2 \Delta y_t + \hat{\beta}_3 ENT\,exp_{t-1}$).[7] The null hypothesis for this test is that the coefficient on the lagged error is zero, which can be rejected when the coefficient is statistically significant.

6.2.2 Results for Aggregate CEX regressions

The results from using the OLS regression model (76) on real mean aggregate expenditures from 1984 to 2001 are presented in tables 6-1 through 6-3, and the summary statistics for the dependent and independent variables are presented in tables 6-4 through 6-6. Panels A through C of Table 6-1 show the results using expenditures on *fees and admissions* as the dependent variable for all consumer units (CUs), all CUs age 25 to 34, and all CUs age 55-64, respectively. Using the same table design, panels A through C of Table 6-2 show the results using expenditures on *other entertainment supplies, equipment and services* as the dependent variable, and panels A through C of Table 6-3 show the results using expenditures on *televisions, radios and sound equipment* as the dependent variable.

Out of the 18 regressions that were run, two specifications were found to fail the overall significance F-test. These two insignificant models were found using the GDP deflator to adjust fees and admissions expenditures for the categories of all CUs and CUs with reference person age 25 to 34. For each of the OLS regressions, we were unable to reject the null hypothesis of no autocorrelation. Across all expenditure categories, across all types of consumers, an average R^2 value of 41.28 percent was found. Among the younger and older consumer groups, average R^2 values of 35.25 and 48.58 percent, respectively, were found across all expenditure categories.

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[4] The age of the reference person in the consumer unit is the member of the consumer unit that responds to the survey questions.

[5] Since we are using differences and lags of sample means for dependent and independent variables, respectively, we also ran weighted least squares (WLS) to correct for any possible heteroscedasticity (using the square root of the sample sizes as the weights). Since the aggregate-level WLS results did not differ from the aggregate-level OLS results, we present only the OLS results.

[6] To provide for better comparisons to the micro-data regressions in the next section of this chapter, we use before tax income. In 2001, the BLS changed the definition of before tax income, making comparisons across 1998 to 2001, the years for which we have the micro-data, difficult. In the regressions on the micro-data, therefore, we use wage and salary income. Since the BLS does not publish the aggregate CEX wage and salary data, we use before tax income.

[7] See Wooldridge (2003), p. 399.

Irrespective of the statistical significance of the parameters, for all 18 OLS regressions, we find a negative relationship between the first difference of the mean expenditure (the dependent variable, $\Delta ENTexp_t$) and the lagged expenditure, $ENTexp_{t-1}$, and a positive relationship between $\Delta ENTexp_t$ and the first difference of income, Δy_t. Overall, our results suggest that, on average, changes in consumers' annual expenditures are negatively related to their level of expenditures in the prior year and positively related to changes in their income. Accounting for the statistical significance of the estimated parameter values, we find variation in these relationships for different age categories of consumers.

Panel A of Table 6-1 shows that, for *all* CUs' *fees and admissions* expenditures, only when adjusting to 2001 dollars with the CPI for all items less food and energy were any relationships found to be statistically significant. For $ENTexp_{t-1}$, a parameter value of (.654)[8] was found to be significant at the 1 percent level, but the coefficient on Δy_t was found to be statistically insignificant. Similarly, panel B shows that, for CUs age 25 to 34, only when *fees and admissions* expenditures were adjusted with the CPI measure were any of the relationships found to be statistically significant. Here, too, a negative relationship was found for $ENTexp_{t-1}$ (a parameter estimate of (.597) at the 1 percent level of significance), and no statistically significant relationship was found for Δy.

On the other hand, for CUs age 55 to 64, regardless of the measure of inflation, the coefficient on Δy_t was found to be positively related to $\Delta ENTexp_t$, and was statistically significant at the 5 percent level of significance using the CPI measure and the 1 percent level using the GDP deflator. Additionally, for this older group of CUs, when the CPI for all items less food and energy was used, the coefficient on $ENTexp_{t-1}$ was found to be negative and statistically significant at the 5 percent level (the parameter value was (.684)). These results suggest that, relative to those of pre-retirement age consumers, younger consumers' expenditures are less sensitive to changes in income. The results presented in Table 6-2 support this finding of consumer heterogeneity across age groups.

Table 6-2 shows the OLS results using the aggregate expenditure category *other entertainment supplies, equipment and services* as the dependent variable, $\Delta ENTexp_t$. For *all* CUs', the parameter estimate on Δy_t was found to be positive and statistically significant (at the 10 percent level) only when the GDP deflator was used. For the oldest group of CUs', however, the estimate on the Δy_t coefficient was found to be positive and statistically significant for both measures of real expenditures (at the 10 percent level). The oldest groups' estimated parameter values on Δy, for the two measures of real expenditures, were .024 and .026, respectively. For the younger group of CUs, the coefficient on Δy was found to be statistically insignificant.

However, for the younger group of CUs, a statistically significant negative relationship was found on the coefficient for $ENTexp_{t-1}$. The younger groups' parameter estimates were (.74) for the CPI adjusted expenditures (at the 1 percent level), and (.85) for the GDP deflator adjusted expenditures (at the 1 percent level). For the oldest CUs' real expenditures, the parameter estimates for $ENTexp_{t-1}$, were significant at the 5 percent level, with estimates of (.616) and (.513) for the CPI and GDP deflator adjusted expenditures, respectively. These results suggest that, for this category of expenditures as well, the relationships between changes in consumers' expenditures and both changes in income and prior year expenditures differ across consumer age groups. The results presented in Table 6-3 suggest that, for expenditures on *television, radios and sound equipment*, consumer heterogeneity across age groups plays less of a role.

[8] Parentheses denote a negative value.

<u>Table 6-1, OLS Results for Fees and Admissions</u>

Panel A - All CUs

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	332.196	105.006	3.164	0.007	0.012	0.231	0.469
Δy	0.006	0.004	1.43	0.175			
$ENTexp_{t-1}$	-0.654	0.204	-3.203	0.006	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	206.572	120.195	1.719	0.108	0.218	0.231	0.195
Δy	0.005	0.005	0.905	0.381			
$ENTexp_{t-1}$	-0.431	0.251	-1.718	0.108	No. Of Observations	17	

Panel B - Age 25 to 34

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	270.374	91.95	2.94	0.011	0.032	0.457	0.387
Δy	.000	0.001	0.176	0.863			
$ENTexp_{t-1}$	-0.597	0.201	-2.969	0.01	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	202.858	125.676	1.614	0.129	0.296	0.572	0.16
Δy	.000	0.002	0.163	0.872			
$ENTexp_{t-1}$	-0.47	0.295	-1.596	0.133	No. Of Observations	17	

Panel C - Age 55 to 64

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	362.199	156.991	2.307	0.037	0.001	0.456	0.612
Δy	0.008	0.004	2.147	0.05			
$ENTexp_{t-1}$	-0.684	0.294	-2.326	0.036	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	172.275	132.905	1.296	0.216	0.004	0.977	0.539
Δy	0.011	0.004	2.793	0.014			
$ENTexp_{t-1}$	-0.349	0.264	-1.323	0.207	No. Of Observations	17	

* b represents the parameter estimate, SE represents the standard error of the estimate, t represents the t statistic for the paremeter estimate, F-Sig. (1) represents the test for overall signficance of the model, where the reported value is the *p* value for the null hypothesis that all coefficients are equal to zero, and F-Sig. (2) represents the *p* value for the null that the coefficient on the lagged error term is equal to zero.

<u>Table 6-2, OLS Results for Other Entertainmnet Supplies, Equipment & Services</u>

Panel A - All CUs

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	343.306	107.803	3.185	0.007	0.008	0.781	0.495
Δ y	0.017	0.011	1.575	0.138			
ENTexp $_{t-1}$	-0.774	0.238	-3.255	0.006	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	294.198	93.019	3.163	0.007	0.007	0.894	0.505
Δ y	0.021	0.012	1.776	0.098			
ENTexp $_{t-1}$	-0.721	0.218	-3.306	0.005	No. Of Observations	17	

Panel B - Age 25 to 34

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	341.01	121.385	2.809	0.014	0.037	0.404	0.376
Δ y	0.001	0.005	0.209	0.837			
ENTexp $_{t-1}$	-0.74	0.26	-2.847	0.013	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	368.897	114.367	3.226	0.006	0.018	0.526	0.435
Δ y	0.001	0.004	0.303	0.767			
ENTexp $_{t-1}$	-0.85	0.263	-3.238	0.006	No. Of Observations	17	

Panel C - Age 55 to 64

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	324.482	128.266	2.53	0.024	0.016	0.527	0.445
Δ y	0.024	0.013	1.868	0.083			
ENTexp $_{t-1}$	-0.616	0.236	-2.612	0.02	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	258.279	118.305	2.183	0.047	0.023	0.551	0.417
Δ y	0.026	0.013	1.955	0.071			
ENTexp $_{t-1}$	-0.533	0.229	-2.329	0.035	No. Of Observations	17	

* b represents the parameter estimate, SE represents the standard error of the estimate, t represents the t statistic for the paremeter estimate, F-Sig. (1) represents the test for overall signficance of the model, where the reported value is the *p* value for the null hypothesis that all coefficients are equal to zero, and F-Sig. (2) represents the *p* value for the null that the coefficient on the lagged error term is equal to zero.

When model (76) was run using the expenditure category *television, radios and sound equipment* as the dependent variable, the results are somewhat different than those found for either of the first two expenditure categories. With this expenditure category, for all three groups of CUs, the coefficient on $ENTexp_{t-1}$ was found to be statistically significant using both measures of 2001 dollars (at least at the 5 percent level of significance). However, the estimated parameter on Δy_t was found to be statistically *insignificant* for each of the groups examined, even the oldest CU group. This is the only expenditure category for which no statistically significant relationship was found on Δy for older CUs. Collectively, the results from these aggregate-level OLS regressions suggest a significant amount of heterogeneity in consumers' expenditures across

different consumer age groups. The summary statistics for these dependent and independent variables are shown on Tables 6-4 through 6-6.

Table 6-3, OLS Results for Televisions, Radios and Sound Equipment

Panel A - All CUs

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	621.687	160.303	3.878	0.002	0.005	0.16	0.528
Δ y	0.001	0.007	0.179	0.86			
ENTexp $_{t-1}$	-0.988	0.256	-3.864	0.002	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	279.883	120.481	2.323	0.036	0.096	0.345	0.285
Δ y	0.004	0.009	0.434	0.671			
ENTexp $_{t-1}$	-0.466	0.204	-2.283	0.039	No. Of Observations	17	

Panel B - Age 25 to 34

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	575.233	169.066	3.402	0.004	0.014	0.351	0.455
Δ y	0.000	0.002	0.122	0.905			
ENTexp $_{t-1}$	-0.855	0.25	-3.418	0.004	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	448.155	180.685	2.48	0.026	0.081	0.69	0.302
Δ y	0.001	0.002	0.293	0.774			
ENTexp $_{t-1}$	-0.704	0.286	-2.46	0.028	No. Of Observations	17	

Panel C - Age 55 to 64

CPI All Less F.E.	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	538.251	138.495	3.886	0.002	0.003	0.717	0.555
Δ y	0.004	0.004	1.038	0.317			
ENTexp $_{t-1}$	-0.92	0.239	-3.845	0.002	No. Of Observations	17	

GDP Deflator	*b*	*SE*	*t*	*p value*	*F -Sig. (1)*	*F -Sig. (2)*	R^2
Constant	264.322	107.604	2.456	0.028	0.051	0.344	0.347
Δ y	0.005	0.004	1.16	0.266			
ENTexp $_{t-1}$	-0.471	0.198	-2.384	0.032	No. Of Observations	17	

* b represents the parameter estimate, SE represents the standard error of the estimate, t represents the t statistic for the paremeter estimate, F-Sig. (1) represents the test for overall signficance of the model, where the reported value is the *p* value for the null hypothesis that all coefficients are equal to zero, and F-Sig. (2) represents the *p* value for the null that the coefficient on the lagged error term is equal to zero.

Table 6-4 shows that the younger consumers, on average, spent less on *fees and admissions* each year while older consumers spent more (an average decrease of almost $2 versus an average increase of about $2).[9] The younger consumers spent less on *fees and admissions*

[9] These averages reflect the changes adjusted with the CPI measure. As seen on Tables 6-4 through 6-6, adjusting to 2001 dollars using the GDP deflator provides estimates of different magnitudes, but the same

even though their prior period average expenditures were less and their average change in income was larger compared to the older consumers. Similarly, Table 6-5 demonstrates that, for *other entertainment supplies, equipment and services*, the average change in younger consumers' expenditures was less than the change for the older group of consumers. For this category as well, when compared to older consumers, the change in younger consumers' spending was less even though their average expenditure was less in the prior period. Using another expenditure category, a slightly different result is seen on Table 6-6.

These results show the summary statistics for the expenditure category of *televisions, radios and sound equipment*. For this category, younger consumers' average change in expenditures is negative (using the CPI measure) while older consumers' average change is positive.[10] However, for this expenditure category, younger consumers' average prior period expenditures is about $100 higher than that of older consumers. To directly test for consumer heterogeneity across consumer age groups, but within expenditure categories, we ran model (76) for all three age classifications (all CUs, CUs age 25 to 34, and CUs age 55 to 64) in a three-equation seemingly unrelated regression (SUR) model. The SUR system was run for each expenditure category (using both measures of inflation) and allowed us to jointly test the hypothesis that model parameters were statistically different across age categories.

The results from the SUR systems and their corresponding joint tests, presented on Table 6-7, show that consumer heterogeneity does exist across age categories. When examining expenditures on *fees and admissions*, we find that, irrespective of the measure of inflation, the parameter estimates on Δy_t are not statistically different for all CUs versus the youngest CUs. However, the joint test that the parameter estimates on Δy_t are the same across all three age groups does reject that the estimates are the same (with a p value of .0551 using the CPI measure, and a p value of .0174 using the GDP deflator). Comparing the youngest group to all CUs, the difference in the coefficients on $ENTexp_{t-1}$ are statistically insignificant using either measure of inflation (a p value of .2865 with the CPI measure and .0685 using the GDP deflator). However, comparing all three age groups, using either measure of inflation, the differences are statistically significant at the 5 percent level.

When using a broader aggregate expenditure category, *other entertainment supplies equipment and services*, we find that the parameter estimates on Δy_t are statistically insignificant when comparing all CUs to the youngest CUs if the CPI measure is used, but significant at the 5 percent level if the GDP deflator is used. When comparing across all three age groups, the differences in the estimates for Δy_t are statistically insignificant. The differences in the parameter estimate for, $ENTexp_{t-1}$, however, are significant at the one percent level using the GDP deflator, and just above the 1 percent level using the CPI measure. Panels E and F of Table 6-7 present the results using the *TV, radios and sound equipment* expenditure category.

For this expenditure category, using either measure of inflation, the differences in the coefficients on Δy_t are statistically insignificant when comparing the younger CUs to the entire group, and when comparing the coefficients across all three age groups. The differences in the parameter estimates on $ENTexp_{t-1}$ are statistically significant at the 1 percent level when comparing across all three age categories, and statistically insignificant when comparing the younger CUs to all CUs (using each measure of inflation). Overall, these results do suggest that,

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differences across age groups exist. For instance, adjusting with the GDP deflator, the younger consumers' average expenditure change was positive, but smaller than the positive change for the older consumers.

[10] Using the GDP deflator, both groups exhibit a positive average change, but the younger groups' average is smaller than the older groups'.

within these aggregate expenditure categories there is significant consumer heterogeneity; the relationships between the dependent and independent variables appear to vary across consumers of different age groups. For instance, the strength of the relationship between a change in consumers' expenditures and their lagged expenditures was found to be statistically different across age categories (within all three expenditure categories).

Table 6-4, Summary Statistics, Fees and Admissions

Panel A - All CUs

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	-1.816	23.995	17
Δy	338.872	1138.676	17
$ENTexp_{t-1}$	513.537	22.878	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	2.741	21.658	17
Δy	680.481	1004.707	17
$ENTexp_{t-1}$	480.705	20.913	17

Panel B - Age 25 to 34

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	-2.142	28.710	17
Δy	368.749	4411.852	17
$ENTexp_{t-1}$	456.442	30.097	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	2.182	26.165	17
Δy	721.888	4231.352	17
$ENTexp_{t-1}$	426.999	22.807	17

Panel C - Age 55 to 64

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	1.935	52.502	17
Δy	324.814	2688.367	17
$ENTexp_{t-1}$	530.885	35.506	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	6.478	49.769	17
Δy	704.859	2527.261	17
$ENTexp_{t-1}$	497.293	38.470	17

Table 6-5, Summary Statistics, Other Ent. Equip. & Svc.

Panel A - All CUs

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	1.223	64.691	17
Δy	338.872	1138.676	17
$ENTexp_{t-1}$	449.258	51.737	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	4.572	62.043	17
Δy	680.481	1004.707	17
$ENTexp_{t-1}$	421.047	53.491	17

Panel B - Age 25 to 34

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	0.816	94.433	17
Δy	368.749	4411.852	17
$ENTexp_{t-1}$	459.986	77.279	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	4.499	87.705	17
Δy	721.888	4231.352	17
$ENTexp_{t-1}$	429.790	67.302	17

Panel C - Age 55 to 64

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	9.243	169.589	17
Δy	324.814	2688.367	17
$ENTexp_{t-1}$	524.085	143.725	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	13.669	161.817	17
Δy	704.859	2527.261	17
$ENTexp_{t-1}$	493.117	144.783	17

Table 6-6, Summary Statistics, Televisions, Radios and Sound Equipment

Panel A - All CUs

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	5.124	44.059	17
Δ *y*	338.872	1138.676	17
$ENTexp_{t-1}$	624.228	32.104	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	9.812	41.547	17
Δ *y*	680.481	1004.707	17
$ENTexp_{t-1}$	585.350	46.122	17

Panel B - Age 25 to 34

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	-1.746	47.997	17
Δ *y*	368.749	4411.852	17
$ENTexp_{t-1}$	674.552	37.828	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	4.209	42.793	17
Δ *y*	721.888	4231.352	17
$ENTexp_{t-1}$	631.396	33.720	17

Panel C - Age 55 to 64

CPI All Less F.E.	Mean	Std. Dev.	N
Δ *ENTexp*	8.670	52.198	17
Δ *y*	324.814	2688.367	17
$ENTexp_{t-1}$	576.972	39.349	17

GDP Deflator	Mean	Std. Dev.	N
Δ *ENTexp*	12.718	46.937	17
Δ *y*	704.859	2527.261	17
$ENTexp_{t-1}$	541.310	51.438	17

<u>Table 6-7 SUR Results; Tests for Differences in Aggregate OLS Parameters</u>

Panel A, Fees and Admissions; CPI for All Items Less Food and Energy

Equation	*No. Of Obs.*	*F Value*	*F -Sig. (1)*	*Joint Tests*	*F -Sig. (2)*	*F -Sig. (3)*
All CUs	17	10.4432	0.0002	*Δ y*	0.2123	0.0551
25 to 34	17	7.2837	0.0019	*ENTexp* $_{t-1}$	0.2865	0.0165
55 to 64	17	14.1170	0.0000			

<u>All CUs</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0028	0.0029	0.9600	0.3420
ENTexp $_{t-1}$	-0.7349	0.1660	-4.4300	0.0000
Constant	374.6214	85.3759	4.3900	0.0000

<u>25 to 34</u>	*b*	*SE*	*t*	*p value*
Δ y	-0.0009	0.0010	-0.9900	0.3290
ENTexp $_{t-1}$	-0.5657	0.1632	-3.4700	0.0010
Constant	256.4174	74.6084	3.4400	0.0010

<u>55 to 64</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0079	0.0034	2.3500	0.0240
ENTexp $_{t-1}$	-0.7132	0.2502	-2.8500	0.0070
Constant	378.0200	133.6113	2.8300	0.0070

Panel B, Fees and Admissions; GDP Deflator

Equation	*No. Of Obs.*	*F Value*	*F -Sig. (1)*	*Joint Tests*	*F -Sig. (2)*	*F -Sig. (3)*
All CUs	17	6.6506	0.0031	*Δ y*	0.1756	0.0174
25 to 34	17	2.3463	0.1081	*ENTexp* $_{t-1}$	0.0685	0.0392
55 to 64	17	10.7977	0.0002			

<u>All CUs</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0035	0.0035	0.9900	0.3290
ENTexp $_{t-1}$	-0.6515	0.1833	-3.5500	0.0010
Constant	313.5649	88.1450	3.5600	0.0010

<u>25 to 34</u>	*b*	*SE*	*t*	*p value*
Δ y	-0.0015	0.0011	-1.4300	0.1600
ENTexp $_{t-1}$	-0.2550	0.2259	-1.1300	0.2650
Constant	112.1415	96.4032	1.1600	0.2510

<u>55 to 64</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0101	0.0035	2.9100	0.0060
ENTexp $_{t-1}$	-0.4500	0.2229	-2.0200	0.0500
Constant	223.1235	112.1951	1.9900	0.0530

* b represents the parameter estimate, SE represents the standard error of the estimate, t represents the t statistic for the paremeter estimate, F-Sig. (1) represents the test for overall signficance of the equation, where the reported value is the *p* value for the null hypothesis that all coefficients are equal to zero, F-Sig. (2) represents the *p* value for the joint signficance test across *all CUs* and *25 to 34 year-old CUs*, and F-Sig. (3) represents the *p* value for the joint signficance test across *all three age groups of CUs.*

Table 6-7 Continued

Panel C, Other Ent. Expenditures; CPI for All Items Less Food and Energy

Equation	*No. Of Obs.*	*F Value*	*F -Sig. (1)*	*Joint Tests*	*F -Sig. (2)*	*F -Sig. (3)*
All CUs	17	9.6736	0.0004	*Δ y*	0.0616	0.0757
25 to 34	17	7.2518	0.0020	*ENTexp* $_{t-1}$	0.5666	0.0187
55 to 64	17	6.2844	0.0041			

<u>All CUs</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0179	0.0090	2.0000	0.0520
ENTexp $_{t-1}$	-0.7124	0.1892	-3.7600	0.0010
Constant	315.2186	85.9690	3.6700	0.0010

<u>25 to 34</u>	*b*	*SE*	*t*	*p value*
Δ y	-0.0008	0.0040	-0.1900	0.8510
ENTexp $_{t-1}$	-0.8782	0.2312	-3.8000	0.0000
Constant	405.0695	107.9882	3.7500	0.0010

<u>55 to 64</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0210	0.0106	1.9700	0.0550
ENTexp $_{t-1}$	-0.5237	0.1900	-2.7600	0.0090
Constant	276.9204	104.2614	2.6600	0.0110

Panel D, Other Ent. Expenditures; GDP Deflator

Equation	*No. Of Obs.*	*F Value*	*F -Sig. (1)*	*Joint Tests*	*F -Sig. (2)*	*F -Sig. (3)*
All CUs	17	11.8980	0.0001	*Δ y*	0.0362	0.0549
25 to 34	17	7.9573	0.0012	*ENTexp* $_{t-1}$	0.4133	0.0080
55 to 64	17	7.0134	0.0024			

<u>All CUs</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0216	0.0093	2.3400	0.0240
ENTexp $_{t-1}$	-0.7039	0.1679	-4.1900	0.0000
Constant	286.2170	71.9475	3.9800	0.0000

<u>25 to 34</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0001	0.0037	0.0300	0.9790
ENTexp $_{t-1}$	-0.9378	0.2358	-3.9800	0.0000
Constant	407.4730	102.7626	3.9700	0.0000

<u>55 to 64</u>	*b*	*SE*	*t*	*p value*
Δ y	0.0223	0.0105	2.1100	0.0410
ENTexp $_{t-1}$	-0.5097	0.1768	-2.8800	0.0060
Constant	249.3068	92.8484	2.6900	0.0100

* b represents the parameter estimate, SE represents the standard error of the estimate, t represents the t statistic for the paremeter estimate, F-Sig. (1) represents the test for overall signficance of the equation, where the reported value is the *p* value for the null hypothesis that all coefficients are equal to zero, F-Sig. (2) represents the *p* value for the joint signficance test across *all CUs* and *25 to 34 year-old CUs*, and F-Sig. (3) represents the *p* value for the joint signficance test across *all three age groups of CUs.*

Table 6-7 Continued

Panel E, TV, Radios and Sound Equip.; CPI for All Items Less Food and Energy

Equation	*No. Of Obs.*	*F Value*	*F -Sig. (1)*	*Joint Tests*	*F -Sig. (2)*	*F -Sig. (3)*
All CUs	17	8.4333	0.0008	*Δ y*	0.8373	0.2773
25 to 34	17	7.7937	0.0013	*ENTexp* $_{t-1}$	0.9207	0.0013
55 to 64	17	10.1416	0.0003			

All CUs	*b*	*SE*	*t*	*p value*
Δ y	-0.0012	0.0061	-0.1900	0.8490
ENTexp $_{t-1}$	-0.8580	0.2108	-4.0700	0.0000
Constant	541.0886	132.1389	4.0900	0.0000

25 to 34	*b*	*SE*	*t*	*p value*
Δ y	0.0001	0.0018	0.0600	0.9520
ENTexp $_{t-1}$	-0.8284	0.2098	-3.9500	0.0000
Constant	556.9923	141.7855	3.9300	0.0000

55 to 64	*b*	*SE*	*t*	*p value*
Δ y	0.0047	0.0030	1.5500	0.1290
ENTexp $_{t-1}$	-0.7940	0.2011	-3.9500	0.0000
Constant	465.2769	116.4623	4.0000	0.0000

Panel F, TV, Radios and Sound Equip.; GDP Deflator

Equation	*No. Of Obs.*	*F Value*	*F -Sig. (1)*	*Joint Tests*	*F -Sig. (2)*	*F -Sig. (3)*
All CUs	17	7.1854	0.0021	*Δ y*	0.8938	0.1572
25 to 34	17	8.4789	0.0008	*ENTexp* $_{t-1}$	0.2418	0.0010
55 to 64	17	9.7040	0.0003			

All CUs	*b*	*SE*	*t*	*p value*
Δ y	-0.0005	0.0071	-0.0800	0.9400
ENTexp $_{t-1}$	-0.5880	0.1553	-3.7900	0.0000
Constant	354.3499	91.7370	3.8600	0.0000

25 to 34	*b*	*SE*	*t*	*p value*
Δ y	0.0004	0.0017	0.2500	0.8070
ENTexp $_{t-1}$	-0.8663	0.2111	-4.1000	0.0000
Constant	550.8639	133.4069	4.1300	0.0000

55 to 64	*b*	*SE*	*t*	*p value*
Δ y	0.0057	0.0030	1.8800	0.0680
ENTexp $_{t-1}$	-0.5698	0.1484	-3.8400	0.0000
Constant	317.1251	80.9828	3.9200	0.0000

* b represents the parameter estimate, SE represents the standard error of the estimate, t represents the t statistic for the paremeter estimate, F-Sig. (1) represents the test for overall signficance of the equation, where the reported value is the *p* value for the null hypothesis that all coefficients are equal to zero, F-Sig. (2) represents the *p* value for the joint signficance test across *all CUs* and *25 to 34 year-old CUs*, and F-Sig. (3) represents the *p* value for the joint signficance test across *all three age groups of CUs.*

6.2.3 Summary of Aggregate OLS Results

Among the OLS regressions run on the aggregate CEX data, the variable with the most explanatory power was one-period lagged expenditures, $ENTexp_{t-1}$. This variable was consistently found to have a negative relationship with consumers' average change in expenditures ($\Delta ENTexp_t$) and a larger coefficient than the first difference of income (Δy_t). Additionally, within expenditure categories, the estimates of $\Delta ENTexp_t$ were statistically different across consumers of different age groups. While using the aggregate-level expenditure data does not allow us to directly test for these factors across CD buying consumers, our aggregate-level OLS results do show significant consumer heterogeneity across age groups within different types of entertainment goods, and they do suggest that prior period expenditures are an important predictor of a change in expenditures. Specifically, our results suggest that, on average, consumers who spend more on goods in a given year are likely to change their spending by less the following year. Unfortunately, the micro-level CEX data do not provide us with consumers' prior year expenditures.

Nonetheless, given that our hypothesis requires significant consumer heterogeneity, our aggregate-level OLS regressions provide some evidence for a necessary condition on our hypothesis (that, due to the recent decrease in copy transaction costs and CD/copy substitutability, some of the consumers using Internet file-sharing services were those previously not in the market). Our hypothesis requires that consumers with different tastes for music will be affected differently by the various factors of demand, and our aggregate-level OLS results do support consumers having different tastes for entertainment goods. To directly examine CD expenditures for any effects from file-sharing, we now turn our attention to the CEX micro data files.

6.3 Consumer Expenditure Survey Micro Data Files

The source of the data examined in this section is the Bureau of Labor and Statistics' (BLS) Consumer Expenditure Survey (CEX) micro data files (available for purchase from the BLS). These data are used by the BLS to compute the Consumer Price Index (CPI), and are collected by the Census Department under contract with the BLS. We use the CEX interview survey data files, where Census employees interview consumers regarding their purchases and demographic characteristics over the three months prior to their interview. The samples in the CEX files are derived from a "complex" survey design. Rather than a simple random sample, the data are collected based on a stratified sample design, whereby two primary sampling units (PSUs) exist per stratum. To calculate more precise variances and standard errors, the data are supplied with 44 half-sample replicate weights (created by the balanced repeated replication (BRR) method).

The expenditure items we examine are annual CD and movie ticket purchases, expenditures on two leisure items which should be affected differently by file sharing. Given that the most popular type of good on file-sharing services is music files, it is unlikely that file sharing would have impacted both types of goods in the same manner. Partially attributable to the longer download times for movies, even Jack Valenti, the president of the Motion Picture Association of America (MPAA), concedes that, unlike the threat to the music industry, file-sharing services are more of a threat *to the future* of the movie industry than to current box office sales.[11]

[11] See Garinger (2003).

6.3.1 Methodology for Consumer Expenditure Survey Micro Data Files

First, we use the Consumer Expenditure Survey (CEX) public-use micro files to create weighted *calendar year* estimates of mean income figures and mean CD and movie ticket expenditures.[12] Each annual release of CEX micro data includes five quarterly *collection period* files which can be used to create either an annual calendar year or collection period sample. Since the files cannot be used to create longitudinal data across years, we use the five quarterly files to create four separate calendar year samples for 1998 through 2001, and one pooled data set that combines the four samples.

Interestingly, the sample size used to calculate calendar year mean expenditures in the CEX data is not equivalent to the number of observations – weighted or unweighted – in the sample. Because of the structure of the interviews and the data files, the number of months each observation (each CU) is "in scope" must be accounted for to arrive at the correct sample size (and U.S. population) estimate. To benchmark against the sample data provided by the BLS, we only examined CUs that were coded with "complete" income. We then used the 44 half-sample replicate weights to calculate standard errors for the means and confidence intervals for the changes in annual means.

The 44 replicate weights are used to create 44 separate "sub-sample" mean estimates to which the standard variance formula can be applied.[13] Employing the 44 replicate weights, the formula for the variance of the mean is as follows,

$$V\left({}_{WK}\overline{X}\right)=\frac{1}{44}\sum_{a=1}^{44}\left({}_{AK}\overline{X}-{}_{WK}\overline{X}\right)^{2}$$

where ${}_{AK}\overline{X}$ represents a weighted mean calculated with a replicate weight, and ${}_{WK}\overline{X}$ represents the weighted mean calculated with each consumer units' unique population weight (named FINLWT21 in the data files).

After calculating the variances and standard errors for the means, we calculate the standard error of the difference between two means (from year to year) using the following standard formula,

$$S.E.\left({}_{WC}\overline{X}_{1},{}_{WC}\overline{X}_{2}\right)=\sqrt{\left(V\left({}_{WC}\overline{X}_{1}\right)+V\left({}_{WC}\overline{X}_{2}\right)\right)}$$

where ${}_{WC}\overline{X}_{1}$ and ${}_{WC}\overline{X}_{2}$ represent the respective sample means. The standard error for the difference between two means is then used to construct both 95 and 90 percent confidence intervals using the following standard formulas,

$$\left(\left|{}_{WC}\overline{X}_{1}-{}_{WC}\overline{X}_{2}\right|\right)\pm 1.96*S.E.\left({}_{WC}\overline{X}_{1},{}_{WC}\overline{X}_{2}\right),$$

and

$$\left(\left|{}_{WC}\overline{X}_{1}-{}_{WC}\overline{X}_{2}\right|\right)\pm 1.64*S.E.\left({}_{WC}\overline{X}_{1},{}_{WC}\overline{X}_{2}\right),$$

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[12] The weights are supplied by the BLS and used to make the sample representative of the U.S. population. The procedures for creating weighted calendar year estimates of expenditure and income categories are discussed in the BLS publication entitled *2001 Consumer Expenditure Interview Survey Public Use Micro-data Documentation*. This publication is available from the BLS at http://www.bls.gov/cex/home.htm.

[13] The procedure for calculating variances and standard errors between the differences of two means is also discussed in more detail in the BLS publication entitled *2001 Consumer Expenditure Interview Survey Public Use Micro-data Documentation*, available from at http://www.bls.gov/cex/home.htm.

respectively.[14] The means, and the respective confidence intervals, are calculated for real expenditures and income (using the CPI for recreation items, the CPI for all items less food and energy, and the GDP deflator) for *all* CUs, *computer owning* CUs, and *non-computer owning* CUs.

While using the micro-level data does not allow us to directly test individuals' expenditure changes across years, it does allow us to directly test for the effects that specific demographic characteristics may have on consumers' expenditures. To test for these effects, we run regressions on the micro data using a program called WesVar. Brogan (1998) and Landis, Lepkowski, Eklund, and Stehouwer (1982) have shown that ignoring the weighting and sample design schemes of complex survey data can lead to biased and inefficient estimators, as well as invalid statistical inferences. The WesVar program produces asymptotically unbiased and efficient estimators and valid statistical tests by using the sample's replicate weights to calculate standard errors, and the full-sample weights to correct for the possibility of heteroscedasticity.[15] A complete description of the regression model used is provided in section 6.3.7 (prior to discussing the regression results).

6.3.2 Expenditures for all consumer units

Table 6-8 shows the annual mean expenditures on CDs and movie tickets in 2001 dollars for *all* CUs, and lists the significance results for the year-to-year changes found with 90 and 95 percent confidence intervals.[16] Using the recreation item CPI, this group's mean expenditures on CDs fell from \$46.96 in 1998 to \$44.62 in 1999, to \$44.05 in 2000, and then to \$40.61 in 2001. Using the same measure of inflation, the group's mean expenditures on movie tickets increased from \$97.21 in 1998 to \$98.48 in 1999, then fell to \$93.92 in 2000 and \$91.35 in 2001. Adjusting to 2001 dollars with either of the other two measures for inflation (the CPI for all items less food and energy or the GDP deflator) does not change the annual trends in mean expenditures for either CDs or movie tickets.

Of all the annual mean expenditure changes for *all* CUs, only the decrease in CD expenditures from 2000 to 2001 was statistically significant (at the 5 percent level). Since these results suggest that the average consumer did not spend differently on CDs from either 1998 to 1999 or from 1999 to 2000, they do provide some evidence in favor of our hypothesis (although more testing is needed). In 1999, when Napster was launched, and in 2000, both years in which aggregate CD sales *increased*, the average CU did not spend any differently on CDs than in the prior year, suggesting that file sharing was being done by consumers formerly not in the market. To further test our hypothesis, we examine the mean CD and movie ticket expenditures for computer owning CUs.

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[14] Since both positive and negative mean expenditure and income changes were found, and since a standard software package cannot be used to compute the significance tests, we constructed two-tailed tests for all changes rather than individual one-tailed tests.

[15] Brogan (1998) and Landis, et al (1982) have also shown that the magnitude of the parameter point estimates can be severely affected by ignoring the sample's weighting scheme, depending on the variability in the weights. There appears to be sufficient variability in the CEX full-sample weights to warrant such special considerations; in 2001, the weights range from 475 to 89,149.

[16] The full confidence interval results are listed in Appendix G.

Table 6-8, Mean CD and Movie Ticket Expenditures; All CUs

Mean CD Expenditures	1998	1999 98-99	2000 99-00	2001 00-01
CPI Rec. Items	46.96	44.62	44.05	40.61 *b*
CPI Less Food/Energy	48.57	45.62	44.53	40.61 *b*
GDP Deflator	47.98	45.34	44.40	40.61 *b*
number of observations	4,921	6,032	5,932	5,857
Mean Movie Ticket Expenditures	1998	1999 98-99	2000 99-00	2001 00-01
CPI Rec. Items	97.21	98.48	93.92	91.35
CPI Less Food/Energy	100.56	100.68	94.93	91.35
GDP Deflator	99.33	100.08	94.67	91.35
number of observations	8,665	10,431	9,539	9,916

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

6.3.3 Expenditures by Computer Owners

As seen on Table 6-9, the annual mean expenditures for both CDs and movies are substantially higher for *computer owning* CUs than are the corresponding mean expenditures for *all* CUs. In 2001 dollars using the recreation item CPI, the mean expenditure on CDs for computer owners decreased from $75.70 in 1998 to $66.21 in 1999, to $61.15 in 2000 and to $56.60 in 2001. Using the same measure for inflation, mean movie ticket expenditures for computer owners increased from $152.69 in 1998 to $153.27 in 1999, then fell to $135.90 and $130.56 in 2000 and 2001, respectively.

Adjusting the mean *CD* expenditures for computer owning CUs to 2001 dollars, using either measure of inflation, does not change the three-year downward trend. In the case of *mean movie ticket* expenditures, however, using either the CPI for all items less food and energy, or the GDP deflator to adjust to 2001 dollars, the trend in mean expenditures changes in 1999. However, using either measure of inflation, the change in mean movie expenditures from 1998 to 1999 was statistically insignificant.

For all measures of inflation, the 1998 to 1999 decrease in mean CD expenditures by computer owning CUs was statistically significant at the 5 percent level. From 1999 to 2000, however, the decreases in both mean CD and movie expenditures for computer owning CUs were statistically significant. The decrease in mean movie expenditures was significant at the 5 percent level of significance, and the decrease in mean CD expenditures varied between the 5 and 10 percent levels depending on the measure of inflation used.

Then, in 2001, the decrease in computer owning CUs' mean CD expenditures was statistically significant,[17] while their decrease in mean movie ticket expenditures was statistically insignificant. These findings show that, on average, while computer owning CUs have been spending less on CDs since 1998, they have also been spending less on movie tickets, spending about $20 less in 2001 than 1998 on both types of entertainment goods (in 2001 dollars).

[17] The decrease was significant at the 10 percent level using the recreation items CPI, but at the 5 percent level using either the CPI for all items less food and energy or the GDP deflator.

Additionally, while computer owning CUs have been spending less on CDs, on average, since 1998, aggregate CD sales increased in both 1999 and 2000 (in 2001 dollars). Again, these results suggest that file sharing was being performed by consumers formerly not in the market. Despite the fact that this group's average CD expenditures have been about $15 to $30 higher than the average for all CUs, their annual average decrease did not correspond to a drop in aggregate CD sales in either 1999 or 2000, and *the average* CU did not spend differently in either of these years. We now examine the mean CD and movie ticket expenditures of *non*-computer owning CUs.

Table 6-9, Mean CD and Movie Ticket Expenditures; Computer Owners

Mean CD Expenditures	1998	1999	98-99	2000	99-00	2001	00-01
CPI Rec. Items	75.70	66.21	*b*	61.15	*a*	56.60	*a*
CPI Less Food/Energy	78.30	67.69	*b*	61.81	*b*	56.60	*b*
GDP Deflator	77.35	67.28	*b*	61.64	*a*	56.60	*b*
number of observations	2,870	3,776		4,061		4,378	
Mean Movie Ticket Expenditures	1998	1999	98-99	2000	99-00	2001	00-01
CPI Rec. Items	152.69	153.27		135.90	*b*	130.56	
CPI Less Food/Energy	157.94	156.69		137.37	*b*	130.56	
GDP Deflator	156.02	155.76		136.99	*b*	130.56	
number of observations	4,870	6,428		6,443		7,315	

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

Table 6-10, Mean CD and Movie Ticket Expenditures; Non-Computer Owners

Mean CD Expenditures	1998	1999	98-99	2000	99-00	2001	00-01
CPI Rec. Items	27.43	27.47		26.72		20.31	*b*
CPI Less Food/Energy	28.37	28.08		27.01		20.31	*b*
GDP Deflator	28.02	27.91		26.94		20.31	*b*
number of observations	2,003	2,189		1,797		1,391	
Mean Movie Ticket Expenditures	1998	1999	98-99	2000	99-00	2001	00-01
CPI Rec. Items	59.82	55.61		51.80		41.15	*b*
CPI Less Food/Energy	61.87	56.85		52.36		41.15	*b*
GDP Deflator	61.12	56.51		52.21		41.15	*b*
number of observations	3,715	3,873		2,969		2,401	

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

6.3.4 Expenditures by Non-computer owners

Comparing Tables 6-9 and 6-10, it is clear that the annual mean expenditures for both CDs and movies are nearly one-third lower for *non*-computer owning CUs than for computer owning CUs. In 2001 dollars (using the recreation item CPI), the mean expenditure on CDs for non-computer owners increased from $27.43 in 1998 to $27.47 in 1999, then fell to $26.72 in 2000 and to $20.31 in 2001. Using the same inflation measure, mean movie ticket expenditures

for non-computer owners decreased steadily from $59.82 in 1998 to $55.61 in 1999, $51.80 in 2000 and $41.15 in 2001. If either the CPI for all items less food and energy or the GDP deflator is used to adjust for inflation, non-computer owning CUs' mean expenditures on CDs decreased from 1998 to 1999 rather than increased. Of all these changes in (for each measure of inflation) mean CD *and* movie expenditures, only the changes from 2000 to 2001 are statistically significant (all at the 5 percent level of significance).

Therefore, on average, both computer owning and non-computer owning CUs spent significantly less on CDs from 2000 to 2001. Incidentally, 2001 was the only year for which the direction of the change in aggregate CD sales matched the direction of the change in both groups' mean CD expenditures. Additionally, while the average computer owner spent less on movie tickets in 2000, the average *non*-computer owner's movie ticket expenditure was the same in 2000, and the opposite was found in 2001 (computer owning CUs spent the same on movie tickets in 2001 as 2000, but non-computer owners spent less). In both 1999 and 2000, when the average *computer owning* CU's expenditures on CDs decreased, average *non*-computer owning CUs' expenditures did not change, and aggregate CD sales increased. Combined, these results suggest there is significant heterogeneity among consumers of both types of entertainment goods, and that at least some of the Internet file-sharing was done by consumers formerly not in the market. Since, on average, non-computer owning CUs spend so much less on CDs and movie tickets, examining the income of these groups of consumers seems prudent.

6.3.5 Mean annual income for all CUs

Since the CEX definition of before tax income changed in 2001, we use wage and salary income for our measure of annual income. Table 6-11 shows that real mean annual income for *all* CUs (using the CPI for all items less food and energy to adjust to 2001 dollars) rose steadily over the four year period, from $35,296 in 1998 to $36,255 in 1999, to $36,485 in 2000, and then to $38,360 in 2001.[18] This trend holds when income is adjusted to 2001 dollars using the GDP deflator. Of these changes, only the increase in real mean income in 2001 was statistically significant (at the 5 percent level for both measures of inflation).

Table 6-12 shows that, for computer owning CUs, annual mean income (using the CPI for all items less food and energy) increased from $53,955 in 1998 to $54,374 in 1999, then decreased to $52,059 in 2000, and increased to $52,617 in 2001. These trends hold when computer owning CUs' income is adjusted to 2001 dollars using the GDP deflator. Computer owning CUs' decrease in mean annual income for 2000 was statistically significant (at the 5 percent level using the CPI measure and the 10 percent level using the GDP deflator). All other changes in computer owning CUs' mean income were statistically insignificant.

Table 6-13 demonstrates that the annual mean income for CUs *not* owning computers declined steadily each year. Using the CPI measure, this group's annual mean income fell from $22,837 in 1998 to $21,952 in 1999, $20,856 in 2000, and to $20,172 in 2001. These trends hold when the income figures are adjusted to 2001 dollars with the GDP deflator. Of these changes, only the decrease from 1999 to 2000 was statistically significant (at the 10 percent level for both measures of inflation). Together, the statistics on Tables 6-11 through 6-13 illustrate that mean annual income is considerably higher – approximately $30,000 higher each year – for computer owning CUs than for those CUs that do not own a computer, and that all groups' mean income

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[18] This trend matches the national mean wage and salary trend for 1998 through 2000. However, according to the BLS, mean wage and salaries in the U.S. did decline in 2001. These data are available from the BLS at http://www.bls.gov/oes/oes_dl.htm.

has remained fairly steady from 1998 to 2001 (with few statistically significant changes in mean annual income).

Thus, for *all* CUs, the lack of a statistically significant change in real mean income from 1998 to 1999 and from 1999 to 2000 corresponds to an unchanged real mean expenditure on either CDs or movie tickets for both periods. However, despite the statistically significant increase in real mean income from 2000 to 2001, the average CU spent less on CDs and the same on movie tickets for the period. Although *computer owning* CUs did not realize a statistically significant change in income in 1999, they spent, on average, significantly less on CDs and the same on movie tickets compared to what they spent in 1998. In 2000, when they realized a statistically significant decrease in mean annual income, computer owning CUs spent less, on average, for both CDs and movie tickets relative to their expenditures in 1999. Then, with no change in mean annual income in 2001, the average computer owning CU spent less on CDs but the same on movie tickets versus what they spent in 2000.

For *non*-computer owning CUs, no change in mean annual income from 1998 to 1999 corresponds to no change, on average, in either mean CD or movie ticket expenditures for the period. However, from 2000 to 2001, when non-computer owning CUs also failed to realize a change in mean annual income, they spent, on average, significantly less on both CDs and movie tickets. Also, from 1999 to 2000, when non-computer owning CUs' mean annual income decreased, they spent the same, on average, for both CDs and movies. When these simple correlations between statistically significant changes in mean annual income and expenditures on CDs and movies are considered, again, there appears to be significant heterogeneity across consumer types within each expenditure category. To further examine the role that income has in CD and movie expenditures, we tested for statistically significant mean changes by income class.

Table 6-11, Mean Annual Income, All CUs

	1998	1999	98-99	2000	99-00	2001	00-01
CPI Less Food/Energy	35,296	36,255		36,485		38,360	*b*
GDP Deflator	34,867	36,039		36,384		38,360	*b*
number of observations	16,167	20,471		20,341		21,907	

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

Percent Changes	98-99	99-00	00-01
CPI Less Food/Energy	2.72%	0.63%	5.14%
GDP Deflator	3.36%	0.96%	5.43%

Table 6-12, Mean Annual Income, Computer Owning CUs

	1998	1999	98-99	2000	99-00	2001	00-01
CPI Less Food/Energy	53,995	54,374		52,059	*b*	52,617	
GDP Deflator	53,339	54,051		51,915	*a*	52,617	
number of observations	7,733	10,775		11,890		14,106	

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

Percent Changes	98-99	99-00	00-01
CPI Less Food/Energy	0.70%	-4.26%	1.07%
GDP Deflator	1.33%	-3.95%	1.35%

Table 6-13, Mean Annual Income, Non-Computer Owning CUs

	1998	1999	98-99	2000	99-00	2001	00-01
CPI Less Food/Energy	22,837	21,952		20,856	*a*	20,172	
GDP Deflator	22,559	21,821		20,798	*a*	20,172	
number of observations	8,277	9,406		8,114		7,369	

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

Percent Changes	98-99	99-00	00-01
CPI Less Food/Energy	-3.87%	-4.99%	-3.28%
GDP Deflator	-3.27%	-4.69%	-3.01%

6.3.6 Mean annual expenditures by income class

Table 6-14 shows the mean expenditures for *computer owning* CUs by income class for 1998 through 2001 (in 2001 dollars using the CPI for recreation items). The change in this group's mean CD expenditures in 1999 was statistically significant (at the 5 percent level) only for the highest income class, CUs with at least $70,000.[19] For the year 2000, the decrease was statistically significant (at the 5 percent level) only for the third income class, and for 2001, the decrease was significant (at the 5 percent level) only for the fifth and sixth income classes. These results hold for each measure of inflation used. The complete set of tables for mean changes in CD and movie ticket expenditures by income class, as well as the results from the 90 and 95 percent confidence intervals, are presented in appendix H. Since these results are secondary to our WLS regression results, we only briefly discuss the results here.

Tables H-1 through H-9 show that there is no consistent pattern in the change of CD or movie expenditures from year to year based solely on income class. For all three groups of CUs, declines in real mean expenditures on CDs and movies were found to be statistically significant for different income classes in each of the three time periods. Table H1 reports the confidence intervals by income class for *all* CUs using the CPI for recreation items to adjust to 2001 dollars. These results demonstrate that, from 1998 to 1999, only CUs in the highest income class (over

[19] We used the income class variable as it was supplied by the BLS. This variable divides income into nine classes, and wage and salary income is topcoded for all CUs with wages and salary over $150,000. The topcoded value used by the BLS is the mean wage and salary of the subset of outliers.

$70,000 in annual income) spent significantly less on CDs (at the 5 percent level of significance). CUs in this income class, whose average CD expenditures were more than double the average expenditure for the entire group of CUs, spent about $30 less on CDs in 1999 than in 1998. From 1999 to 2000, however, none of the income classes spent significantly less on CDs. Then, from 2000 to 2001, only the fifth and sixth income classes, those with between $20,000 to $39,999, spent significantly less on CDs (at the 5 percent level).

Similarly, statistically significant declines on *all* CUs' mean movie expenditures were found among none of the income classes for 1998 to 1999, the second highest class from 1999 to 2000 (at the 5 percent level), and among the second and fifth income classes from 2000 to 2001 (at the 10 percent level). Furthermore, patterns different from these were found among *non*-computer owning CUs. Since a wide dispersion of statistically significant changes by income class was found for all three groups of CUs, it appears that there is heterogeneity in the relationship between changes in income and entertainment expenditures across income classes within each category of expenditures. This evidence also bolsters our hypothesis because it shows that, on average, only certain groups of consumers, even within our three classes of CUs, spent significantly less on CDs in any of the given years. We further explore this relationship in the next sub-section, where we run several weighted least squares regressions using the CEX micro data.

Table 6-14, Mean CD Exp. By Income Class (Rec. CPI; $2001), Computer Owners

Income Class		1998	1999	98-99	2000	99-00	2001	00-01
Less than $5,000		$72.04	$43.59		$51.11		$48.23	
	n	*122*	*110*		*111*		*138*	
$5,000 to $9,999		40.78	51.45		41.48		54.60	
	n	*78*	*101*		*122*		*113*	
$10,000 to $14,999		75.94	58.43		36.02	*b*	42.10	
	n	*85*	*126*		*114*		*126*	
$15,000 to $19,999		48.22	42.31		35.27		30.82	
	n	*108*	*140*		*123*		*124*	
$20,000 to $29,999		38.06	46.36		48.79		32.34	*b*
	n	*185*	*265*		*328*		*344*	
$30,000 to $39,999		55.30	50.01		53.85		39.33	*b*
	n	*294*	*364*		*413*		*421*	
$40,000 to $49,999		49.81	52.47		53.74		51.76	
	n	*294*	*367*		*411*		*461*	
$50,000 to $69,999		69.17	70.25		61.57		61.50	
	n	*583*	*767*		*787*		*851*	
$70,000 and over		116.85	88.26	*b*	81.43		75.75	
	n	*1,121*	*1,536*		*1,652*		*1,800*	
Total		75.70	66.21	*b*	61.15		56.60	
	n	*2,870*	*3,776*		*4,061*		*4,378*	

* *a* and *b* denote statistically significant changes at the 10 and 5 percent levels of signficance, respectively

6.3.7 CEX Micro Data WLS Results

Using WesVar, we run the following weighted least squares regression (WLS) for both CD and movie ticket expenditures.

$$ln\ ENT\ exp = \hat{\beta}_1 + \hat{\beta}_2\ ln\ y + \hat{\beta}_3 COMP + \hat{\beta}_4 INT_1 + \hat{\beta}_5 INT_2 + \hat{\beta}_6 INT_3 \qquad (77)$$

Model (77) is run separately for the following two dependent variables: the natural log of CD expenditures and the natural log of movie ticket expenditures. The dependent variable is represented by the term *ln ENT exp* in model (77). Since the CEX definition of before tax income was changed in 2001, we use the natural log of wage and salary income as an independent variable (represented by *ln y*).[20] The independent variable on the third coefficient in (77) is a dummy variable, set to one if the household owns at least one computer. The last three coefficients are interaction variables meant to capture age and family size differences.

The CEX contains several variables each for consumer unit size, consumer unit age, and age and number of children, and there is no apparent "best" way to capture these interactions. Therefore, we create interaction variables between family size and reference person's age. First, we create four dummy variables to group the reference person of the CU into four age categories (*AgeCat1*, *AgeCat2*, *AgeCat3* and *AgeCat4*).[21] These age groupings are as follows: under 31, between 31 and 55, between 56 and 65, and over 65.

For the family size of the CU, we then create a new variable to reclassify the CEX variable *fam_size*. The new variable, *fmsz*, is structured so that all consumer units consisting of 6 or more people are in the largest family size category. The age dummies and *fmsz* are then multiplied to create the interaction variables. So, for instance, INT_1 is equal to (*AgeCat1 * fmsz*), INT_2 is equal to (*AgeCat2 * fmsz*) and so on. Since, prior to 2001, the survey does not include information on whether CUs subscribed to the Internet, we are unable to test this relationship over time. For completeness, we do examine expenditures for Internet and non-Internet subscribers in 2001, but these WLS results are presented in Appendix J.

Using model (77), we run WLS regressions for the natural log of CD and movie ticket expenditures for the years 1998 through 2001, respectively, and on a pooled data set using the observations from all years. We use two measures of inflation to adjust the pooled data to 2001 dollars (the CPI for all items less food and energy, and the GDP deflator). In general, we find fairly low R^2 values and variation in the sensitivity to the independent variables across consumer types and years. The results from the WLS regressions are presented in Tables 6-15 through 6-25, and, as an added check for heteroscedasticity in the data, the results from Goldfeld-Quandt tests are in Appendix I.

As seen on Tables 6-15 through 6-18, where the natural log of CD expenditures is the dependent variable, the R^2 statistic is less than 8 percent in each of the respective years, and there is some variation by year as to which independent variable coefficients are statistically significant. In 1998, all coefficients are statistically significant at the 1 percent level of significance. For this year, the natural log of CD expenditures is positively related to both the natural log of income (*lny*) and computer ownership (*COMP*), with parameter estimates of .1940

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[20] For the aggregate CEX data, before tax income was used because the BLS does not publish wage and salary aggregates from the CEX files.
[21] The CEX variable name is *ref_age*.

and .1169, respectively. However, for 1998, the natural log of CD expenditures is negatively related to all three age interaction variables (INT_1, INT_2 and INT_3), with parameter estimates of (.0723), (.0496), and (.0940), respectively.

Given the results described in the previous sub-sections, the positive relationship between the log of CD expenditures and both *lny* and *COMP* is as expected. However, since the comparison dummy variable (INT_4) is for the oldest age group, the negative relationship for all three age interaction variables seems somewhat unusual. In alternative specifications to (77), where the model was run with separate age and family size dummy variables, it appears that the age effect could be overtaking the family size effect.[22] However, the alternative specifications did not reveal any consistent patterns in the relationship between age categories or family size and either of the dependent variables; in several instances, no statistically significant relationship was found and the sign of the parameter estimates, even when still statistically significant, changed. Due to the difficulty in classifying the exact age of a CU, we run our main regressions with the interaction variables as described in (77).[23] Using the model as specified in (77), with the natural log of CD expenditures as the dependent variable, only the coefficient on *lny* remains statistically significant for all four years, with a parameter estimate of approximately .20 in each year.

In 2000, the coefficient on *COMP* is statistically insignificant, and it is only marginally significant in 2001 (only at the 10 percent level of significance), with a parameter estimate of .0708. In 1999, of the three interaction variables, only the coefficient on INT_2 is statistically significant (at the 1 percent level), with a parameter estimate of (.0338). In 2000, the coefficient on INT_3 is significant at the 10 percent level, with an estimated parameter value of (.0333), and, in 2001, the parameters on both INT_2 and INT_3 are significant at the 1 percent level, with estimated values of (.0337) and (.0610), respectively. In terms of the statistical significance of the interaction variables, similar variation is found when they are regressors, instead, for the natural log of movie ticket expenditures.

[22] These results are presented in Appendix I.

[23] For instance, it is not entirely clear that the age of the reference person is the best measure of CU age, but it is just as ambiguous whether using the spouse's age, or the oldest/youngest child's age is the best measure of CU age. Based on our results, these ambiguities are not alleviated by eliminating multiple CU housholds (these households account for less than 5 percent of the observations in a given year).

Table 6-15, WLS Results on 1998 CD Expenditures

No. Of Observations		Overall Fit	
Unweighted:	4,407	F Value:	47.3480
Weighted:	79,003,370	Prob > F:	0.0000
		R^{2}:	0.0770

Independent Variable	*b*	*SE*	*p value*
Intercept	1.7425	0.1565	0.0000
lny	0.1940	0.0169	0.0000
COMP	0.1169	0.0301	0.0003
INT_1	-0.0723	0.0181	0.0002
INT_2	-0.0496	0.0106	0.0000
INT_3	-0.0940	0.0213	0.0001

Table 6-16, WLS Results on 1999 CD Expenditures

No. of Observations		Overall Fit	
Unweighted:	5,392	F Value:	32.9817
Weighted:	73,344,767	Prob > F:	0.0000
		R^{2}:	0.0713

Independent Variable	*b*	*SE*	*p value*
Intercept	1.5351	0.1576	0.0000
lny	0.2101	0.0186	0.0000
COMP	0.0678	0.0289	0.0236
INT_1	-0.0022	0.0210	0.9174
INT_2	-0.0338	0.0125	0.0094
INT_3	-0.0304	0.0256	0.2414

Table 6-17, WLS Results on 2000 CD Expenditures

No. Of Observations		Overall Fit	
Unweighted:	5,349	F Value:	42.5399
Weighted:	73,407,856	Prob > F:	0
		R^{2}:	0.0612

Independent Variable	*b*	*SE*	*p value*
Intercept	1.7548	0.1364	0.0000
lny	0.1895	0.0146	0.0000
COMP	-0.0127	0.0291	0.6638
INT_1	-0.0033	0.0180	0.8548
INT_2	-0.0171	0.0111	0.1284
INT_3	-0.0334	0.0186	0.0797

Table 6-18, WLS Results on 2001 CD Expenditures

No. Of Observations		Overall Fit	
Unweighted:	5,283	F Value:	47.1252
Weighted:	74,053,311	Prob > F:	0.0000
		$R^{2:}$	0.0784

Independent Variable	*b*	*SE*	*p value*
Intercept	1.4934	0.1494	0.0000
lny	0.2154	0.0170	0.0000
COMP	0.0708	0.0367	0.0600
INT_1	-0.0029	0.0158	0.8570
INT_2	-0.0337	0.0105	0.0025
INT_3	-0.0610	0.0185	0.0019

Tables 6-19 through 6-22 present the WLS results with movie ticket expenditures as the dependent variable. These regressions show a slightly higher R^2 than when the log of CD expenditures served as the dependent variable, but the R^2 statistics are still less than 12 percent in all years. Nonetheless, *lny* and *COMP* are positively related to the log of movie ticket expenditures, and remain statistically significant at the 1 percent level of significance for each of the four years. There also appears to be some variation in the magnitude of *lny* and *COMP* relative to when they serve as regressors for the natural log of CD expenditures. For instance, in all the years, the coefficient on *lny* is around .27 when a regressor for the log of movie expenditures, versus .20 when a regressor for the log of CD expenditures.

Similarly, in 2001, the coefficient on *COMP* was .1638 when a regressor for the log of movie expenditures, versus .0708 when a regressor for the log of CD expenditures. In 1999, the parameter estimate on *COMP* was .1228 when a regressor for the log of movie expenditures, and .0678 when a regressor for the log of CD expenditures. As for the interaction dummy variables, when the dependent variable is the log of movie expenditures, none are statistically significant in either 1998 or 2001, while the coefficients on both INT_2 and INT_3 are significant in 1999, and INT_1 is significant in 2000. In 1999, INT_2 is estimated at (.0184) and is significant at the 5 percent level, and the value of INT_3 is estimated as .0639 and is significant at the 1 percent level. In 2000, INT_1 is significant at the 5 percent level and is estimated at (.0286). The regression results on the pooled data set, for either CD or movie expenditures, do nothing to contradict the results found on the individual years.

Table 6-19, WLS Results on 1998 Movie Ticket Expenditures

No. Of Observations		Overall Fit	
Unweighted:	7,515	F Value:	70.4908
Weighted:	135,412,496	Prob > F:	0.0000
		R^2:	0.1092

Independent Variable	*b*	*SE*	*p value*
Intercept	0.8564	0.1331	0.0000
lny	0.2780	0.0145	0.0000
COMP	0.1293	0.0280	0.0000
INT_1	-0.0186	0.0149	0.2205
INT_2	-0.0152	0.0094	0.1128
INT_3	0.0116	0.0194	0.5514

Table 6-20, WLS Results on 1999 Movie Ticket Expenditures

No. Of Observations		Overall Fit	
Unweighted:	9,016	F Value:	70.4908
Weighted:	122,659,051	Prob > F:	0.0000
		R^2:	0.1089

Independent Variable	*b*	*SE*	*p value*
Intercept	0.9256	0.1193	0.0000
lny	0.2743	0.0140	0.0000
COMP	0.1228	0.0258	0.0000
INT_1	-0.0082	0.0194	0.6735
INT_2	-0.0184	0.0086	0.0382
INT_3	0.0639	0.0217	0.0051

Table 6-21, WLS Results on 2000 Movie Ticket Expenditures

No. Of Observations		Overall Fit	
Unweighted:	8,256	F Value:	74.0798
Weighted:	113,128,494	Prob > F:	0.0000
		R^2:	0.1026

Independent Variable	*b*	*SE*	*p value*
Intercept	1.0337	0.1351	0.0000
lny	0.2647	0.0160	0.0000
COMP	0.0997	0.0312	0.0026
INT_1	-0.0286	0.0126	0.0282
INT_2	0.0025	0.0104	0.8090
INT_3	0.0371	0.0249	0.1427

Table 6-22, WLS Results on 2001 Movie Ticket Expenditures

No. Of Observations		Overall Fit	
Unweighted:	8,722	F Value:	105.8939
Weighted:	121,959,282	Prob > F:	0.0000
		$R^{2:}$	0.1151

Independent Variable	*b*	*SE*	*p value*
Intercept	0.9057	0.1186	0.0000
lny	0.2711	0.0139	0.0000
COMP	0.1638	0.0275	0.0000
INT_1	0.0099	0.0154	0.5234
INT_2	0.0142	0.0093	0.1368
INT_3	0.0063	0.0169	0.7090

The pooled CD and movie ticket regression results are presented in Tables 6-23 and 6-24, respectively. With the natural log of CD expenditures as the dependent variable, all coefficients are statistically significant using either measure of inflation, with all except for INT_1 being statistically significant at the 1 percent level.[24] When regressors for the natural log of movie expenditures, the coefficients on *lny* and *COMP* are statistically significant at the 1 percent level (using either measure of inflation). Similar to what was found in the individual year regressions, we find that the estimates for the *lny* and *COMP* parameters are a bit higher when regressors for the log of movie expenditures instead of the log of CD expenditures. When serving as regressors for the log of movie expenditures, *lny* is estimated at about .27, and *COMP* is estimated at approximately .13. When regressors for CD expenditures, the estimated value of *lny* is found to be .20, and the estimated value for *COMP* is approximately .06. The results from the pooled regressions also show that, using the log of CD expenditures as the dependent variable, INT_1, INT_2 *and* INT_3 are statistically significant for each measure of inflation.

Using each inflation measure, INT_1 is statistically significant only at the 10 percent level, and INT_2 and INT_3 are significant at the 1 percent level, with parameter estimates of approximately (.02), (.034) and (.057), respectively. However, when the log of movie expenditures is the dependent variable, the results from the pooled regressions show that, for each measure of inflation, only INT_3 is statistically significant (at the 5 percent level). In fact, INT_3 has an estimated value of about .03, which is of the opposite sign found for this parameter estimate when INT_3 is a regressor for the log of CD expenditures. These results to suggest significant consumer heterogeneity across consumer types within each expenditure category. Still, a more interesting question is whether the relationship between computer ownership and entertainment expenditures changed from 1998 to 2001. Given the differences in parameter estimates in 1998 and 2001, we further investigated the possibility of a structural break in the data.

[24] The first interaction dummy, INT_1, is significant at the 10 percent level of significance using each measure of inflation.

Table 6-23, WLS Results on Pooled CD Expenditures, 1998 to 2001

Panel A, CPI all Items Less Food and Energy ($2001)

No. Of Observations		Overall Fit	
Unweighted:	20,431	F Value:	83.9358
Weighted:	299,809,303	Prob > F:	0.0000
		$R^{2:}$	0.0699

Independent Variable	*b*	*SE*	*p value*
Intercept	1.6667	0.1100	0.0000
lny	0.2020	0.0116	0.0000
COMP	0.0564	0.0185	0.0039
INT_1	-0.0208	0.0121	0.0932
INT_2	-0.0338	0.0057	0.0000
INT_3	-0.0575	0.0124	0.0000

Panel B, GDP Deflator ($2001)

No. Of Observations		Overall Fit	
Unweighted:	20,431	F Value:	83.9730
Weighted:	299,809,303	Prob > F:	0.0000
		$R^{2:}$	0.07

Independent Variable	*b*	*SE*	*p value*
Intercept	1.6626	0.1100	0.0000
lny	0.2019	0.0116	0.0000
COMP	0.0575	0.0185	0.0033
INT_1	-0.0208	0.0121	0.0941
INT_2	-0.0338	0.0057	0.0000
INT_3	-0.0574	0.0124	0.0000

Table 6-24, WLS Results on Pooled Movie Ticket Expenditures,

Panel A, CPI all Items Less Food and Energy ($2001)

No. Of Observations		Overall Fit	
Unweighted:	33,509	F Value:	229.8378
Weighted:	493,159,323	Prob > F:	0.0000
		R^2:	0.1084

Independent Variable	*b*	*SE*	*p value*
Intercept	0.9529	0.0858	0.0000
lny	0.2723	0.0094	0.0000
COMP	0.1314	0.0159	0.0000
INT_1	-0.0110	0.0092	0.2377
INT_2	-0.0043	0.0060	0.4795
INT_3	0.0292	0.0119	0.0186

Panel B, GDP Deflator ($2001)

No. Of Observations		Overall Fit	
Unweighted:	33,509	F Value:	230.4163
Weighted:	493,159,323	Prob > F:	0.0000
		R^2:	0.1086

Independent Variable	*b*	*SE*	*p value*
Intercept	0.9479	0.0857	0.0000
lny	0.2723	0.0094	0.0000
COMP	0.1323	0.0159	0.0000
INT_1	-0.0110	0.0092	0.2387
INT_2	-0.0043	0.0060	0.4775
INT_3	0.0292	0.0119	0.0183

As presented in Tables 6-15 through 6-22, our WLS results show that, when a regressor for the log of CD expenditures, the coefficient on *COMP* is .1169 in 1998, but only .0708 in 2001. While this relationship between CD expenditures and computer ownership appears to have weakened over the four year period, a similar pattern was not found when *COMP* was a regressor for the log of movie expenditures. Rather than finding a weaker relationship, when serving as a regressor for movie expenditures, the parameter estimate for *COMP* was actually higher in 2001 than in 1998 (.1293 versus .1638). To test for a significant change in the relationship between *COMP* and either expenditure item, we estimated a difference-in-differences estimator using pooled data from the years 1998 and 2001. The specification for this test consisted of adding a year dummy and interaction dummy variable to the independent variables in (77).[25] The resulting right-hand side of (77) is as follows.

$$\hat{\beta}_1 + \hat{\beta}_2 \ln y + \hat{\beta}_3 COMP + \hat{\beta}_4 INT_1 + \hat{\beta}_5 INT_2 + \hat{\beta}_6 INT_3 + \hat{\beta}_7 Y01 + \hat{\beta}_8 CMPINT$$

The seventh parameter is the year dummy, set to one for expenditures made in the year 2001, and the eighth is the interaction variable, whereby the year dummy (*Y01*) is multiplied by the *COMP* dummy (set to one for CUs owning a computer). Using the added categorical variables, we ran the model for the log of both real CD and movie ticket expenditures, using both the CPI for all items less food and energy and the GDP deflator to adjust to 2001 dollars. For all four regressions, both *Y01* and *CMPINT* were found to be statistically insignificant, even at the 10 percent level of significance.[26] Thus, while we certainly can point to a positive relationship between computer ownership and CD expenditures, we cannot report a significant weakening of this positive relationship from 1998 to 2001. Another question that can be addressed from the WLS regressions regards the change in computer owning CUs' CD and movie expenditures in 2000, when their real mean income dropped roughly 3 percent.

From 1999 to 2000, among computer owning CUs, the average expenditure on CDs fell from about \$68 to \$62 (8.8 percent), and the average expenditure on movie tickets fell from around \$157 to \$137 (12 percent).[27] Our WLS regressions show that the coefficient on *lny* is about .20 for CD expenditures and .27 for movie ticket expenditures, and that the coefficient on *COMP* is about .06 for CDs and .13 for movies. Therefore, without regard to different types of computer owning consumers, the average change in computer owning CUs' income appears to only explain about 1 percent of the decline in the average expenditure of either good ((.06+.2)*3 = .78 for CDs and (.13+.27)*3 = 1.2) for movie tickets).

6.3.8 Summary of WLS Results on Micro-Level CEX Data

Overall, our micro-level WLS results demonstrate that there is a positive relationship between both income and computer ownership for expenditures on both CDs and movie tickets. Additionally, using the available measures of consumer age and family size, we find that the relationship between these variables and expenditures varies across consumer types. These differences provide evidence for a necessary condition of our hypothesis: that significant heterogeneity exists among CD buying consumers. Furthermore, despite the downward trend in real mean CD expenditures by computer owning CUs from 1999 to 2001, we find that the

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[25] See Wooldridge (2003), p. 434.

[26] Even when all multiple CU households were eliminated from the data, the results were unchanged. The full results for these tests are presented in Appendix K.

[27] Both expenditure category changes were found to be statistically significant, as was the change in real income from 1999 to 2000.

positive relationship between computer ownership and CD expenditures is not statistically different in 1998 versus 2001. Therefore, the data does not appear to support any *systematic* effect from file sharing on CD expenditures, and we cannot reject our hypothesis that some of the file-sharing since 1999 has been undertaken by consumers formerly not in the market.

6.4 Summary and Conclusions

We test the hypothesis, derived from our model in chapter 4, that some of the music file-sharing since 1998 has been done by consumers formerly not in the market for CDs. After running regressions on both aggregate and micro-level consumer expenditure data, we are unable to reject our hypothesis. In aggregate-level OLS regressions, for three different categories of entertainment goods, we find a negative relationship between changes in mean expenditures and one-period lagged mean expenditures, as well as a positive relationship between changes in mean income and expenditures. The negative relationship with lagged expenditures is more robust than the relationship with changes in income, and we find that these relationships are statistically different across consumer types. Our hypothesis requires consumers with different tastes for music to be affected differently by the various factors of music demand, and our aggregate-level OLS results show that consumer heterogeneity exists across different types of consumers within three different entertainment expenditure categories. We find that evidence of such heterogeneity exists at the micro-level as well.

Using nearly all of the available measures for age and family size, our micro-level regressions show that the relationship between these variables and expenditures vary across types of consumers, thus providing evidence for the required consumer heterogeneity. We also find some direct evidence for our hypothesis in that the positive relationship between computer ownership and CD expenditures, while of a lower magnitude, was not significantly different in 2001 than in 1998. As for the positive relationship between movie ticket expenditures and computer ownership over this time period, we also find that the relationship is not significantly different (though the magnitude is slightly larger). Since this relationship did not change over these years, despite the simultaneous downward trend in computer owning consumers' real mean CD and movie ticket expenditures, we cannot report any evidence of a wide-spread effect from file sharing on CD sales.

The micro data also show that the average consumer did not spend any differently on CDs in 1999, the year Napster went online, than in 1998. While the average *computer owning* consumer did spend less on CDs in 1999 versus 1998, aggregate CD sales increased in 1999 by more than $1 billion. However, from 2000 to 2001, average expenditures on CDs among both computer owning and non-computer owning consumers decreased, as did aggregate CD sales. While some consumers probably did spend less on CDs because of file-sharing, there does not appear to be any *systematic* effect from file sharing in the 1998 to 2001 Consumer Expenditure Survey data, and we cannot reject our hypothesis that some of the music file-sharing since 1999 has been done by consumers frequently not in the market for CDs.

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Appendix A, Chapter 3 – Different Forms of Copying

The following four scenarios outline the copying choices faced by consumers:

Case #1 – The consumer can buy the CD or copy it directly onto a CD-R after borrowing it from a friend ("ripping" tracks is included in this scenario).

Case #2 – The consumer can buy the CD or copy individual songs (all of the songs from a particular album or just a few of the songs) from an Internet sharing service at no charge.

Case #3 – The consumer can buy a digital download or obtain the download from an Internet sharing service at no charge.

Case #4 – The consumer can buy the digital download or obtain the download from one individual (perhaps through email).

The first case is very much the same choice faced by consumers for the last 25 or so years – either buying an album or making a copy from a friend who already has the album – only with newer formats (CDs versus cassette tapes). The choice will depend largely on the value that the consumer places on the good and the transaction costs (including all opportunity costs and the cost of buying blank CD-Rs) that would be incurred by making the copy. Of course, the value that consumers place on the CD is revealed by the price they are willing to pay (measured ex-post). The higher the price of the CD relative to a consumer's transaction costs, the more likely that consumer is to copy. Conversely, the higher the transaction costs relative to the price, the more likely the consumer is to buy. While some consumers may make a copy and also buy, this action is equivalent to raising the overall cost of the good through positive transaction costs, and it still allows both the artist and the label to receive payment (some would argue that it allows them to receive higher payments). Case # 2 is, essentially, an extension of the first case through even newer technologies – namely the Internet.

In this scenario, consumers do not have to know anyone else who owns a copy of the album they are looking for – a rather significant difference from the first case. Instead, the consumer can log onto the Internet and find either some or all of the songs from virtually any album. Still, the choice made will depend on the consumer's valuation of the CD price and the transaction costs of copying. Just as in Case # 1, those who perceive a relatively higher price to transaction costs will copy, and those who perceive relatively higher transaction costs to price will buy. Also similar to the first case, those consumers who choose to buy *after* copying are only raising their overall cost for the CD and are not preventing the artist and the label from receiving compensation.

The third case is more relevant to a structure dominated by digital distribution or, at least, more relevant to predicting whether a shift to digital distribution will occur. In this case, consumers would choose between paying for a digital copy of a song or acquiring a nearly perfect substitute free of charge. Given that the hardware costs and the transaction costs to acquire either good are practically identical, only the increasingly smaller chance that a "bad" copy of the song is on the sharing service prevents these goods from being perfect substitutes. Since most consumers would choose the free copy, it is very likely that the predicted shift to digital distribution will not occur if sharing services are allowed to continue operating. The fourth case, which also involves a choice between digital downloads, is still very different from Case # 3.

In Case # 4, consumers are no longer able to go online and download any song they can think of. Instead, they would have to obtain the songs they are looking for either by knowing another person with that song or conducting an Internet search for someone who has posted that song to a website. Either of these alternatives is different from using an Internet sharing service in that the transaction (or search) costs are greater.

If the consumer has to locate a friend with that same song, Case # 4 is very similar to Case #1 – some sort of relationship between two people is needed for this form of copying to take place. If, however, the consumer has to perform an Internet search for any given song, a lack of any relationship between people would not prevent copying. Still, a general Internet search for a downloadable copy of *one* song would be more cumbersome than searching for any given title on a sharing service. Therefore, these larger transaction costs make Case # 4 similar to Case #1 with low transaction costs. All four cases are similar in that the choice to buy or copy hinges on consumers' evaluation of price and transaction costs.

Appendix B, Consumer Demand With Fixed Transaction Costs

The model derived in Chapter 4 does not include a fixed component in the transaction costs of copying. In order to show that omitting these fixed costs does not substantially change the implications of the model, this appendix derives equations (2) through (8) with fixed transaction costs, *T*, included.

Given all the assumptions discussed above, the utility function is now taken to be of the form

$$U_x = \begin{cases} \theta_x q^{CD} - p & \text{if the consumer buys the CD,} \\ \theta_x q^{COPY} - t(1-x) - \mathrm{T} & \text{if the consumer copies,} \\ 0 & \text{if the consumer does neither} \end{cases} \tag{B2}$$

where the fixed component of the transaction costs of copying, *T*, is added to the utility surplus for consumers who copy. Next, by setting the utilities of the buying and copying consumers equal, a new critical value of the taste parameter, θ, is obtained for a given x

$$\hat{\theta}_x = \frac{p - t(1-x) - T}{q} \tag{B3}$$

where $q = q^{CD} - q^{COPY}$ ($q > 0$), and the following new critical value of the cost type, x, is obtained for a given θ, as follows

$$x^* = \frac{\theta_x q - p + t + T}{t} \tag{B4}$$

where $q = q^{CD} - q^{COPY}$.

All consumers of type x whose taste parameter is larger than this critical value, $\hat{\theta}_x$, in equation (B3) will buy a CD, and those whose θ is smaller than $\hat{\theta}_x$ but larger than $t(1-x)-T/q$ will copy. Even though the fixed component of the transaction cost of copying, *T*, is now included, an examination of equation (B3) reveals that, just as in equation (3), $\hat{\theta}_x$ will increase if the price of the CD (p) increases, the marginal cost of copying (t) decreases, or the difference in the CD and copy quality (q) decreases. Additionally, $\hat{\theta}_x$ will increase if the fixed component of the transaction cost of copying, *T*, decreases. Alternatively, $\hat{\theta}_x$ decreases and CD buying increases when the price of the CD (p) decreases, the marginal cost of copying (t) increases, the fixed component of the transaction cost of copying (T), increases, or the difference in the CD and copy quality (q) increases.

All consumers whose cost type exceeds the point of indifference in equation (B4), x^*, will copy, and those whose x is smaller than x^* will buy. Therefore, as x^* decreases, more consumers will copy whereas when x^* increases, more consumers will buy CDs. Just as in equation (4), an examination of equation (B4) shows that, for a given θ, copying will increase if the price of the CD increases, the quality of the copy improves, or the quality of the CD declines. Also, if there is no difference in the quality of the CD and the copy ($q = 0$), x^* increases as the marginal cost of copying (t) is increased and/or the fixed component of the transaction cost of copying (T), is increased; consumers will then buy more and copy less.

Just as in the original version of the model, if the taste parameter, θ, were low enough, consumers would choose between not consuming music at all and copying. So, by setting the utility of copying equal to 0 (the utility from the choice of "neither"), a new critical value for the taste parameter, θ, is found to be

$$\hat{\theta}_x = \frac{t(1-x)+T}{q^{COPY}} \tag{B5}$$

This new critical value, $\hat{\theta}_x$, splits the consumers into those who neither buy nor copy and those who copy (for a given cost type, x). Those consumers of a given cost type, x, whose taste parameter, θ, exceeds this critical value (B5) will copy, and those with a taste parameter less than this critical value (B5) will neither buy nor copy. Equation (B5) is positively related to the marginal transaction cost of copying, t, and the fixed cost of copying, T, and is negatively related to the quality of the copy, q^{COPY}. So, as either the marginal or fixed transaction cost of copying rises or the quality of the copy falls, the critical taste parameter (B5) will rise, indicating that fewer consumers will copy and more will stay out of the market altogether.

Next, a new critical cost type, x^*, is found by setting the utility of the copying consumers equal to the utility of those choosing to neither buy nor copy, i.e., $\theta q^{COPY} - t(1\text{-}x) - T = 0$. Therefore, this point of indifference represents the division of consumers who are indifferent toward copying and staying completely out of the market (for a given θ) and is represented by the following expression:

$$x^* = \frac{T+t-\theta q^{COPY}}{t} \tag{B6}$$

Consumers whose cost type, x, exceeds this critical value will copy, and those whose cost type is less than x^* will stay out of the market completely. This point of indifference (B6) is positively related to both the fixed and marginal transaction costs of copying, T and t, respectively, and negatively related to the quality of the copy, q^{COPY}. Therefore, if either transaction cost of copying rises, x^* will increase, indicating that fewer consumers will copy. Alternatively, if the quality of the copy rises, x^* will decrease, indicating that more consumers will copy.

Just as in the original version of the model, these equations are then used to derive the following alternate demands for CDs and copies (given θ):

$$\text{Demand for CDs} = \frac{T+t-p+\theta\ q}{t} \tag{B7}$$

$$\text{Demand for copies} = 1-\frac{T+t-\theta q^{COPY}}{t} \tag{B8}$$

Since θ is uniformly distributed from 0 to 1, in order to obtain the market demands for CDs and copies, the above demand equations have to be integrated with respect to θ. It has already been shown that consumers with a very low θ will not buy music. The lower integration

limit will be slightly different now that the fixed component of the transaction cost of copying is included; the taste parameter θ must now be at least as large as $(p\text{-}t\text{-}T)/q$). Thus, the following market demand functions for CDs is obtained.

$$\text{Demand for CDs} = \int_{\frac{p-t-T}{q}}^{1} \frac{T+t-p+\theta q}{t} d\theta = \frac{1}{2qt}(q-p+t+T)^2 \equiv y^{CD} \qquad \text{(B9)}$$

Next, the demand for copies is shown for those values of the taste parameter, θ, where the quality adjusted cost of the copy is lower than the quality adjusted cost difference between buying and copying; i.e., $\frac{t}{q^{COPY}} < \frac{p-t}{q}$.

$$\text{Demand for copies} = \int_{0}^{\frac{T+t}{q^{COPY}}} \left[1-\frac{T+t-\theta q^{COPY}}{t}\right] d\theta + \int_{\frac{T+t}{q^{COPY}}}^{\frac{p-t-T}{q}} 1 d\theta + \int_{\frac{p-t-T}{q}}^{1} \left[1-\frac{T+t-p+\theta q}{t}\right] d\theta =$$

$$-\frac{1}{2}\left[\frac{T+t}{q^{COPY}} - \frac{2p-q}{t} - \frac{T^{2+}t^{2}-p^{2}}{qt}\right] - \frac{T+t-p}{q} \equiv y^{COPY} \qquad \text{(B10)}$$

Finally, the demand for copies is shown for those values of the taste parameter, θ, where the quality adjusted cost of the copy is equal to the quality adjusted cost difference between buying and copying; i.e., $\frac{t}{q^{COPY}} = \frac{p-t}{q}$.

$$\text{Demand for copies} = \int_{0}^{\frac{T+t}{q^{COPY}}} \left[1-\frac{T+t-\theta q^{COPY}}{t}\right] d\theta + \int_{\frac{T+t}{q^{COPY}}}^{1} \left[1-\frac{T+t-p+\theta q}{t}\right] d\theta =$$

$$\frac{1}{2}\left[\frac{1}{q^{COPY}}\left(T+t+\frac{qtT-2pq^{COPY}}{q^{COPY}}\right) + \frac{2p-q}{t}\right] \equiv y^{COPY} \qquad \text{(B11)}$$

It is clear from comparing the market demands in equations (9), (10) and (11) to the alternate market demands in equations (B9), (B10) and (B11), that the only difference is that a new fixed term (T), one which is signed the opposite of the price of the CD (p) and signed identically to the marginal transaction cost (t), is now included. Since the fixed component of the transaction costs of copying, T, can be viewed as an additional transaction cost and an additional "price" component of copying, and since adding this fixed component (T) does not change the original equations in any other way, it is clear that the same inferences can be made from both the original and alternate versions of the equations. Therefore, to make the model more parsimonious, the fixed component of the transaction costs of copying, T, are omitted from the original model.

Appendix C, Consumer Demand With Quadratic Transaction Costs

The model derived in chapter 4 is linear in transaction costs, with the transaction cost of copying introduced as $t(1\text{-}x)$, > 0. D'Aspremont, Gabszewizc and Thisse (1979) pointed out that a pure strategy equilibrium did not always exist in Hotelling's model if consumers were distributed uniformly and transportation costs were linear. This non-existence of an equilibrium disappeared, they argued, when transportation costs were quadratic. Subsequently, Goerce and Ramer (1994), Tabuchi and Thisse (1995) and Baake and Oechssler (1997) have shown that a pure strategy equilibrium could still be non-existent even when transportation costs are quadratic. Even though an optimal price can be found in the original model above, this appendix partially derives an alternative model to show that the market demands for CDs and copies would not substantially change when transaction costs are quadratic.

Given all the assumptions discussed above, the utility functions from buying, copying, or choosing to stay out of the market is now taken to be of the form

$$U_x = \begin{cases} \theta_x q^{CD} - p & \text{if the consumer buys the CD,} \\ \theta_x q^{COPY} - t(1-x)^2 & \text{if the consumer copies,} \\ 0 & \text{if the consumer does neither} \end{cases} \tag{C2}$$

where the only difference from the original utility functions is that transaction costs of copying are now quadratic, i.e., $t(1\text{-}x)^2$, > 0. Next, by setting the utilities of the buying and copying consumers equal, a critical value of the taste parameter, θ, is obtained for a given x

$$\hat{\theta}_x = \frac{p - t(1-x)^2}{q} \tag{C3}$$

where $q = q^{CD}\text{-}q^{COPY}$ (q > 0). Then, by setting the copy utility equal to the utility from choosing neither, a new critical value of the taste parameter, θ, is obtained for a given x

$$\hat{\theta}_x = \frac{t(1-x)^2}{q^{COPY}} \tag{C5}$$

Based on these values of the critical taste parameter, the market demands for CDs and copies can be derived just as in the case with linear transaction costs. In fact, the new version of either Figure 4-2A or Figure 4-2B is exactly the same as the original versions –the endpoints of both lines are exactly the same. Furthermore, for both equations (C3) and (C5), the first and second derivatives with respect to the cost type, x, are as follows

$$\frac{\partial \hat{\theta}_x}{\partial x} = 2t(1-x) \tag{C6}$$

$$\frac{\partial \hat{\theta}_x^{\,2}}{\partial^2 x} = -2t < 0 \tag{C7}$$

Since these results mean that both of the boundaries are concave, even if quadratic transaction costs result in curvature at the boundaries, none of the inferences from the original version of the model (with linear transaction costs) will change.

Appendix D, Derivations of Partial Derivatives From Chapter 4

This appendix lists all partial derivatives that were not explained in the main body of the text, and also describes the optimal price solutions given in equations (24) and (25). The partial derivatives for the critical taste parameter, $\hat{\theta}_x$, given in equation (3), are as follows:

$$\frac{\partial \hat{\theta}_x}{\partial p} = \frac{1}{q} \geq 0 \qquad \text{(D1)}$$

$$\frac{\partial \hat{\theta}_x}{\partial t} = \frac{-(1-x)}{q} \leq 0 \text{ when } q = 0 \qquad \text{(D2)}$$

$$\frac{\partial \hat{\theta}_x}{\partial q} = \frac{-(p-t)(1-x)}{q^2} \leq 0 \qquad \text{(D3)}$$

The partial derivatives for the critical cost type, x^*, given in equation (4), are as follows:

$$\frac{\partial x^*}{\partial p} = \frac{-1}{t} \leq 0 \qquad \text{(D4)}$$

$$\frac{\partial x^*}{\partial t} = \frac{1}{t}\left[1 - \frac{\theta q - p + t}{t}\right] \geq 0 \qquad \text{(D5)}$$

$$\frac{\partial x^*}{\partial q} = \frac{h}{t} \geq 0 \qquad \text{(D6)}$$

The partial derivatives for the critical taste parameter, $\hat{\theta}_x$, found in equation (5), when the utility of copying is set equal to the utility of staying out of the market (0), are as follows:

$$\frac{\partial \hat{\theta}_x}{\partial t} = \frac{(1-x)}{q^{COPY}} \geq 0 \qquad \text{(D7)}$$

$$\frac{\partial \hat{\theta}_x}{\partial q^{COPY}} = \frac{-t(1-x)}{(q^{COPY})^2} \leq 0 \qquad \text{(D8)}$$

The partial derivatives for the critical cost type, x^*, found in equation (6), when the utility of copying is set equal to the utility of staying out of the market (0), are as follows:

$$\frac{\partial x^*}{\partial t} = \frac{1}{t}\left[1 - \frac{t - \theta q^{COPY}}{t}\right] \geq 0 \qquad \text{(D9)}$$

$$\frac{\partial x^*}{\partial q^{COPY}} = \frac{-h}{t} \leq 0 \qquad \text{(D10)}$$

Since the critical cost type, x^*, derived in equation (4) represents the proportion of consumers who buy CDs (for a given θ), equation (4) represents the individual demand for CDs for a given taste parameter, θ. Therefore, the partial derivatives for the individual demand for CDs in equation (7) are identical to those in equations (D4), (D5) and (D6). Since the *complement* of the critical cost type, x*, derived in equation (6) represents the proportion of consumers who copy (for a given θ), the partial derivatives for the individual demand for copying in equation (9) are as follows:

$$\frac{\partial y}{\partial t} = -\frac{1}{t}\left[1 + \frac{t - \theta q^{COPY}}{t}\right] \leq 0 \qquad \text{(D11)}$$

$$\frac{\partial y}{\partial q^{COPY}} = \frac{h}{t} \geq 0 \qquad \text{(D12)}$$

Next, we explain the derivation of the optimal price solutions (equations (24) and (25)). The first step, substituting the demand for CDs (8) into the profit function (23), results in the following expression.

$$\pi = (1-\mu_A)\left[\frac{p(q-p+t)^2}{2qt}\right] - \left[\frac{c(q-p+t)^2}{2qt}\right] - F \;=\; \frac{(q-p+t)^2}{2qt}\left[(1-\mu_A)p - c\right] - F \qquad \text{(D13)}$$

Then, maximizing profit with respect to price, p, results in the following expression.

$$\frac{\partial \pi}{\partial p} = \frac{-(q-p+t)}{qt}\left[(1-\mu_A)p - c\right] + \frac{(q-p+t)^2(1-\mu_A)}{2qt} =$$

$$\frac{q-p+t}{qt}\left[\frac{(1-\mu_A)(q-p+t)}{2} - (1-\mu_A)p + c\right] \qquad \text{(D14)}$$

Then, equation (D14) was solved for the price variable, p, resulting in the following two solutions:

$$p^* = \frac{1}{3}\left[q + t + \frac{2c}{1-\mu_A}\right] \quad , \qquad \text{(D15)}$$

and,

$$p^* = q + t \qquad \text{(D16)}$$

The comparative statics on these optimal price solutions were derived in the main text, as was a description of when the respective solutions were the "true" profit maximizing price. In section 4.8.1 of the text we stated that when $q + t > c/(1-\mu_A)$, solution (D15) (equation (24) in the main body of the text) is the true maximum, and when $q + t < c/(1-\mu_A)$, solution (D16) (equation (25) in the main body of the text) is the true maximum. These relationships are determined by substituting the derived consumer demand expression (8) into the profit expression

(23), maximizing with respect to price, and examining the sign of the corresponding derivative for different values of price p. This process is now described in detail.

Substituting the demand expression (8) into the profit expression (23) results in the following expression.

$$\pi = (1-\mu_A)\left[\frac{p}{2qt}(q+t-p)^2\right] - \left[\frac{c}{2qt}(q+t-p)^2\right] - F$$
$$= \frac{1}{2qt}\left[\left[(1-\mu_A)p(q+t-p)^2\right] - \left[c(q+t-p)^2\right]\right] - F$$

Ignoring the constant term and maximizing the bracketed term with respect to price results in the following expression,

$$= (\hat{q}-p)\left[(1-\mu_A)(\hat{q}-p) - 2p(1-\mu_A) + 2c\right] \quad \text{(D17)}$$

where $\hat{q}$ is equal to $q + t$, and the product of these two bracketed terms is equivalent to the derivative of the profit expression with respect to price. Setting the first and second term, respectively, equal to zero and solving for p results in the following two solutions for the optimal price.

$$p_1^* = \hat{q}$$
$$p_2^* = \frac{\hat{q}}{3} + \frac{2c}{3(1-\mu_A)}$$

As seen by comparing to (D15) and (D16), these two sets of optimal price solutions are identical. Since we are interested in which of these two expressions is the true maximum, we construct and simplify the following inequality.

$$\hat{q} < \frac{\hat{q}}{3} + \frac{2c}{3(1-\mu_A)}$$
$$\hat{q} - \frac{\hat{q}}{3} < \frac{2}{3}\frac{c}{(1-\mu_A)}$$
$$\hat{q} < \frac{c}{(1-\mu_A)}$$

We can then examine the signs of each bracketed term in (D17) and their product (the derivative of the profit expression) for different values of the price p under the respective assumptions that $\hat{q}$ is less than or greater than $c / (1 - \mu_A)$). Starting with the $\hat{q}$ term, assuming $\hat{q} < c / (1 - \mu_A)$, we know that if $p < \hat{q}$, $\hat{q}$ must be positive, and that if $p > \hat{q}$, $\hat{q}$ must be negative (since we have set the term $\hat{q}$ equal to zero). Similarly, for the second term, we know that if $p <$ the second term in (D17), the term must be positive, and if p > the second term in (D17), then the term must be negative. These results are illustrated below on Table D-1, and the results assuming (instead) that $\hat{q} > c / (1 - \mu_A)$ are presented on Table D-2.

Table D-1, Signs of Profit Derivative Assuming $\hat{q} < c / (1 - \mu_A)$

term 1	+	-	-
term 2	+	+	-
Product	+	-	+

p_1^* p_2^* p

Table D-2, Signs of Profit Derivative Assuming $\hat{q} > c / (1 - \mu_A)$

term 1	+	+	-
term 2	+	-	-
Product	+	-	+

p_2^* p_1^* p

Table D-1 shows that, assuming $\hat{q} < c / (1 - \mu_A)$, the derivative is at a maximum when $p_1^* = \hat{q}$. And Table D-2 shows that, assuming $\hat{q} > c / (1 - \mu_A)$, the derivative is at a maximum when $p_2^* = \frac{\hat{q}}{3} + \frac{2c}{3(1-\mu_A)}$.

Appendix E, Derivations for Chapter Five

Part 1: Derivatives of the Profit Function

In equation (36), profit was given the expression $\left(\dfrac{2k^3}{qt(1-\mu)^2}\right) - F$, where $k = z(1- \mu) - c$, and $z = \dfrac{1}{3}\left(q + t + \dfrac{2c}{1-\mu}\right)$.[1] To explain how this simplification was made, we now present the equations and substitutions used. Before substituting the *k* expression into the profit function, equation (36) would be expressed as:

$$\pi(\mu) = \left(\left[\frac{(q-z+t)^2}{2qt}\right]\left[(1-\mu)z - c\right]\right) - F \tag{E1}$$

where

$$z = \frac{1}{3}\left(q + t + \frac{2c}{1-\mu}\right) \tag{E2}$$

To further simplify equation (E1), the *z* expression (E2) was solved for *q* + *t*. This operation resulted in the following expression for *q* + *t*.

$$q + t = -2\frac{c}{(1-\mu)} + 3z \tag{E3}$$

Then, (E3) was substituted into equation (E1). The resulting expression then simplifies to

$$\left(\frac{2(\mathrm{z}(1-\mu)-\mathrm{c})^3}{qt(\mu-1)^2}\right) - F \tag{E4}$$

Setting $k = z(1- \mu) - c$ then yields equation (36), as used in the main body of the text. Taking the derivative of equation (36) with respect to the artist's share of album sales, μ, yields the following result.

$$\frac{\partial \pi(\mu)}{\partial \mu} = -\frac{2k^2 z}{qt(1-\mu)^2} < 0 \tag{E5}$$

As expected, the label's total profit is negatively related to the artist's share of album sales. For any fixed amount of profit, the larger the share given to the artist, the smaller the share left for the label. To derive equation (E5), we manipulate the equations for the *z* and *k* parameters, and take their partial derivatives with respect to the artist's share of album sales, μ.

First, we know that $z = \dfrac{1}{3}\left(q + t + \dfrac{2c}{1-\mu}\right)$ and $k = z(1- \mu) - c$ imply the following expression.

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[1] For simplification, the subscript "*A*" is dropped from the artist's share of album sales, μ.

$$q + t = 3z - \frac{2c}{1-\mu} \tag{E6}$$

By subtracting z from both sides of (E6), we obtain the following equivalent expressions.

$$q + t - z = \frac{-2c}{1-m} + 2z = \frac{2[(1-\mu)z - c]}{1-\mu} = \frac{2k}{1-\mu} \tag{E7}$$

We also know from equation (E2) that $3z = \frac{(q+t)(1-\mu)}{(1-\mu)} + 2c$, which leads to the following two expressions.

$$3(1-\mu)z = (q+t)(1-\mu) + 2c \tag{E8}$$

$$k = \frac{(q+t)(1-\mu) - c}{3} \tag{E9}$$

Next, we take the partial derivatives of the *k* and *z* parameters with respect to μ, yielding the following results

$$\frac{\partial k}{\partial \mu} = \frac{2c}{3(1-\mu)} - \frac{q+t}{3} - \frac{2c}{3(1-\mu)} = -\frac{q+t}{3} < 0 \tag{E10}$$

$$\frac{\partial z}{\partial \mu} = \frac{6c}{9(1-\mu)^2} = \frac{2c}{3(1-\mu)^2} > 0 \tag{E11}$$

We can now derive equation (E5), the partial derivative of profit (36) with respect to the artist's share of album sales, μ.

$$\frac{\partial \pi(\mu)}{\partial \mu} = \frac{6k^2(\frac{\partial k}{\partial \mu})qt(1-\mu)^2 + 2k^3 2qt(1-\mu)}{q^2t^2(1-\mu)^4} = \frac{6k^2(-\frac{q+t}{3})qt(1-\mu)^2 + 2k^3 2qt(1-\mu)}{q^2t^2(1-\mu)^4} =$$

$$\frac{6k^2(-\frac{q+t}{3})qt(1-\mu)^2 + 2k^3 2qt(1-\mu)}{q^2t^2(1-\mu)^4} = \frac{2k^2[(q+t)(1-\mu) + 2k]}{qt(1-\mu)^3} = \frac{-2k^2[k+c]}{qt(1-\mu)^3}$$

Then, since $k + c = z(1\text{-}\mu)$, we have equation (E5), $\frac{\partial \pi(\mu)}{\partial \mu} = \frac{-2k^2 z}{qt(1-\mu)^2} < 0$.

Using the original form of equation (36), and then substituting as necessary from equations (E6) through (E11), the second derivative with respect to the artist's share of album sales is as follows

$$\frac{\partial^2 \pi}{\partial \mu^2} = \frac{-4c[\mu(q+t) - q - t + c]}{9qt(\mu-1)^4} = \frac{4ck}{3qt(1-\mu)^4} \tag{E12}$$

By combining the bracketed terms in the numerator of the first expression for equation (E12), and using equation (E9), $k = \dfrac{(q+t)(1-\mu)-c}{3}$, we can derive the final form of equation (E12).

Since all other terms are positive, the sign of equation (E12) depends on the sign of the term *k*. As noted previously, $k = z(1-\mu) - c$ and $z = \dfrac{1}{3}\left(q + t + \dfrac{2c}{1-\mu}\right)$. From chapter 4, we know that the expression for *z* is equivalent to the optimal price, p^*, a term which is positive. The lower the marginal cost of producing a CD, *c*, and lower the artist's share of album sales, μ, the higher the value for *k*. Given that the marginal cost of producing a CD has been close to zero for many years, and that most artists receive about 10 to 15 percent of album sales (gross), there is no reason to believe that the parameter *k* would be negative. Therefore, it is argued that the second derivative, equation (E12), is positive and, since the first derivative (E5) is negative, that profit is convex in the artist's share of album sales, μ.

We now present the partial derivatives for equation (36) (and the expressions for *k* and *z*) with respect to the quality difference between CDs and copies, *q*, the transaction cost of copying, *t*, the marginal cost of producing CDs, *c*, and the label's fixed cost, *F*.

Since the expression for *z* is equal to the optimal price, p^*, derived in chapter 4, the partial derivatives for *z* are identical to those derived for p^* . Restated for *z*, these derivatives are as follows.

$$\frac{\partial z}{\partial t} = \frac{\partial z}{\partial q} = \frac{1}{3}, > 0 \qquad \text{(E13)[2]}$$

$$\frac{\partial z}{\partial c} = \frac{2}{3(1-\mu)}, > 0 \qquad \text{(E14)}$$

These results are then used to present the partial derivatives of *k*, where $k = z(1-\mu) - c$. Substituting *z* into *k* results in the following expression for *k*

$$k = \frac{1}{3}\left(q + t + \frac{2c}{1-\mu}\right)(1-\mu) - c \equiv \frac{(1-\mu)}{3}q + \frac{(1-\mu)}{3}t + \frac{2}{3}c - c$$

Using this expression, it is clear that the partial derivatives for *k* are as follows.

$$\frac{\partial k}{\partial t} = \frac{\partial k}{\partial q} = \frac{1-\mu}{3}, > 0 \qquad \text{(E15)}$$

$$\frac{\partial k}{\partial c} = -\frac{1}{3}, < 0 \qquad \text{(E16)}$$

[2] It was also noted in Chapter 4 that the derivative of the optimal price (*z* in Chapter 5) with respect to *q* can be decomposed into two parts. As such, the optimal price (or *z*) is negatively related to the quality of the copy and positively related to the quality of the CD.

Equations (E15) and (E16) can then be used to derive the partial derivatives of the profit function, $\pi(\mu) = \left(\frac{2k^3}{qt(\mu-1)^2}\right) - F$, with respect to the quality difference between CDs and copies, q, the transaction cost of copying, t, and the marginal cost of producing CDs, c. The partial derivative of (36) with respect to the label's fixed cost, F, is also presented here. The partial derivative with respect to q is as follows.

$$\frac{\partial\pi(\mu)}{\partial q} = \frac{6k^2(\frac{\partial k}{\partial q})qt(\mu-1)^2 - 2k^3t(\mu-1)^2}{\left(qt(\mu-1)^2\right)^2} = \frac{2k^2qt(\mu-1)^2\left[3\frac{\partial k}{\partial q} - k\frac{1}{q}\right]}{\left(qt(\mu-1)^2\right)^2} =$$
$$= \frac{2k^2\left[3\frac{\partial k}{\partial q} - k\frac{1}{q}\right]}{qt(\mu-1)^2} = \frac{2k^2}{qt(\mu-1)^2}\left[(1-\mu) - k\frac{1}{q}\right] > 0 \qquad \text{(E17)}$$

That equation (E17) is positive can be seen by recognizing that k represents a positive fraction of (1-μ) less marginal cost, c. Therefore the second bracketed term in (E17), $k\frac{1}{q}$, is a positive fraction of the term (1-μ). As a result, the term must be less than (1-μ), and (E17) must be positive. Profit, therefore, is positively related to the quality difference of the CD and the copy, q. The same logic can be applied to the next partial derivative to show that profit is positively related to transaction costs, t. This partial derivative is shown with the following expression.

$$\frac{\partial\pi(\mu)}{\partial t} = \frac{6k^2(\frac{\partial k}{\partial t})qt(\mu-1)^2 - 2k^3q(\mu-1)^2}{\left(qt(\mu-1)^2\right)^2} = \frac{2k^2qt(\mu-1)^2\left[3\frac{\partial k}{\partial t} - k\frac{1}{t}\right]}{\left(qt(\mu-1)^2\right)^2} =$$
$$= \frac{2k^2\left[3\frac{\partial k}{\partial t} - k\frac{1}{t}\right]}{qt(\mu-1)^2} = \frac{2k^2}{qt(\mu-1)^2}\cdot\left[(1-\mu) - k\frac{1}{t}\right] > 0 \qquad \text{(E18)}$$

The partial derivatives of profit with respect to the marginal cost of producing CDs, c, and to the label's fixed cost, F, are as follows:

$$\frac{\partial\pi(\mu)}{\partial c} = \frac{6k^2(\frac{\partial k}{\partial c})qt(\mu-1)^2 - 0}{\left(qt(\mu-1)^2\right)^2} = \frac{6k^2(-\frac{1}{3})qt(\mu-1)^2}{\left(qt(\mu-1)^2\right)^2} = \frac{-2k^2}{qt(\mu-1)^2} < 0 \qquad \text{(E19)}$$

$$\frac{\partial\pi(\mu)}{\partial F} = -1 < 0 \qquad \text{(E20)}$$

The sign of (E19) is clear since we have a negative term divided by a positive term, and the sign of (E20) is clear since we have only one negative term. These partial derivatives, equations (E15) through (E20), will be used to derive the comparative statics for the optimal payoffs of the artist and label.

Part 2: Derivations of Optimal Shares and Optimal Utilities

Muthoo (1999) develops several corollaries, propositions, and lemmas concerning the optimal shares and utilities obtained using the Nash bargaining solution. For instance, Muthoo presents the optimal money payoffs for players A and B in a symmetric Nash framework, where player A is risk averse and both players have a disagreement point equal to zero.[3] We have applied Muthoo's method for the analogous artist-label bargaining arrangement, and we have generalized his method to derive results for the artist-label arrangement in the asymmetric Nash framework.

All of the following derivations are made by using the same basic Nash framework with different substitutions. These substitutions originate mainly from the following definition

- from the strict monotonicity of U_i, there exists a unique share $x_A \in [0,\pi]$ such that $U_A(x_A) = u_A$.

In other words, $x_A = U_A^{-1}(u_A)$, where U_A^{-1} denotes the inverse of U_A. Thus, we can write that $g(u_A) \equiv U_B(\pi - U_A^{-1}(u_A))$, resulting in a Nash product of the following form

$$N = (U_A - d_A)^{\alpha_A} (g(u_A) - d_B)^{\alpha_B} \quad \text{(E21)}$$

where $g(u_A)$ is identically equal to player B's utility when player A obtains utility u_A. When using the Nash product to derive a symmetric bargaining expression, the bargaining powers in (E21) are simply restricted to equal one.

2.1 Risk Averse Artist, Asymmetric Bargaining

In this section of the appendix, we present the derivation of the optimal money payoffs from section 5.4 of the main body of the text. To derive the artist's optimal money payoff in the asymmetric, risk-averse case, we implement the following asymmetric Nash product,

$$N = \left(x_A^{\gamma} - d_A\right)^{\alpha_A} \left((\pi(\mu) - x_A) - d_L\right)^{\alpha_L} = \left(x_A^{\gamma}\right)^{\alpha} \left(\pi(\mu) - x_A\right)^{1-\alpha} \quad \text{(E22)}$$

where α_A and α_L sum to one, d_L and d_A are equal to zero, and $g(u_A) \equiv (\pi(\mu) - x_A)$. Since the utility of player B is equal to B's payoff after player A obtains A's payoff, we know that $U_B = \pi - x_A$ (presented as $(\pi(\mu) - x_A)$ in (E22)). For ease of exposition, α_A and α_L sum to one (i.e., $\alpha_L = 1-\alpha_A$), and the "A" subscript for the artist's bargaining power, α_A, is dropped. To solve for the artist's optimal payoff, we maximized (E22) and solved the resulting expression for the artist's payoff, x_A. Maximizing (E22) with respect to x_A results in the following first order condition.

[3] See Muthoo (1999) page 16.

$$\frac{\partial N}{\partial x_A}=\frac{\alpha\gamma(x_A^{\gamma})^{\alpha}(\pi(\mu)-x_A)^{1-\alpha}}{x_A}-(1-\alpha)(x_A^{\gamma})^{\alpha}(\pi(\mu)-x_A)^{-\alpha}=0 \qquad \text{(E23)}$$

Solving (E23) for x_A results in the following optimal share for the artist,

$$x_A^*=\frac{\alpha\gamma(\pi(\mu))}{\alpha(\gamma-1)+1} \qquad \text{(E24)}$$

which corresponds to (49) in section 5.4 of the main body of the text. The derivation of (E24) is as follows.

$$\frac{\partial N}{\partial x_A}=\frac{\alpha\gamma(x_A^{\gamma})^{\alpha}(\pi(\mu)-x_A)^{1-\alpha}}{x_A}-(1-\alpha)(x_A^{\gamma})^{\alpha}(\pi(\mu)-x_A)^{-\alpha}$$

$$0=\frac{\alpha\gamma(x_A^{\gamma})^{\alpha}(\pi(\mu)-x_A)^{1-\alpha}}{x_A}-\frac{(1-\alpha)(x_A^{\gamma})^{\alpha}}{(\pi(\mu)-x_A)^{\alpha}}$$

$$\frac{\alpha\gamma(x_A^{\gamma})^{\alpha}(\pi(\mu)-x_A)}{x_A(\pi(\mu)-x_A)^{\alpha}}=\frac{(1-\alpha)(x_A^{\gamma})^{\alpha}x_A}{x_A(\pi(\mu)-x_A)^{\alpha}}$$

$$\alpha\gamma(\pi(\mu)-x_A)=(1-\alpha)x_A$$

$$\alpha\gamma\pi(\mu)=x_A(\alpha\gamma+1-\alpha)$$

$$x_A^*=\frac{\alpha\gamma\pi(\mu)}{1-\alpha(1-\gamma)}$$

By substituting the definition of x_A into the left hand side of the optimal payoff, where $x_A = \mu\pi(\mu)$, and dividing both sides by $\pi(\mu)$, we obtain the optimal share presented in section 5.4 of the text as equation (49) ($\mu^*=\frac{\alpha\gamma}{1-\alpha(1-\gamma)}$). The comparative statics for the optimal payoffs in the asymmetric case are as follows.

$$\frac{\partial x_A^*}{\partial\alpha}=\frac{\gamma\pi(\mu)}{(\alpha(\gamma-1)+1)^2} \quad >0 \qquad \text{(E25)}$$

$$\frac{\partial x_A^*}{\partial\gamma}=\frac{\alpha\pi(\mu)}{(\alpha(\gamma-1)+1)^2} \quad >0 \qquad \text{(E26)}$$

$$\frac{\partial x_A^*}{\partial\pi(\mu)}=\frac{\alpha\gamma}{\alpha(\gamma-1)+1} \quad >0 \qquad \text{(E27)}$$

$$\frac{\partial x_A^*}{\partial q}=\frac{\alpha\gamma}{\alpha(\gamma-1)+1}\cdot\frac{\partial\pi(\mu)}{\partial q}>0 \qquad \text{(E28)}$$

$$\frac{\partial x_A^*}{\partial t}=\frac{\alpha\gamma}{\alpha(\gamma-1)+1}\cdot\frac{\partial\pi(\mu)}{\partial t}>0 \qquad \text{(E29)}$$

$$\frac{\partial x_A^*}{\partial c}=\frac{\alpha\gamma}{\alpha(\gamma-1)+1}\cdot\frac{\partial\pi(\mu)}{\partial c}<0 \qquad \text{(E30)}$$

$$\frac{\partial x_A^*}{\partial F} = -\frac{\alpha\gamma}{\alpha(\gamma-1)+1} \quad <0 \tag{E31}$$

$$\frac{\partial x_L^*}{\partial \alpha} = -\frac{\gamma\pi(\mu)}{\left(\alpha(\gamma-1)+1\right)^2} \quad <0 \tag{E32}$$

$$\frac{\partial x_L^*}{\partial \gamma} = -\frac{\alpha\pi(\mu)}{\left(\alpha(\gamma-1)+1\right)^2} \quad <0 \tag{E33}$$

$$\frac{\partial x_L^*}{\partial \pi(\mu)} = \frac{1-\alpha}{\alpha(\gamma-1)+1} >0 \tag{E34}$$

$$\frac{\partial x_L^*}{\partial q} = \frac{1-\alpha}{\alpha(\gamma-1)+1} \cdot \frac{\partial \pi(\mu)}{\partial q} >0 \tag{E35}$$

$$\frac{\partial x_L^*}{\partial t} = \frac{1-\alpha}{\alpha(\gamma-1)+1} \cdot \frac{\partial \pi(\mu)}{\partial t} >0 \tag{E36}$$

$$\frac{\partial x_L^*}{\partial c} = \frac{1-\alpha}{\alpha(\gamma-1)+1} \cdot \frac{\partial \pi(\mu)}{\partial c} <0 \tag{E37}$$

$$\frac{\partial x_L^*}{\partial F} = -\frac{1-\alpha}{\alpha(\gamma-1)+1} <0 \tag{E38}$$

In both the symmetric and asymmetric cases, both the artist's and label's payoffs are positively related to profit, $\pi(\mu)$, quality difference, q, and transaction costs, t, and negatively related to marginal cost, c, and fixed cost, F. Also, the relationship between the respective money payoffs and the γ parameter are of opposite sign (equations (E26) and(E33)), a result which, as will be seen below, holds for the symmetric case as well. The artist's payoff increases with γ (as the artist becomes less risk averse), and the label's payoff decreases with γ. The key difference between the asymmetric and symmetric cases, however, is that the asymmetric case introduces asymmetric bargaining power into the derivation of the optimal money payoffs.

Equations (E25) and (E32) demonstrate the effect the relative bargaining power parameter, α, has on the artist's and label's optimal payoffs. The artist's optimal payoff is increasing in the artist's own bargaining power, (E25), and the label's optimal payoff is decreasing in the artist's bargaining power (E32). Furthermore, all of the remaining comparative statics for both players, equations (E27) through (E31) for the artist, and (E34) through (E38) for the label, have identical denominators and second terms. These comparative statics differ only in their numerators: $\alpha\gamma$ for the artist's comparative statics, and (1-α) for the label's.

The numerators for the artist's equations all posses the parameter for the artist's bargaining power, α, while the numerators for the label's equations all posses the complement of this term, 1-α. The artist's optimal payoff is positively related to the artist's bargaining power, and the label's optimal payoff is negatively related to the artist's bargaining power.

2.2 Risk Averse Artist, Symmetric Bargaining

This section of the appendix corresponds to the last part of section 5.4 of the main body of the text. To derive the artist's optimal share of profit in the symmetric, risk-averse case, we implement the following symmetric Nash product,[4]

$$N = \left(x_A^\gamma - d_A\right)^{\alpha_A} \left((\pi(\mu) - x_A) - d_L\right)^{\alpha_L} = \left(x_A^\gamma\right)\left(\pi(\mu) - x_A\right) \quad \text{(E39)}$$

where α_A and α_L are both equal to one, d_L and d_A are equal to zero, and $g(u_A) \equiv (\pi(\mu) - x_A)$. Since the utility of player B is equal to B's payoff after player A obtains A's payoff, we know that $U_B = \pi - x_A$ (presented as $(\pi(\mu) - x_A)$ in (E39)). In equation (E39), both players have equal bargaining powers, the artist is risk averse and the label is risk neutral. Maximizing (E39) with respect to x_A results in the following first order condition

$$\frac{\partial N}{\partial x_A} = \frac{\gamma x_A^\gamma}{x_A} \cdot \pi(\mu) - \gamma x_A^\gamma - x_A^\gamma = 0 \quad \text{(E40)}$$

Solving (E40) for x_A gives the artist's optimal money payoff. This derivation is as follows.

$$\frac{\gamma x_A^\gamma}{x_A} \cdot \pi(\mu) - \gamma x_A^\gamma - x_A^\gamma = 0$$

$$\frac{\gamma x_A^\gamma}{x_A} \cdot \pi(\mu) - x_A^\gamma(\gamma + 1) = 0$$

$$x_A^\gamma(\gamma + 1) = \frac{\gamma x_A^\gamma \pi(\mu)}{x_A}$$

$$x_A^{\gamma+1} = x_A^\gamma \cdot \frac{\gamma \pi(\mu)}{(\gamma + 1)}$$

$$x_A^* = \frac{\gamma \pi(\mu)}{\gamma + 1}$$

Since it is a special case of the asymmetric Nash bargaining framework presented in the beginning of section 5.4, the expression for the symmetric optimal *money payoff*, $x_A^* = \frac{\gamma \pi(\mu)}{\gamma + 1}$, is not presented in the main body of the text. Nonetheless, it is clear that substituting the definition of x_A into the left hand side of the optimal payoff, where $x_A = \mu\pi(\mu)$, and dividing both sides by $\pi(\mu)$ results in the optimal share presented in the text as equation (53) ($\mu^* = \frac{\gamma}{\gamma + 1}$). The comparative statics for the optimal payoffs in the symmetric case are as follows.

[4] Equation (A39) is presented as equation (52) in section 5.4.

$$\frac{\partial x_A^*}{\partial \pi(\mu)} = \frac{\gamma}{(\gamma+1)} > 0 \qquad \text{(E41)}$$

$$\frac{\partial x_A^*}{\partial \gamma} = \frac{\pi(\mu)}{(\gamma+1)^2} > 0 \qquad \text{(E42)}$$

$$\frac{\partial x_A^*}{\partial q} = \frac{\gamma}{(\gamma+1)^2} \cdot \frac{\partial \pi(\mu)}{\partial q} > 0 \qquad \text{(E43)}$$

$$\frac{\partial x_A^*}{\partial t} = \frac{\gamma}{(\gamma+1)^2} \cdot \frac{\partial \pi(\mu)}{\partial t} > 0 \qquad \text{(E44)}$$

$$\frac{\partial x_A^*}{\partial c} = \frac{\gamma}{(\gamma+1)^2} \cdot \frac{\partial \pi(\mu)}{\partial c} < 0 \qquad \text{(E45)}$$

$$\frac{\partial x_A^*}{\partial F} = \frac{\gamma}{(\gamma+1)^2} \cdot \frac{\partial \pi(\mu)}{\partial F} < 0 \qquad \text{(E46)}$$

$$\frac{\partial x_L^*}{\partial \pi(\mu)} = \frac{1}{\gamma+1} > 0 \qquad \text{(E47)}$$

$$\frac{\partial x_L^*}{\partial \gamma} = \frac{-\pi(\mu)}{(\gamma+1)^2} < 0 \qquad \text{(E48)}$$

$$\frac{\partial x_L^*}{\partial q} = \frac{1}{\gamma+1} \cdot \frac{\partial \pi(\mu)}{\partial q} > 0 \qquad \text{(E49)}$$

$$\frac{\partial x_L^*}{\partial t} = \frac{1}{\gamma+1} \cdot \frac{\partial \pi(\mu)}{\partial t} > 0 \qquad \text{(E50)}$$

$$\frac{\partial x_L^*}{\partial c} = \frac{1}{\gamma+1} \cdot \frac{\partial \pi(\mu)}{\partial c} < 0 \qquad \text{(E51)}$$

$$\frac{\partial x_L^*}{\partial F} = \frac{1}{\gamma+1} \cdot \frac{\partial \pi(\mu)}{\partial F} < 0 \qquad \text{(E52)}$$

With the exception of those on the γ parameter, all of the above comparative statics are signed using the partial derivatives of the profit function as shown in first section of this appendix. Equations (E41) and (E47) show that both the artist's and label's optimal money payoffs are positively related to the profit from album sales, and that the artist and label would split the profit equally if γ equals one. In other words, as γ increases (the artist becomes less risk averse), the artist's and label's optimal payoffs approach each other.

Equations (E42) and (E48) show that the artist's and label's optimal money payoffs are positively and negatively related, respectively, to the γ parameter. For instance, as the artist becomes less risk averse (γ increases), the artist's optimal payoff rises and the label's falls. From the remainder of these comparative statics, we see that all are signed identically for both the artist and the label.

Both the artist's and label's optimal money payoffs are positively related to the quality difference in CDs and copies, q, as well as the transaction costs of copying, t. Additionally, both the artist's and label's optimal money payoffs are negatively related to marginal and fixed costs, c and F, respectively. These likenesses seem to make sense in that any variable that increases

(decreases) profit would increase (decrease) the total amount of money to be split. For example, as marginal costs go down, the overall profit would tend to rise, increasing the level of the profits to be split.

2.3 Risk Averse Artist, Symmetric Bargaining and a Nonzero d_A

This section of the appendix corresponds to section 5.6 of the main body of the text. To examine the relationship between the artist's optimal payoff and disagreement point, we implemented the following symmetric Nash product,[5]

$$N = \left(x_A^{\gamma} - d_A\right)^{\alpha_A} \left((\pi(\mu) - x_A) - d_L\right)^{\alpha_L} = \left(x_A^{\gamma} - d_A\right)\left(\pi(\mu) - x_A\right) \qquad \text{(E53)}$$

where α_A and α_L are both equal to one, d_L is equal to zero, d_A is nonzero, and $g(u_A) \equiv (\pi(\mu) - x_A)$. Maximizing (E53) with respect to the artist's optimal payoff, x_A, resulted in the following first order condition.

$$\frac{\partial N}{\partial x_A} = \gamma x_A^{\gamma-1}(\pi(\mu) - x_A) - x_A^{\gamma} + d_A \equiv \gamma x_A^{\gamma-1}\pi(\mu) - \gamma x_A^{\gamma} - x_A^{\gamma} + d_A = 0 \qquad (62)$$

Due to the difficulty in finding a closed form solution for the first order condition, the implicit function theorem was then used to examine the relationship between the artist's optimal payoff and disagreement point (a closed form solution for x_A can only be obtained from (62) when γ is equal to one). Using the implicit function theorem, we demonstrated that the artist's optimal payoff, x_A, was positively related to d_A, the artist's disagreement point. This result was presented as the following expression,

$$\frac{\partial x_A}{\partial d_A} = -\frac{F_{d_A}}{F_{x_A}} = -\frac{1}{\gamma x_A^{\gamma-2}\pi(\mu)(\gamma-1) - \gamma x_A^{\gamma-1}(\gamma+1)} > 0 \qquad (63)$$

where, since F_{x_A} is less than zero, $\frac{\partial x_A}{\partial d_A}$ must be greater than zero. The derivation of F_{x_A}, the partial derivative of (62) with respect to the artist's optimal payoff, is as follows,

$$\begin{aligned} F_{x_A} &= (\gamma-1)\gamma x_A^{\gamma-2}\pi(\mu) - \gamma^2 x_A^{\gamma-1} - \gamma x_A^{\gamma-1} \\ &= (\gamma^2-\gamma)x_A^{\gamma-2}\pi(\mu) - \gamma^2 x_A^{\gamma-1} - \gamma x_A^{\gamma-1} \\ &= \gamma^2 x_A^{\gamma-2}\pi(\mu) - \gamma x_A^{\gamma-2}\pi(\mu) - \gamma^2 x_A^{\gamma-1} - \gamma x_A^{\gamma-1} \\ &= \gamma x_A^{\gamma-2}\pi(\mu)(\gamma-1) - \gamma x_A^{\gamma-1}(\gamma+1) \end{aligned}$$

whereby F_{x_A} is negative since, as is clearly seen in the second to last line of the derivation, the first term is less than the second term, and all other terms are negative.

[5] Equation (A53) is presented as equation (61) in section 5.6.

Part 3: Derivations of Comparative Statics

This section of the appendix explains the derivations of the comparative statics presented in sections 5.4 and 5.5 in the main body of the text. In section 5.4, we presented the following expressions for the artist's optimal share of album sales, μ*, and its corresponding comparative statics.

$$\mu^* = \frac{\alpha\gamma}{1-\alpha(1-\gamma)} \tag{49}$$

$$\frac{\partial\mu^*}{\partial\alpha} = \frac{\gamma}{(1-\alpha(1-\gamma))^2} > 0 \tag{50}$$

$$\frac{\partial\mu^*}{\partial\gamma} = \frac{\alpha(1-\alpha)}{(1-\alpha(1-\gamma))^2} > 0 \tag{51}$$

The derivation for comparative static (50) is as follows,

$$\frac{\partial\mu^*}{\partial\alpha} = \frac{\gamma(1-\alpha(1-\gamma)) - \alpha\gamma(\gamma-1)}{(1-\alpha(1-\gamma))^2}$$

$$= \frac{\alpha\gamma^2 - \alpha\gamma + \gamma - \alpha\gamma^2 + \alpha\gamma}{(1-\alpha(1-\gamma))^2}$$

$$= \frac{\gamma}{(1-\alpha(1-\gamma))^2}$$

and the derivation for comparative static (51) is as follows,

$$\frac{\partial\mu^*}{\partial\gamma} = \frac{\alpha(1-\alpha(1-\gamma)) - \alpha\gamma(\alpha)}{(1-\alpha(1-\gamma))^2}$$

$$= \frac{\alpha - \alpha^2 + \alpha^2\gamma - \alpha^2\gamma}{(1-\alpha(1-\gamma))^2}$$

$$= \frac{\alpha(1-\alpha)}{(1-\alpha(1-\gamma))^2}$$

whereby both numerators are positive since α and γ are between zero and one. Since the denominators, identical for both (50) and (51), are also positive, both comparative statics are positive.

In section 5.5, we presented the optimal price and consumer demand functions as well as their corresponding comparative statics after substituting the endogenous optimal share solution (49) into the optimal price solution (24) derived in chapter four, where the artist's share was exogenous. In chapter four, the optimal price expression with an exogenous artist's share was presented as follows.[6]

$$p^* = \frac{1}{3}\left[q + t + \frac{2c}{1-\mu_A}\right] \tag{24}$$

[6] Two optimal price solutions were presented in Chapter 4, but only (24) includes the artist's share.

In chapter five, the following expressions for the optimal price, with an endogenous artist's share, and its corresponding comparative statics were presented in the main body of the text.

$$p^* = \frac{1}{3}\left[q + t + 2c\left[\frac{1-\alpha(1-\gamma)}{1-\alpha}\right]\right] \tag{55}$$

$$\frac{\partial p^*}{\partial \alpha} = \frac{2c}{3}\left[\frac{\frac{\partial \mu^*}{\partial \alpha}}{(1-\mu^*)^2}\right] \equiv \frac{2c}{3}\frac{\gamma}{(1-\alpha)^2} > 0 \tag{56}$$

$$\frac{\partial p^*}{\partial \gamma} = \frac{2c}{3}\left[\frac{\frac{\partial \mu^*}{\partial \gamma}}{(1-\mu^*)^2}\right] \equiv \frac{2c}{3}\frac{\alpha}{(1-\alpha)} > 0 \tag{57}$$

The derivation of the new optimal price expression (55), with an endogenous artist's share, is as follows.

$$p^* = \frac{1}{3}\left[q + t + 2c\left[\frac{1}{1-\left(\frac{\alpha\gamma}{1-\alpha(1-\gamma)}\right)}\right]\right]$$

$$= \frac{1}{3}\left[q + t + 2c\left[\frac{1}{\frac{1-\alpha+\alpha\gamma-\alpha\gamma}{1-\alpha+\alpha\gamma}}\right]\right]$$

$$= \frac{1}{3}\left[q + t + 2c\left[\frac{1}{\frac{1-\alpha}{1-\alpha(1-\gamma)}}\right]\right]$$

$$= \frac{1}{3}\left[q + t + 2c\left[\frac{1-\alpha(1-\gamma)}{1-\alpha}\right]\right]$$

The derivation of the comparative statics ((56) and (57)) for the newly derived optimal price make use of the comparative statics for the optimal artist share, expressions (50) and (51). The derivation for (56) is as follows,

$$\frac{\partial p^*}{\partial \alpha} = \frac{2c}{3}\left[\frac{\frac{\partial \mu^*}{\partial \alpha}}{(1-\mu^*)^2}\right] \equiv \frac{2c}{3}\frac{\frac{\gamma}{(1-\alpha(1-\alpha)^2)}}{\left(1-\frac{\alpha\gamma}{1-\alpha(1-\gamma)}\right)^2}$$

$$= \frac{2c}{3} \frac{\dfrac{\gamma}{(1-\alpha(1-\alpha)^2)}}{\left(\dfrac{1-\alpha(1-\gamma)-\alpha\gamma}{1-\alpha(1-\gamma)}\right)^2}$$

$$= \frac{2c}{3} \frac{\gamma}{(1-\alpha(1-\alpha)-\alpha\gamma)^2}$$

$$= \frac{2c}{3} \frac{\gamma}{(1-\alpha)^2}$$

and the derivation for (57) is as follows,

$$\frac{\partial p^*}{\partial \gamma} = \frac{2c}{3}\left[\frac{\dfrac{\partial \mu^*}{\partial \gamma}}{(1-\mu^*)^2}\right] \equiv \frac{2c}{3} \frac{\dfrac{\alpha(1-\alpha)}{(1-\alpha(1-\alpha)^2)}}{\left(1-\dfrac{\alpha\gamma}{1-\alpha(1-\gamma)}\right)^2}$$

$$= \frac{2c}{3} \frac{\dfrac{\alpha(1-\alpha)}{(1-\alpha(1-\alpha)^2)}}{\left(\dfrac{1-\alpha(1-\gamma)-\alpha\gamma}{1-\alpha(1-\gamma)}\right)^2}$$

$$= \frac{2c}{3} \frac{\alpha(1-\alpha)}{(1-\alpha(1-\alpha)-\alpha\gamma)^2}$$

$$= \frac{2c}{3} \frac{\alpha(1-\alpha)}{(1-\alpha)^2}$$

$$= \frac{2c}{3} \frac{\alpha}{(1-\alpha)}$$

whereby both expressions (56) and (57) are clearly positive.

Taking account of the endogenous artist's share, the following expressions for the optimal consumer demand function and its corresponding comparative statics were presented in the main body of the text.

$$y^{CD} \equiv \frac{1}{2qt}\left(\frac{2}{3}\left[q+t-c\left(\frac{1-\alpha(1-\gamma)}{1-\alpha}\right)\right]\right)^2 \tag{58}$$

$$\frac{\partial y^{CD}}{\partial \alpha} = \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{\partial p^*}{\partial \alpha}\right) \equiv \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{2c}{3}\frac{\gamma}{(1-\alpha)^2}\right) \leq 0 \tag{59}$$

$$\frac{\partial y^{CD}}{\partial \gamma} = \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{\partial p^*}{\partial \gamma}\right) \equiv \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{2c}{3}\frac{\alpha}{(1-\alpha)}\right) \leq 0 \tag{60}$$

To derive the new expression for the optimal consumer demand for CDs (58), we substituted the newly derived optimal price expression (55) into the demand function presented

as equation (8) in chapter four, $y^{CD} \equiv \frac{1}{2qt}(q - p + t)^2$, where the optimal price was taken as exogenous. Making this substitution, the derivation of the new optimal demand expression (58) is as follows.

$$y^{CD} \equiv \frac{1}{2qt}\left(q - \left[\frac{1}{3}\left[q + t + 2c\left[\frac{1-\alpha(1-\gamma)}{1-\alpha} \right]\right]\right] + t \right)^2$$

$$= \frac{1}{2qt}\left(q - \left[\frac{1}{3}q + \frac{1}{3}t + \frac{2c}{3}\left[\frac{1-\alpha(1-\gamma)}{1-\alpha} \right]\right] + t \right)^2$$

$$= \frac{1}{2qt}\left(\frac{2}{3}q + \frac{2}{3}t - \frac{2c}{3}\left[\frac{1-\alpha(1-\gamma)}{1-\alpha} \right]\right)^2$$

$$= \frac{1}{2qt}\left(\frac{2}{3}\left[q + t - c\left(\frac{1-\alpha(1-\gamma)}{1-\alpha} \right)\right]\right)^2$$

Next, making use of the previously derived comparative static expressions (56) and (57), we present the derivations for the consumer demand comparative statics (59) and (60). For ease of exposition, we present the demand expression (58) as follows,

$$y^{CD} \equiv \frac{1}{2qt}\left(q - p^* + t\right)^2 \qquad \text{(E54)}$$

where $p^* = \frac{1}{3}\left[q + t + 2c\left[\frac{1-\alpha(1-\gamma)}{1-\alpha} \right]\right]$. Using expression (E54), the comparative static (59) is derived as follows,

$$\frac{\partial y^{CD}}{\partial \alpha} = \frac{2}{2qt}\left(q - p^* + t\right)\left(-\frac{\partial p^*}{\partial \alpha} \right)$$

$$= \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{\partial p^*}{\partial \alpha} \right)$$

$$\equiv \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{2c}{3}\frac{\gamma}{(1-\alpha)^2} \right) \leq 0$$

and the comparative static (60) is derived as follows.

$$\frac{\partial y^{CD}}{\partial \gamma} = \frac{2}{2qt}\left(q - p^* + t\right)\left(-\frac{\partial p^*}{\partial \gamma} \right)$$

$$= \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{\partial p^*}{\partial \gamma} \right)$$

$$\equiv \frac{1}{qt}\left(p^* - t - q\right)\left(\frac{2c}{3}\frac{\alpha}{(1-\alpha)}\right) \leq 0$$

Since both $\frac{\partial p^*}{\partial \alpha}$ and $\frac{\partial p^*}{\partial \gamma}$ are positive, and since it is assumed that $p - t \leq q$ (see chapter four), both comparative statics (59) and (60) are less than or equal to zero.

Part 4: Derivations of Variable Profit Expressions

In section 5.7 of the main body of the text, we examined the effect that bargaining over a variable profit has on the artist's optimal share. This section of the appendix derives the expressions presented in section 5.7. To begin, we reformulated the Nash product (46) in terms of the profit shares as follows,

$$\max_{(\mu)} \left((\mu\pi(\mu))^{\gamma}\right)^{\alpha} \left((1-\mu)\pi(\mu)\right)^{1-\alpha} \tag{64}$$

where $\gamma < 1$, α_A and α_L sum to one (i.e., $\alpha_L = 1- \alpha_A$), d_L and d_A are equal to zero, the "A" subscript for the artist's bargaining power, α_A, is dropped for ease of exposition, and where the expression for profit as a function of the artist's share, $\pi(\mu)$, is as derived in equation (36).[7] Taking the log of (64) resulted in the following expression for the Nash product,

$$\max_{(\mu)} \quad \alpha\gamma \log\mu + \alpha\gamma \log\pi(\mu) + (1-\alpha)\log(1-\mu) + (1-\alpha)\log\pi(\mu) \tag{65}$$

which was then maximized to obtain the following first order condition,

$$\frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} - (1-\alpha(1-\gamma))\frac{2z}{k} = 0 \tag{67}$$

where $k = z(1-\mu) - c$, $z = \frac{1}{3}\left(q + t + \frac{2c}{1-\mu}\right)$ and, for simplicity, the label's fixed cost is equal to zero.

To derive the first order condition (67), we first show that the ratio $\frac{\pi'(\mu)}{\pi(\mu)}$ is equal to $\frac{-z}{k}$ (when the label's fixed cost is equal to zero). As shown in part one of this appendix, we have the following expressions for the numerator and denominator of $\frac{\pi'(\mu)}{\pi(\mu)}$.

$$\pi(\mu) = \left(\frac{2k^3}{qt(1-\mu)^2}\right) - F$$

[7] For simplicity, we have also dropped the "A" subscript from the artist's share, denoting profit as $\pi(\mu)$.

$$\frac{\partial \pi(\mu)}{\partial \mu} = \frac{-2k^2 z}{qt(1-\mu)^2}$$

Therefore, when the label's fixed cost, *F*, is equal to zero, the ratio of $\frac{\pi'(\mu)}{\pi(\mu)}$ can be expressed as follows.

$$\frac{-2k^2 z}{qt(1-\mu)^2}\frac{qt(1-\mu)^2}{2k^3} \equiv \frac{-z}{k}$$

We can now complete the derivation of the first order condition (67). Maximizing (65) with respect to μ and using the above result for the ratio $\frac{\pi'(\mu)}{\pi(\mu)}$, we obtain the following set of expressions.

$$\begin{aligned}
&\frac{\alpha\gamma}{\mu} + \frac{\alpha\gamma\pi'(\mu)}{\pi(\mu)} - \frac{1-\alpha}{(1-\mu)} + \frac{(1-\alpha)\pi'(\mu)}{\pi(\mu)} \\
&= \frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} + \frac{\alpha\gamma + (1-\alpha)2\pi'(\mu)}{\pi(\mu)} \\
&= \frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} + (1-\alpha(1-\gamma))\frac{2z}{k}
\end{aligned}$$

Next, in section 5.7 of the main body of the text, we defined the following two functions,

$$g(\mu) = \frac{\alpha\gamma}{\mu} - \frac{1-\alpha}{(1-\mu)} \tag{68}$$

$$f(\mu) = 2\left[\frac{z}{z(1-\mu)-c}\right] \tag{69}$$

where $g(\mu)$ and $f(\mu)$ are identically equal to the first two terms and the last term (without the multiplier) of the first order condition (67), respectively. Expression (69) was also restated as follows,

$$f(\mu) = 2\left[\frac{z}{z(1-\mu)-c}\right] \equiv \frac{2mx+4c}{x(mx-c)} \tag{72}$$

where, for simplicity, $x = (1\text{-}\mu)$, and $m = q + t$. We note that $z = \frac{1}{3}\left(q + t + \frac{2c}{1-\mu}\right)$, and we derive (72) as follows.

$$f(\mu) = 2\left[\frac{z}{z(1-\mu)-c}\right]$$

$$= 2\left[\frac{\frac{mx+2c}{3x}}{\left(\frac{mx+2c}{3x}\right)x - c}\right]$$

$$= 2\left[\frac{\frac{mx+2c}{3x}}{\frac{mx-c}{3}}\right]$$

$$= \left[\frac{2mx+4c}{x(mx-c)}\right]$$

Using expression (72) simplifies the task of deriving the partial derivative of (69). The partial derivative of (69) with respect to (1-μ) was presented as the following expression in the main body of the text,

$$f'(\mu) = -2\frac{mx(mx+4c)-2c^2}{[x(mx-c)]^2} \leq 0 \tag{70}$$

where, for simplicity, x = (1-μ), and $m = q + t$. The derivation of (70) is as follows.

$$f'(\mu) = \frac{2m[mx^2 - cx] - ([2mx+4c][2mx-c])}{[x(mx-c)]^2}$$

$$= \frac{2m^2x^2 - 2cmx - 4m^2x^2 + 2cmx - 8cmx + 4c^2}{[x(mx-c)]^2}$$

$$= \frac{-2m^2x^2 - 8cmx + 4c^2}{[x(mx-c)]^2}$$

$$= -2\frac{m^2x^2 + 4cmx - 2c^2}{[x(mx-c)]^2}$$

$$= -2\frac{mx(mx+4c) - 2c^2}{[x(mx-c)]^2}$$

As long as the parameter for the label's marginal costs, c, is quite low, the numerator is positive. Given that the label's marginal costs have been very low for some time, we assume that the numerator is positive and, consequently, that expression (70) is decreasing in (1- μ) and increasing in μ.

In section 5.7 of the main body of the text, we also presented the following partial derivatives of (72).

$$\frac{\partial f(\mu)}{\partial m} \equiv -\frac{6cx^2}{(x[mx-c])^2} < 0 \tag{73}$$

$$\frac{\partial f(\mu)}{\partial c} \equiv \frac{6mx^2}{(x[mx-c])^2} > 0 \tag{74}$$

The derivation of (73) is as follows,

$$\frac{\partial f(\mu)}{\partial m} = \frac{2x[mx^2 - cx] - \left([2mx+4c]x^2\right)}{[x(mx-c)]^2}$$

$$= \frac{2mx^3 - 2cx^2 - 2mx^3 - 4cx^2}{[x(mx-c)]^2}$$

$$= -\frac{6cx^2}{(x[mx-c])^2}$$

and the derivation of (74) is as follows.

$$\frac{\partial f(\mu)}{\partial c} = \frac{4[mx^2 - cx] - \left([2mx+4c](-x)\right)}{[x(mx-c)]^2}$$

$$= \frac{4mx^2 - 4cx + 2mx^2 + 4cx}{[x(mx-c)]^2}$$

$$= \frac{6mx^2}{(x[mx-c])^2}$$

Appendix F, An Empirical Examination of Artists' Income

Part 1, Introduction

To study artists' income, we use tax return data from all Schedule C filers who indicated they were artists by use of the specified principal business code on their Schedule C. The summary statistics on these data are taken from a confidential data set from the U.S. Treasury's Statistics on Income (SOI) division. From 1998 to the present, the IRS has required filers to use the 6 digit North American Industry Classification System (NAICS) code 711510, which is assigned to the following occupations: *Independent Artists, Writers and Performers*. Since the key year in this time period is 1999, when Napster was launched, we have a consistent business code for "artists" before and after file-sharing services were launched. Unfortunately, there is no way to disaggregate the tax return data into any subcategories. For example, it is not possible to partition the sample into only "musical artists" and "writers."

Nonetheless, from 1998 to 2001, there are only three occupational categories in the sample, all of which could be at least indirectly affected by file sharing. If, for example, file sharing has caused a significant number of consumers to exit the market for CDs, movies and books, we would expect to see decreases in artists' income. Of course, using the SOI data to make robust conclusions about the effects of music file-sharing on CD sales does not seem sensible.

Part 2, Methodology for SOI data

The methodology used to study the SOI data is rather straightforward and simplistic. Since we do not have permanent access to the micro data, and since we cannot disaggregate the types of artists in the sample, we examine trends in the summary statistics (mean, median and quartiles) and whether these trends have any implications for artists' income in relation to industry sales aggregates. We adjust nominal income data to 2001 dollars using three measures of inflation: the CPI for all items less food and energy, the GDP deflator, and the CPI for recreation items. To examine artists' income, we obtained a sample representative of all Schedule C filers with the business code 711510, and we examined the following income fields.

- Schedule C Gross Receipts or Sales
- Schedule E Royalties
- Adjusted Gross Income

Royalties for album sales would be most likely to show up in the Schedule C field "Gross Receipts or Sales." Provided the tax forms are filled out properly, royalty income from other sources (e.g., radio and television) should show up on the Schedule E. To control for economy wide effects, we examined Schedule C receipts, Schedule E royalties and Adjusted Gross Income (AGI) for *all Schedule C filers*, and AGI for *all tax filers*. The summary statistics for the artist and control samples are presented in both nominal and 2001 dollars on Tables F-1 and F-2.

Part 3, Aggregate Artists' Income

As panel A of Table F-1 shows, the nominal aggregate amount of artists' Schedule C receipts increased from \$9.8 billion in 1998 to \$10.3 billion in 1999, to \$11.5 billion in 2000, and then decreased to \$11.3 billion in 2001. As panels B through D of Table F-1 show, adjusting these totals to 2001 dollars (using either of the three measures of inflation) does not change the underlying trends.

Panel A of Table F-3 shows that these aggregate Schedule C receipts total about half of the combined aggregate sales totals for the music and movie industries. For instance, in 2001, total Schedule C receipts for artists were $11.3 billion, while total retail sales in the music industry totaled $12.4 billion, and total box office receipts were $8.4 billion in the movie industry. Since artists in the music industry only receive about 10 to 20 percent of total album sales (less than $3 billion in 2001), it appears that the SOI data set is "noisy" in that in includes a great deal of income from sources other than those that we are most interested in. Again, using the SOI data to make robust conclusions about the effects of music file-sharing on CD sales does not seem prudent.

Instead, we use the SOI data to make broad comparisons of the direction of income for "artists," as defined by NAICS 711510, relative to the direction of income for tax-filers in other occupations. We also compare the SOI data to movements in aggregate sales in the music and movie industries, keeping in mind that the SOI data include income from other types of artists (such as writers).

3.1 Schedule C Receipts

Tables F-1 and F-2 demonstrate that Schedule C receipts for both artists and all tax-filers are highly skewed, with mean receipts being larger than even the third quartile for both samples. Panels A through D of Table F-1 show that the trends in artists' Schedule C receipts are basically the same from 1998 through 2001 in both nominal and 2001 dollars (for all three measures of inflation). For instance, in nominal and 2001 dollars, artists' median and third quartile receipts decreased from 1998 to 1999, increased from 1999 to 2000 and increased from 2000 to 2001. In 1999 and 2000, artists' nominal and real *mean* Schedule C receipts follow these same trends.

However, using the CPI for all items less food and energy, and the GDP deflator, artists' annual real mean Schedule C receipts decreased from 2000 to 2001, whereas measured in either nominal or 2001 dollars using the recreation CPI, the mean increased (just as the median and third quartile). These data show that most artists in the sample realized a decrease in Schedule C receipts from 1998 to 1999, and an increase in both 2000 and 2001 (in both nominal and real terms).

Panels A through D of Table F-2 show that, using nominal and 2001 dollars (with all three measures of inflation), median Schedule C receipts for *all Schedule C filers* increased from 1998 to 1999 and from 1999 to 2000, and then decreased in 2001. These trends are in the opposite direction of artists' median Schedule C receipts from 1998 to 1999 as well as from 2000 to 2001. However, the change in the median receipts for both groups (an increase) is the same for 1999 to 2000.

The trends in the third quartiles for artists and all Schedule C filers match from 1998 to 1999 (a decrease) and from 1999 to 2000 (an increase), but are in the opposite direction from each other in 2001. At the mean, the trends for the two groups is less clear. From 1998 to 1999, all Schedule C filers' mean receipts increased, while artists' mean receipts decreased. Then, from 1999 to 2000, both groups' mean receipts increased. These trends from 1998 through 2000 hold for both nominal and 2001 dollars, using each of the measures of inflation.

From 2000 to 2001, however, the differences in the trend of the mean receipts for these two groups is sensitive to the measure of inflation used to adjust to 2001 dollars. For instance, in

both nominal dollars and when the CPI for recreation items is used, mean receipts increased for artists and decreased for all Schedule C filers. Alternatively, when either the CPI for all items less food and energy or the GDP deflator is used, real mean receipts decreased for both groups from 2000 to 2001.

At both the mean and the third quartile, real and nominal income for artists and all Schedule C filers moved together in two of the three years (1999 and 2000 for the third quartile and 2000 and 2001 for the mean). At the median, real and nominal income for artists and all Schedule C filers moved together in 2000, but not in 1999 or 2001. Overall, there does not appear to be any consistent relationship (through the four year period) between artists' Schedule C receipts and the receipts of all Schedule C filers.

3.2 Schedule E Royalties

Panels A through D of Tables F-1 and F-2 show that Schedule E royalties, for both artists and all Schedule C filers, are even more highly skewed than Schedule C receipts. For both the artist and control samples, the first, second and third quartiles are zero for the entire four year period. Nonetheless, mean Schedule E royalties for artists and all filers, using both nominal and 2001 dollars (with each measure of inflation), show the opposite trend in 1999, but the same trend in both 2000 and 2001.

From 1998 to 1999, all filers' mean Schedule E royalties increased while artists' decreased. From 1999 to 2000, mean Schedule E royalties for both artists and all filers decreased, and, from 2000 to 2001, mean Schedule E royalties for both artists and all filers increased. These data show that, for this type of income, the artists in our sample realized a change in income that was experienced by all Schedule C filers in 2000 and 2001, but not in 1999. Given the highly skewed nature of the Schedule E royalties, and that this type of income probably does not include artists' album sales, the Schedule E data do not appear very useful for our purposes.

3.3 Adjusted Gross Income

Panels A through D of Table F-1 demonstrate that artists' adjusted gross income (AGI) is also highly skewed, with the mean AGI near or higher than the third quartile in every year. Panels A through D of Table F-2 show that AGI for all Schedule C filers and for all tax filers is also skewed, though not as highly skewed as artists' AGI.

For the entire four-year period, artists' median AGI and all Schedule C filers' median AGI move in the same direction.[8] Both groups' median AGI also moves in the same direction as median AGI for *all tax-filers* from 1998 to 1999 and from 1999 to 2000, but in the opposite direction from 2000 to 2001 (the median AGI for all tax filers rose consecutively each year from 1998 to 2001). These trends hold when using both nominal and 2001 dollars, for each measure of inflation used.

Since there was no definitional change to AGI in 2001, these data demonstrate that business owners' (including artists) AGI moved in a different direction from that of non-business owners from 2000 to 2001, but in the same direction in the years prior to 2001. These data seem to support the idea that business owners' income can be affected by factors which do not affect

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[8] Artists' and all Schedule C filers' AGI at the mean and first quartile also move in the same direction, as well as at the third quartile for all years except 1999.

non-business owners' income. Also, given that AGI includes nearly all types of income, and that artists' Schedule C receipts do not seem to move with the Schedule C receipts of all filers, the similar trends in their AGI data suggest that artists in this sample have a significant amount of income from other sources.

Part 4, Industry Sales Data

Panels A through D of Table F-3 show that, depending on the measure of "industry sales revenue," as well as on the measure of inflation, different conclusions can be drawn from the aggregate sales data. For instance, when music industry sales are measured by total retail units, sales increased from 1998 to 1999, then decreased sequentially in 2000 and 2001. These trends hold when total retail sales are in 2001 dollars (for all three measures of inflation). When only CD sales are examined, however, we see increases for the first two years followed by a decrease from 2000 to 2001. These trends also hold when CD sales are in 2001 dollars (for all three measures of inflation).

Given that the SOI artist income data measures the income of "Independent Artists, Writers and Performers," however, it is more appropriate to compare the SOI data to a broader measure of "industry sales." To construct these broader measures, we combine RIAA sales data with "box office receipts" published by the Motion Picture Association of America (MPAA).[9] We construct the following two measures of aggregate industry sales: (1) CD and box office sales; and (2) total retail units and box office sales. For comparing industry sales data to the SOI artist income data, the second measure would be the best since it includes sales from a larger variety of entertainment industry goods. For completeness, we compare the SOI data to both aggregates.

Table F-3 shows that the first aggregate measure, CD and box office sales, increased each year from 1998 through 2001 in nominal dollars as well as in 2001 dollars if the recreation CPI is used. However, when either the CPI for all items less food and energy or the GDP deflator is used to adjust to 2001 dollars, real sales revenue for this category increased sequentially in 1999 and 2000, and then decreased in 2001.

The table also shows that the broader aggregate measure, in both nominal and real dollars, increased from 1998 to 1999, and then decreased from 1999 to 2000. However, for the broader aggregate, the direction of total sales revenue in 2001 is sensitive to the measure of inflation used. In nominal dollars, and when the recreation CPI is used, the total sales figure for the broader aggregate increased in 2001. Alternatively, when either the CPI for all items less food and energy or the GDP deflator is used, the total sales figure decreased in 2001. In the next sub-section, we compare the changes in these aggregates to the SOI data.

Part 5, Comparisons of Industry Sales Data and SOI Artist Income Data

Unless other types of artists income dominate the SOI sample, we should expect to see similar movements in artists' income and in the broadest of our sales aggregates, total retail units and box office sales. Depending on the relative importance of each type of artist income, we may also expect to see similar trends in the alternative aggregate, where box office sales are combined

[9] The RIAA data can be found at www.riaa.org, and the MPAA data can be found at www.mpaa.org.

with CD sales.[10] Table F-3 shows two matrices detailing when the trends in artists' median Schedule C receipts match those in the aggregate industry sales data.[11]

Panel A shows that the trends in the broader aggregate (total retail unit and box office sales) and in artists' median Schedule C income only match in two instances. When examined in nominal dollars or in 2001 dollars adjusted with the recreation CPI, the trends in artists' median income and industry sales match from 2000 to 2001. In each of the other ten possibilities, the trends do not match.

Panel B shows that the trends in the narrower aggregate (CD and box office sales) and in artists' median Schedule C income match in six out of twelve instances. For the period 1998 to 1999, none of the trends match, while from 1999 to 2000, all of the trends match (the aggregate and artists' median income both increased from 1999 to 2000 whether measured in nominal or 2001 dollars).

From 2000 to 2001, however, the trend matched only when the aggregate and median income are measured in nominal dollars or the recreation CPI (both the aggregate and income increased from 2000 to 2001 using these measures of inflation). However, when either the CPI for all items less food and energy or the GDP deflator is used to measure the aggregate and median income, the aggregate decreased from 2000 to 2001 while artists' median income increased.

Focusing on the broader aggregate (panel A of Table F-3), we see that, using either nominal or any of the three measures of real dollars, the trend in the aggregate and in artists' median income moved in the opposite direction for both 1999 and 2000. In 2001, using either nominal or 2001 dollars as measured with the CPI for recreation items, the aggregate and artists' median income moved together (they both decreased). However, using either the CPI for all items less food and energy or the GDP deflator, the trends moved in the opposite direction in 2001 (the aggregate decreased while artists' median income increased).

Table F-1 also shows that, using both nominal and 2001 dollars, similar patterns emerged between artists' median income and the aggregate income in the SOI sample. For instance, in 1999, artists' income at the mean, median and third quartile fell while the aggregate income increased (and the sample size increased). In 2001, aggregate Schedule C receipts decreased (and the sample size decreased) while artists' income at the mean, median and third quartile increased. In 2000, however, this pattern did not hold; the aggregate income (and sample size), income at the mean, median and third quartile all increased. Although these patterns do not directly provide any evidence for an effect on artists' income from file sharing, they do provide a framework for interpreting industry aggregate sales data.

These findings demonstrate that artists' income data is highly skewed and, therefore, that both aggregate income and aggregate industry sales data can be significantly impacted by the "few" artists at the top of the income scale. It appears that a significant drop in the industry's aggregate sales data, for example, could be largely attributed to a decline in sales from the "biggest" few artists. In other words, low valuation consumers could enter the market for CDs to purchase the "biggest" artists' music, but then remain out of the market for other artists' CDs. If this type of buying activity takes place in the presence of popular music trends, it could lead to

[10] Given that CD sales are a significant percentage of the music industry's total retail unit sales, this idea does not seem completely unreasonable.
[11] The trend in median artists' Schedule C receipts also matches the trend at the third quartile.

significant swings in the industry's aggregate sales through time.[12] Unfortunately, we do not have the type of sales data that would allow us to directly test this hypothesis. Nonetheless, it is possible that declines in aggregate sales data could be explained by such phenomena, whereby the end of a fad, for example, contributes to a decline in sales because only high valuation consumers remain in the market for CDs.

[12] For instance, if low valuation consumers were brought into the market to buy CDs based on the 1990's "grunge" fad, the large increases in aggregate CD sales through these years could have been largely attributed to popularity of that type of music.

Table F-1, Artists' Income Data

Panel A, Nominal Dollars

Schedule C Receipts

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	9,754,352,379	15,246	974	3,050	10,000
1999	732,210	10,305,076,532	14,074	799	2,657	9,921
2000	774,358	11,500,445,479	14,852	888	3,120	11,168
2001	748,664	11,295,064,605	15,087	911	3,362	11,491

Form 1040 AGI

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	45,994,684,319	71,887	14,480	35,566	72,552
1999	732,210	53,960,883,447	73,696	15,887	39,693	72,497
2000	774,358	63,061,413,943	81,437	18,939	43,646	79,470
2001	748,664	56,270,408,934	75,161	15,685	41,626	76,884

Schedule E Royalties

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	488,076,238	763	0	0	0
1999	732,210	445,296,372	608	0	0	0
2000	774,358	456,193,977	589	0	0	0
2001	748,664	674,699,458	901	0	0	0

Table F-1, Panel B, CPI for Recreation Items

Schedule C Receipts

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$10,120,984,813	$15,819	$1,011	$3,165	$10,376
1999	732,210	10,598,064,002	14,474	821.7167	2,733	10,203
2000	774,358	11,678,574,354	15,082	901.7541	3,168	11,341
2001	748,664	11,295,064,605	15,087	911	3,362	11,491

Form 1040 AGI

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$47,723,465,728	$74,589	$15,024	$36,903	$75,279
1999	732,210	55,495,065,427	75,791	16,339	40,822	74,558
2000	774,358	64,038,163,820	82,698	19,232	44,322	80,701
2001	748,664	56,270,408,934	75,161	15,685	41,626	76,884

Schedule E Royalties

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$506,421,339	$792	$0	$0	$0
1999	732,210	457,956,759	625	0	0	0
2000	774,358	463,259,905	598	0	0	0
2001	748,664	674,699,458	901	0	0	0

Table F-1, Panel C, CPI for All Items Less Food and Energy

Schedule C Receipts

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$10,468,771,498	$16,363	$1,045	$3,273	$10,732
1999	732,210	10,834,885,551	14,798	840.0785	2,794	10,431
2000	774,358	11,804,925,006	15,245	911.5102	3,203	11,464
2001	748,664	11,295,064,605	15,087	911	3,362	11,491

Form 1040 AGI

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$49,363,383,805	$77,152	$15,541	$38,171	$77,866
1999	732,210	56,735,143,556	77,485	16,704	41,734	76,224
2000	774,358	64,730,993,573	83,593	19,440	44,802	81,574
2001	748,664	56,270,408,934	75,161	15,685	41,626	76,884

Schedule E Royalties

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$523,823,460	$819	$0	$0	$0
1999	732,210	468,190,140	639	0	0	0
2000	774,358	468,271,920	605	0	0	0
2001	748,664	674,699,458	901	0	0	0

Table F-1, Panel D, GDP Deflator

Schedule C Receipts

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$10,341,479,908	$16,164	$1,033	$3,234	$10,602
1999	732,210	10,770,394,658	14,710	835	2,777	10,369
2000	774,358	11,772,260,960	15,203	909	3,194	11,432
2001	748,664	11,295,064,605	15,087	911	3,362	11,491

Form 1040 AGI

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$48,763,165,945	$76,214	$15,352	$37,707	$76,919
1999	732,210	56,397,447,320	77,024	16,604	41,485	75,771
2000	774,358	64,551,883,905	83,362	19,387	44,678	81,348
2001	748,664	56,270,408,934	75,161	15,685	41,626	76,884

Schedule E Royalties

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	639,817	$517,454,200	$809	$0	$0	$0
1999	732,210	465,403,401	635	0	0	0
2000	774,358	466,976,219	603	0	0	0
2001	748,664	674,699,458	901	0	0	0

Table F-2 - Control Samples, SOI Data

Table F-2, Panel A, Nominal Dollars

Receipts from all Schedule C Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	909,005,015,091	52,215	2,450	9,610	36,891
1999	17,575,643	958,843,087,452	54,555	2,447	10,129	36,600
2000	17,902,791	1,010,337,250,040	56,435	2,500	10,401	37,582
2001	18,338,190	1,008,970,814,580	55,020	2,529	10,334	37,086

AGI from All Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	124,770,643	5,416,449,500,369	43,411	11,517	25,212	50,336
1999	127,075,248	5,855,401,059,850	46,078	11,785	26,122	52,647
2000	129,373,153	6,366,630,364,742	49,211	12,286	27,357	54,858
2001	130,255,251	6,171,448,466,866	47,380	12,603	28,118	55,656

AGI from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	1,014,773,156,911	58,291	14,232	34,280	64,596
1999	17,575,643	1,089,644,046,280	61,997	14,554	35,644	67,042
2000	17,902,791	1,182,156,209,724	66,032	14,772	37,114	70,897
2001	18,338,190	1,121,013,209,694	61,130	14,352	36,367	69,825

Royalties from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	3,229,552,835	186	0	0	0
1999	17,575,643	5,481,075,643	312	0	0	0
2000	17,902,791	4,356,335,809	243	0	0	0
2001	18,338,190	5,212,182,260	284	0	0	0

Table F-2, Panel B, CPI Recreation Items

Receipts from all Schedule C Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$943,171,375,698	$54,178	$2,542	$9,971	$38,278
1999	17,575,643	986,104,312,487	56,106	2,517	10,417	37,641
2000	17,902,791	1,025,986,229,711	57,309	2,539	10,562	38,164
2001	18,338,190	1,008,970,814,580	55,020	2,529	10,334	37,086

AGI from All Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	124,770,643	$5,620,035,139,354	$45,043	$11,950	$26,160	$52,228
1999	127,075,248	6,021,878,148,807	47,388	12,120	26,865	54,144
2000	129,373,153	6,465,242,258,097	49,973	12,476	27,781	55,708
2001	130,255,251	6,171,448,466,866	47,380	12,603	28,118	55,656

AGI from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$1,052,914,976,854	$60,482	$14,767	$35,568	$67,024
1999	17,575,643	1,120,624,122,106	63,760	14,968	36,657	68,948
2000	17,902,791	1,200,466,470,475	67,055	15,001	37,689	71,995
2001	18,338,190	1,121,013,209,694	61,130	14,352	36,367	69,825

Royalties from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$3,350,940,578	$193	$0	$0	$0
1999	17,575,643	5,636,910,147	321	0	0	0
2000	17,902,791	4,423,810,517	247	0	0	0
2001	18,338,190	5,212,182,260	284	0	0	0

Table F-2, Panel C, CPI for All Items Less Food and Energy

Receipts from all Schedule C Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$975,581,506,969	$56,039	$2,629	$10,314	$39,593
1999	17,575,643	1,008,139,539,971	57,360	2,573	10,650	38,482
2000	17,902,791	1,037,086,388,486	57,929	2,566	10,676	38,577
2001	18,338,190	1,008,970,814,580	55,020	2,529	10,334	37,086

AGI from All Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	124,770,643	$5,813,156,009,335	$46,590	$12,361	$27,059	$54,023
1999	127,075,248	6,156,441,453,323	48,447	12,391	27,465	55,354
2000	129,373,153	6,535,189,800,764	50,514	12,611	28,081	56,310
2001	130,255,251	6,171,448,466,866	47,380	12,603	28,118	55,656

AGI from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$1,089,096,219,730	$62,560	$15,274	$36,791	$69,327
1999	17,575,643	1,145,665,293,857	65,184	15,302	37,477	70,489
2000	17,902,791	1,213,454,333,313	67,780	15,163	38,097	72,774
2001	18,338,190	1,121,013,209,694	61,130	14,352	36,367	69,825

Royalties from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$3,466,088,712	$200	$0	$0	$0
1999	17,575,643	5,762,871,057	328	0	0	0
2000	17,902,791	4,471,671,782	249	0	0	0
2001	18,338,190	5,212,182,260	284	0	0	0

Tabel F-2, Panel D, GDP Deflator

Receipts from all Schedule C Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$963,719,243,916	$55,358	$2,597	$10,188	$39,112
1999	17,575,643	1,002,138,939,510	57,018	2,557	10,586	38,253
2000	17,902,791	1,034,216,786,329	57,769	2,559	10,647	38,470
2001	18,338,190	1,008,970,814,580	55,020	2,529	10,334	37,086

AGI from All Filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	124,770,643	$5,742,472,847,285	$46,024	$12,210	$26,730	$53,366
1999	127,075,248	6,119,797,373,849	48,159	12,317	27,302	55,024
2000	129,373,153	6,517,107,030,658	50,374	12,576	28,004	56,155
2001	130,255,251	6,171,448,466,866	47,380	12,603	28,118	55,656

AGI from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$1,075,853,711,794	$61,800	$15,089	$36,343	$68,484
1999	17,575,643	1,138,846,119,112	64,796	15,211	37,253	70,069
2000	17,902,791	1,210,096,723,754	67,593	15,121	37,991	72,573
2001	18,338,190	1,121,013,209,694	61,130	14,352	36,367	69,825

Royalties from all Schedule C filers

	No. of Returns	Amount	Mean	Q1	Median	Q3
1998	17,408,809	$3,423,943,944	$197	$0	$0	$0
1999	17,575,643	5,728,569,569	326	0	0	0
2000	17,902,791	4,459,298,735	249	0	0	0
2001	18,338,190	5,212,182,260	284	0	0	0

Table F-3, RIAA and MPA Sales data

Table F-3, Panel A, Nominal

(in millions)

Year:	1998	1999	2000	2001
RIAA data				
CD	$11,416	$12,816	$13,215	$12,909
net units shipped	*847*	*939*	*943*	*882*
Total Retail Units	$12,165	$13,048	$12,705	$12,389
net units shipped	*1,124*	*1,161*	*1,079*	*969*
MPA data				
Box Office Sales	$6,949	$7,448	$7,661	$8,413
RIAA and MPA				
Box Office and Total CD Sales	$18,365	$20,264	$20,876	$21,322
Box Office and Total Retail Units	$19,114	$20,496	$20,366	$20,802

Table F-3, Panel B, CPI For Recreation Items

(in millions)

Year:	1998	1999	2000	2001
RIAA data				
CD	$11,845	$13,180	$13,420	$12,909
net units shipped	*847*	*939*	*943*	*882*
Total Retail Units	$12,622	$13,419	$12,902	$12,389
net units shipped	*1,124*	*1,161*	*1,079*	*969*
MPA data				
Box Office Sales	$7,210	$7,660	$7,780	$8,413
RIAA and MPA				
Box Office and Total CD Sales	$19,055	$20,840	$21,199	$21,322
Box Office and Total Retail Units	$19,832	$21,079	$20,681	$20,802

Table F-3, Panel C, CPI For All Items Less Food and Energy
(in millions)

Year:	1998	1999	2000	2001
RIAA data				
CD	$12,252	$13,475	$13,565	$12,909
net units shipped	*847*	*939*	*943*	*882*
Total Retail Units	$13,056	$13,719	$13,041	$12,389
net units shipped	*1,124*	*1,161*	*1,079*	*969*
MPA data				
Box Office Sales	$7,458	$7,831	$7,864	$8,413
RIAA and MPA				
Box Office and Total CD Sales	$19,710	$21,306	$21,429	$21,322
Box Office and Total Retail Units	$20,514	$21,550	$20,905	$20,802

Table F-3, Panel D, GDP Deflator
(in millions)

Year:	1998	1999	2000	2001
RIAA data				
CD	$12,103	$13,395	$13,527	$12,909
net units shipped	*847*	*939*	*943*	*882*
Total Retail Units	$12,897	$13,637	$13,005	$12,389
net units shipped	*1,124*	*1,161*	*1,079*	*969*
MPA data				
Box Office Sales	$7,367	$7,784	$7,842	$8,413
RIAA and MPA				
Box Office and Total CD Sales	$19,470	$21,179	$21,369	$21,322
Box Office and Total Retail Units	$20,264	$21,421	$20,847	$20,802

Table F-4, Comparison of Industry Sales Data and SOI Data

Table F-4, Panel A, Schedule C Receipts Vs. Total Retail Units and Box Office Sales

	1998-1999	1999-2000	2000-2001
Nominal Dollars	opposite	opposite	same
CPI Recreation	opposite	opposite	same
CPI All Less Food and Energy	opposite	opposite	opposite
GDP Deflator	opposite	opposite	opposite

Table F-4, Panel B, Schedule C Receipts Vs. Total CD Sales and Box Office Sales

	1998-1999	1999-2000	2000-2001
Nominal Dollars	opposite	same	same
CPI Recreation	opposite	same	same
CPI All Less Food and Energy	opposite	same	opposite
GDP Deflator	opposite	same	opposite

Appendix G, Confidence Intervals on Expenditures and Income

This appendix presents the results from 90 and 95 percent confidence intervals on the changes in real mean CD and movie expenditures, as well as in real mean wage and salary income, from the micro-level CEX data. The tables list the results for *all CUs*, *computer owning CUs* and *non-computer owning CUs*, and the statistics are for the years 1998 through 2001, in 2001 dollars. The expenditure categories are adjusted using the CPI for recreation items, the CPI for all items less food and energy and the GDP deflator, while the income figures are adjusted using the CPI for all items less food and energy and the GDP deflator.

Table G-1, Ninety Percent Confidence Intervals; All CUs

Panel A

CD Expenditures		98-99	99-00	00-01
CPI Rec. Items	Lower	-1.15493	-2.31621	0.775754
	Upper	5.83397	3.449755	6.103231
CPI Less Food/Energy	Lower	-0.64422	-1.84359	1.235397
	Upper	6.556421	4.018009	6.596776
GDP Deflator	Lower	-0.92702	-1.97908	1.116577
	Upper	6.201054	3.856892	6.469178

Panel B

Movie Expenditures				
CPI Rec. Items	Lower	-4.47966	-1.23134	-3.00081
	Upper	7.005545	10.3521	8.141733
CPI Less Food/Energy	Lower	-5.78585	-0.13937	-2.02092
	Upper	6.031677	11.62906	9.194024
GDP Deflator	Lower	-5.10702	-0.45121	-2.27422
	Upper	6.599685	11.26776	8.921972

Table G-2, Ninety Percent Confidence Intervals; Computer Owning CUs

Panel A

CD Expenditures		98-99	99-00	00-01
CPI Rec. Items	Lower	2.79497	0.373318	0.565592
	Upper	16.18709	9.736482	8.534381
CPI Less Food/Energy	Lower	3.709072	1.109551	1.20171
	Upper	17.51654	10.63595	9.221496
GDP Deflator	Lower	3.232017	0.899648	1.037272
	Upper	16.89523	10.38216	9.043853

Panel B

Movie Expenditures				
CPI Rec. Items	Lower	-10.0335	7.373425	-2.81837
	Upper	11.17701	27.36074	13.50109
CPI Less Food/Energy	Lower	-9.64699	9.145937	-1.39583
	Upper	12.14782	29.49732	15.01913
GDP Deflator	Lower	-10.5404	8.642455	-1.76356
	Upper	11.06566	28.8957	14.62666

Table G-3, Ninety Percent Confidence Intervals; Non-Computer Owning CUs

Panel A

CD Expenditures		98-99	99-00	00-01
CPI Rec. Items	Lower	-3.21033	-2.71193	3.689891
	Upper	3.288581	4.194888	9.137208
CPI Less Food/Energy	Lower	-3.04819	-2.44584	3.956738
	Upper	3.627376	4.578026	9.448624
GDP Deflator	Lower	-3.19773	-2.52252	3.887758
	Upper	3.421286	4.469931	9.368111

Panel B

Movie Expenditures				
CPI Rec. Items	Lower	-1.72238	-1.76969	5.896139
	Upper	10.14037	9.399595	15.40179
CPI Less Food/Energy	Lower	-1.07819	-1.18379	6.425001
	Upper	11.122	10.17824	15.99367
GDP Deflator	Lower	-1.43648	-1.35142	6.288292
	Upper	10.65239	9.95882	15.84065

Table G-4, Ninety Five Percent Confidence Intervals; All CUs

Panel A

CD Expenditures		98-99	99-00	00-01
CPI Rec. Items	Lower	-1.83678	-2.87874	0.2559996
	Upper	6.515814	4.012288	6.6229854
CPI Less Food/Energy	Lower	-1.34673	-2.41546	0.7123353
	Upper	7.258923	4.589873	7.1198375
GDP Deflator	Lower	-1.62244	-2.54844	0.5943724
	Upper	6.896476	4.426255	6.9913832

Panel B

Movie Expenditures				
CPI Rec. Items	Lower	-5.60017	-2.36143	-4.087892
	Upper	8.126053	11.48219	9.2288107
CPI Less Food/Energy	Lower	-6.93878	-1.28751	-3.115058
	Upper	7.184606	12.7772	10.288165
GDP Deflator	Lower	-6.24914	-1.59453	-3.366536
	Upper	7.741803	12.41107	10.014284

Table G-5, Ninety Five Percent Confidence Intervals; Computer Owning CUs

Panel A

CD Expenditures		98-99	99-00	00-01
CPI Rec. Items	Lower	1.488421	-0.54016	-0.211851
	Upper	17.49364	10.64996	9.311824
CPI Less Food/Energy	Lower	2.362002	0.180146	0.419292
	Upper	18.86361	11.56536	10.003914
GDP Deflator	Lower	1.89902	-0.02548	0.2561423
	Upper	18.22823	11.30729	9.8249832

Panel B

Movie Expenditures				
CPI Rec. Items	Lower	-12.1028	5.423442	-4.410513
	Upper	13.24633	29.31073	15.093233
CPI Less Food/Energy	Lower	-11.7733	7.160436	-2.997295
	Upper	14.27415	31.48282	16.620586
GDP Deflator	Lower	-12.6483	6.666529	-3.362611
	Upper	13.17357	30.87163	16.22571

Table G-6, Ninety Five Percent Confidence Intervals; Non-Computer Owning CUs

Panel A

CD Expenditures		98-99	99-00	00-01
CPI Rec. Items	Lower	-3.84437	-3.38577	3.1584458
	Upper	3.92262	4.868724	9.6686531
CPI Less Food/Energy	Lower	-3.69947	-3.1311	3.4209439
	Upper	4.278651	5.263281	9.9844173
GDP Deflator	Lower	-3.84348	-3.20471	3.3530898
	Upper	4.067043	5.152121	9.9027796

Panel B

Movie Expenditures				
CPI Rec. Items	Lower	-2.87972	-2.85938	4.9687581
	Upper	11.29771	10.48928	16.32917
CPI Less Food/Energy	Lower	-2.26845	-2.29228	5.491472
	Upper	12.31226	11.28673	16.927201
GDP Deflator	Lower	-2.61588	-2.45486	5.3563555
	Upper	11.83179	11.06226	16.772584

Table G-7, Ninety Percent Confidence Intervals; Mean Income Changes, All CUs

Income		98-99	99-00	00-01
CPI Less Food/Energy	Lower	-149.419	-890.112	659.26107
	Upper	2066.676	1350.454	3090.7238
GDP Deflator	Lower	74.44553	-770.661	761.85847
	Upper	2269.566	1460.683	3190.0322

Table G-8, Ninety Percent Confidence Intervals; Mean Income, Computer Owners

Income		98-99	99-00	00-01
CPI Less Food/Energy	Lower	-1946.76	455.6147	-1339.633
	Upper	2704.826	4175.876	2456.0979
GDP Deflator	Lower	-1590.38	284.227	-1193.156
	Upper	3014.23	3988.065	2597.7116

Table G-9, Ninety Percent Confidence Intervals; Mean Income, Non-Computer Owners

Income		98-99	99-00	00-01
CPI Less Food/Energy	Lower	-198.095	69.70758	-396.2639
	Upper	1967.663	2122.066	1763.4377
GDP Deflator	Lower	-334.299	0.866684	-452.3266
	Upper	1809.839	2045.001	1704.0837

Table G-10, Ninety-Five Percent Confidence Intervals; Mean Income Changes, All CUs

Income		98-99	99-00	00-01
CPI Less Food/Energy	Lower	-365.624	-1108.7	422.04519
	Upper	2282.881	1569.045	3327.9397
GDP Deflator	Lower	-139.713	-988.353	524.96348
	Upper	2483.724	1678.375	3426.9272

Table G-11, Ninety-Five Percent Confidence Intervals; Mean Income, Computer Owners

Income		98-99	99-00	00-01
CPI Less Food/Energy	Lower	-2400.57	92.6624	-1709.948
	Upper	3158.639	4538.828	2826.413
GDP Deflator	Lower	-2039.61	-77.1231	-1562.996
	Upper	3463.46	4349.415	2967.5524

Table G-12, Ninety-Five Percent Confidence Intervals; Mean Income, Non-Computer Owners

Income		98-99	99-00	00-01
CPI Less Food/Energy	Lower	-409.388	-130.522	-606.9665
	Upper	2178.956	2322.296	1974.1403
GDP Deflator	Lower	-543.484	-198.561	-662.7081
	Upper	2019.023	2244.428	1914.4651

Appendix H, Summary Statistics and Confidence Intervals By Income Class

This appendix presents tables with summary statistics and confidence intervals by income class for the micro-level CEX data. The tables list the mean values and the 90 and 95 percent confidence intervals for both CD and movie ticket expenditures for *all CUs*, *computer owning CUs* and *non-computer owning CUs*. The statistics are for the years 1998 through 2001, in 2001 dollars. The expenditures are adjusted using the CPI for recreation items, the CPI for all items less food and energy and the GDP deflator.

<u>Table H1, Mean Expenditures By Income Class, All CUs, Rec. CPI</u>

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$43.81	$30.33	$29.08	$29.94
$5,000 to $9,999	14.79	17.42	16.46	18.70
$10,000 to $14,999	22.91	22.30	20.54	17.73
$15,000 to $19,999	23.70	24.04	21.61	21.58
$20,000 to $29,999	27.74	31.54	36.49	23.71
$30,000 to $39,999	41.17	40.99	42.87	32.45
$40,000 to $49,999	43.54	47.65	49.83	45.46
$50,000 to $69,999	59.53	62.27	58.11	54.07
$70,000 and over	105.80	82.06	75.81	71.93
Total	46.96	44.62	44.05	40.61

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-3.15891	-9.52188	-11.1851
	Upper	30.1152	12.02707	12.90183
$5,000 to $9,999	Lower	-3.51242	-5.14332	-5.29055
	Upper	8.780798	7.058726	9.768406
$10,000 to $14,999	Lower	-10.3854	-4.28083	-3.99658
	Upper	11.60867	7.80182	9.611838
$15,000 to $19,999	Lower	-4.80974	-3.73166	-8.00475
	Upper	5.486523	8.591443	8.07057
$20,000 to $29,999	Lower	-2.70379	-1.25878	7.251108
	Upper	10.29429	11.15594	18.29927
$30,000 to $39,999	Lower	-7.97105	-6.92593	2.637449
	Upper	8.341735	10.69762	18.20132
$40,000 to $49,999	Lower	-6.49546	-8.65187	-5.18008
	Upper	14.7027	13.01947	13.91628
$50,000 to $69,999	Lower	-5.4107	-5.13821	-4.77767
	Upper	10.90494	13.47179	12.86059
$70,000 and over	Lower	9.758927	-3.96807	-4.71365
	Upper	37.71913	16.45935	12.48021
Total	Lower	-1.83678	-2.87874	0.256
	Upper	6.515814	4.012288	6.622985

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-0.44265	-7.76279	-9.21879
	Upper	27.39895	10.26797	10.93556
$5,000 to $9,999	Lower	-2.5089	-4.14723	-4.06125
	Upper	7.77727	6.062641	8.539103
$10,000 to $14,999	Lower	-8.58992	-3.29449	-2.88569
	Upper	9.813237	6.815482	8.500947
$15,000 to $19,999	Lower	-3.96923	-2.72569	-6.69247
	Upper	4.646011	7.585476	6.758299
$20,000 to $29,999	Lower	-1.64272	-0.24533	8.152999
	Upper	9.233218	10.1425	17.39738
$30,000 to $39,999	Lower	-6.63939	-5.48727	3.907969
	Upper	7.01008	9.258963	16.9308
$40,000 to $49,999	Lower	-4.765	-6.88278	-3.6212
	Upper	12.97224	11.25039	12.35739
$50,000 to $69,999	Lower	-4.07881	-3.61903	-3.33781
	Upper	9.573049	11.9526	11.42073
$70,000 and over	Lower	12.04139	-2.30052	-3.31007
	Upper	35.43667	14.79181	11.07663

Table H-1 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$53.59	$56.81	$58.48	$60.12
$5,000 to $9,999	30.42	35.08	38.24	28.18
$10,000 to $14,999	43.75	36.93	40.10	36.64
$15,000 to $19,999	50.22	50.86	47.16	43.37
$20,000 to $29,999	63.89	61.37	63.39	51.69
$30,000 to $39,999	91.02	85.26	78.45	78.04
$40,000 to $49,999	103.88	101.52	91.93	79.95
$50,000 to $69,999	120.48	129.24	107.76	109.76
$70,000 and over	216.81	210.68	200.60	188.08
Total	97.21	98.48	93.92	91.35

95% Confidence Intervals

		98-99	99-00	00-01
		Movie	Movie	Movie
Less than $5,000	Lower	-14.1497	-16.1055	-16.7733
	Upper	20.59477	19.44671	20.05086
$5,000 to $9,999	Lower	-6.15522	-9.39814	-1.4756
	Upper	15.47484	15.71528	21.59334
$10,000 to $14,999	Lower	-5.97829	-4.42513	-6.92371
	Upper	19.61221	10.75969	13.84811
$15,000 to $19,999	Lower	-15.0374	-12.0825	-10.3572
	Upper	16.3241	19.48241	17.94245
$20,000 to $29,999	Lower	-8.81303	-12.0503	-2.15488
	Upper	13.86237	16.08859	25.54402
$30,000 to $39,999	Lower	-18.1244	-15.2485	-13.565
	Upper	29.6392	28.86943	14.39821
$40,000 to $49,999	Lower	-16.4577	-6.0445	-3.49616
	Upper	21.17074	25.22121	27.45617
$50,000 to $69,999	Lower	-5.9772	6.031825	-12.2325
	Upper	23.49803	36.91513	16.22998
$70,000 and over	Lower	-16.5763	-10.3001	-5.70436
	Upper	28.84218	30.44626	30.75591
Total	Lower	-5.60017	-2.36143	-4.08789
	Upper	8.126053	11.48219	9.228811

90% Confidence Intervals

		Movie	Movie	Movie
Less than $5,000	Lower	-11.3134	-13.2032	-13.7673
	Upper	17.75849	16.54449	17.0448
$5,000 to $9,999	Lower	-4.3895	-7.34806	0.407582
	Upper	13.70912	13.6652	19.71016
$10,000 to $14,999	Lower	-3.88927	-3.18556	-5.22805
	Upper	17.52319	9.520111	12.15245
$15,000 to $19,999	Lower	-12.4773	-9.5058	-8.04703
	Upper	13.76398	16.90568	15.63227
$20,000 to $29,999	Lower	-6.96197	-9.75329	0.106252
	Upper	12.01131	13.79153	23.28289
$30,000 to $39,999	Lower	-14.2253	-11.647	-11.2823
	Upper	25.74013	25.26797	12.1155
$40,000 to $49,999	Lower	-13.386	-3.49219	-0.96944
	Upper	18.09903	22.66891	24.92945
$50,000 to $69,999	Lower	-3.57106	8.552911	-9.90901
	Upper	21.09189	34.39405	13.90651
$70,000 and over	Lower	-12.8687	-6.97384	-2.72801
	Upper	25.13455	27.12003	27.77956
Total	Lower	-4.47966	-1.23134	-3.00081
	Upper	7.005545	10.3521	8.141733

<u>Table H2, Mean Expenditures By Income Class, All CUs, F/E CPI</u>

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$45.32	$31.01	$29.39	$29.94
$5,000 to $9,999	15.30	17.81	16.64	18.70
$10,000 to $14,999	23.70	22.80	20.76	17.73
$15,000 to $19,999	24.52	24.58	21.84	21.58
$20,000 to $29,999	28.70	32.24	36.88	23.71
$30,000 to $39,999	42.59	41.90	43.34	32.45
$40,000 to $49,999	45.04	48.71	50.37	45.46
$50,000 to $69,999	61.57	63.67	58.74	54.07
$70,000 and over	109.43	83.89	76.63	71.93
Total	48.57	45.62	44.53	40.61

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-2.87043	-9.32385	-11.5635
	Upper	31.48203	12.55539	12.65104
$5,000 to $9,999	Lower	-3.79185	-5.04725	-5.48495
	Upper	8.822532	7.38502	9.606549
$10,000 to $14,999	Lower	-10.4512	-4.11059	-3.79877
	Upper	12.25254	8.183818	9.858512
$15,000 to $19,999	Lower	-5.24175	-3.51283	-7.80933
	Upper	5.363998	8.979402	8.342758
$20,000 to $29,999	Lower	-3.14555	-1.66643	7.602394
	Upper	10.23886	10.94359	18.73751
$30,000 to $39,999	Lower	-7.70734	-7.51358	3.035918
	Upper	9.075886	10.38117	18.73055
$40,000 to $49,999	Lower	-7.21057	-9.37068	-4.69337
	Upper	14.55469	12.68715	14.50778
$50,000 to $69,999	Lower	-6.29102	-4.52164	-4.21027
	Upper	10.47732	14.38102	13.55052
$70,000 and over	Lower	11.13829	-3.14157	-3.93975
	Upper	39.94351	17.65975	13.34678
Total	Lower	-1.34673	-2.41546	0.712335
	Upper	7.258923	4.589873	7.119837

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-0.06615	-7.53779	-9.58679
	Upper	28.67775	10.76933	10.67434
$5,000 to $9,999	Lower	-2.76211	-4.03237	-4.25299
	Upper	7.792786	6.370141	8.37459
$10,000 to $14,999	Lower	-8.59781	-3.10696	-2.68389
	Upper	10.39918	7.180193	8.743631
$15,000 to $19,999	Lower	-4.37597	-2.49306	-6.4908
	Upper	4.498223	7.959628	7.02422
$20,000 to $29,999	Lower	-2.05295	-0.63704	8.511383
	Upper	9.146257	9.914197	17.82852
$30,000 to $39,999	Lower	-6.33728	-6.05278	4.317113
	Upper	7.705827	8.920372	17.44936
$40,000 to $49,999	Lower	-5.43381	-7.57005	-3.12593
	Upper	12.77794	10.88651	12.94034
$50,000 to $69,999	Lower	-4.92217	-2.97857	-2.76041
	Upper	9.108472	12.83795	12.10066
$70,000 and over	Lower	13.48974	-1.4435	-2.5286

Table H-2 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$55.43	$58.08	$59.12	$60.12
$5,000 to $9,999	31.47	35.87	38.66	28.18
$10,000 to $14,999	45.25	37.76	40.53	36.64
$15,000 to $19,999	51.94	52.00	47.67	43.37
$20,000 to $29,999	66.09	62.74	64.07	51.69
$30,000 to $39,999	94.15	87.17	79.30	78.04
$40,000 to $49,999	107.44	103.79	92.93	79.95
$50,000 to $69,999	124.62	132.13	108.93	109.76
$70,000 and over	224.26	215.38	202.77	188.08
Total	100.56	100.68	94.93	91.35

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-15.2284	-17.0198	-17.5151
	Upper	20.52947	19.08741	19.52713
$5,000 to $9,999	Lower	-6.70751	-9.97135	-1.14151
	Upper	15.50416	15.54802	22.08675
$10,000 to $14,999	Lower	-5.71908	-4.93268	-6.52684
	Upper	20.7091	10.48439	14.31887
$15,000 to $19,999	Lower	-16.0533	-11.7343	-9.92554
	Upper	16.16176	20.38677	18.53129
$20,000 to $29,999	Lower	-8.3303	-12.9256	-1.58828
	Upper	15.02808	15.59277	26.34898
$30,000 to $39,999	Lower	-17.5274	-14.634	-12.7922
	Upper	31.48713	30.3679	15.32301
$40,000 to $49,999	Lower	-15.7321	-5.02247	-2.59441
	Upper	23.04702	26.74701	28.54362
$50,000 to $69,999	Lower	-7.62638	7.486252	-13.4777
	Upper	22.64314	38.90471	15.14344
$70,000 and over	Lower	-14.4905	-8.1161	-3.64147
	Upper	32.24133	33.33705	33.03366
Total	Lower	-6.93878	-1.28751	-3.11506
	Upper	7.184606	12.7772	10.28816

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-12.3094	-14.0722	-14.4912
	Upper	17.61045	16.13989	16.50328
$5,000 to $9,999	Lower	-4.89431	-7.88814	0.754675
	Upper	13.69096	13.46481	20.19056
$10,000 to $14,999	Lower	-3.56168	-3.67414	-4.82515
	Upper	18.55169	9.225855	12.61718
$15,000 to $19,999	Lower	-13.4235	-9.11215	-7.60253
	Upper	13.53196	17.76464	16.20828
$20,000 to $29,999	Lower	-6.42349	-10.5975	0.692312
	Upper	13.12127	13.26474	24.06839
$30,000 to $39,999	Lower	-13.5262	-10.9603	-10.4971
	Upper	27.48595	26.69428	13.02788
$40,000 to $49,999	Lower	-12.5664	-2.42904	-0.05253
	Upper	19.88138	24.15358	26.00174
$50,000 to $69,999	Lower	-5.1554	10.05102	-11.1413
	Upper	20.17216	36.33994	12.80702
$70,000 and over	Lower	-10.6757	-4.73217	-0.64758
	Upper	28.42649	29.95312	30.03978
Total	Lower	-5.78585	-0.13937	-2.02092
	Upper	6.031677	11.62906	9.194024

<u>Table H3, Mean Expenditures By Income Class, All CUs, GDP Deflator</u>

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$44.76	$30.83	$29.31	$29.94
$5,000 to $9,999	15.11	17.71	16.60	18.70
$10,000 to $14,999	23.41	22.66	20.71	17.73
$15,000 to $19,999	24.22	24.43	21.78	21.58
$20,000 to $29,999	28.35	32.05	36.78	23.71
$30,000 to $39,999	42.07	41.65	43.22	32.45
$40,000 to $49,999	44.49	48.42	50.23	45.46
$50,000 to $69,999	60.82	63.29	58.57	54.07
$70,000 and over	108.10	83.39	76.42	71.93
Total	47.98	45.34	44.40	40.61

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-3.04514	-9.38306	-11.4656
	Upper	30.92389	12.40813	12.71584
$5,000 to $9,999	Lower	-3.66191	-5.07613	-5.43468
	Upper	8.852528	7.293964	9.648379
$10,000 to $14,999	Lower	-10.4778	-4.16037	-3.84989
	Upper	11.97418	8.077084	9.794725
$15,000 to $19,999	Lower	-5.03714	-3.57632	-7.85983
	Upper	5.463011	8.8712	8.27237
$20,000 to $29,999	Lower	-2.92307	-1.55048	7.511592
	Upper	10.3304	11.00737	18.6242
$30,000 to $39,999	Lower	-7.89748	-7.34792	2.932921
	Upper	8.72919	10.47451	18.59372
$40,000 to $49,999	Lower	-6.8631	-9.1681	-4.81917
	Upper	14.72262	12.78568	14.35484
$50,000 to $69,999	Lower	-5.84782	-4.69899	-4.35693
	Upper	10.77357	14.12551	13.37214
$70,000 and over	Lower	10.45162	-3.37846	-4.13979
	Upper	38.96762	17.32205	13.12273
Total	Lower	-1.62244	-2.54844	0.594372
	Upper	6.896476	4.426255	6.991383

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-0.27216	-7.60419	-9.49163
	Upper	28.15091	10.62925	10.74184
$5,000 to $9,999	Lower	-2.64032	-4.06632	-4.20341
	Upper	7.830942	6.28416	8.417108
$10,000 to $14,999	Lower	-8.64495	-3.1614	-2.73605
	Upper	10.14137	7.078108	8.680878
$15,000 to $19,999	Lower	-4.17999	-2.5602	-6.54292
	Upper	4.605855	7.855076	6.955456
$20,000 to $29,999	Lower	-1.84115	-0.52535	8.418744
	Upper	9.248485	9.982243	17.71705
$30,000 to $39,999	Lower	-6.5402	-5.89303	4.211354
	Upper	7.37191	9.019619	17.31529
$40,000 to $49,999	Lower	-5.101	-7.37595	-3.25394
	Upper	12.96052	10.99354	12.78961
$50,000 to $69,999	Lower	-4.49097	-3.16229	-2.90966
	Upper	9.41672	12.58882	11.92486
$70,000 and over	Lower	12.77945	-1.68862	-2.73061

Table H-3 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$54.76	$57.74	$58.95	$60.12
$5,000 to $9,999	31.09	35.65	38.55	28.18
$10,000 to $14,999	44.70	37.53	40.42	36.64
$15,000 to $19,999	51.31	51.69	47.54	43.37
$20,000 to $29,999	65.28	62.37	63.90	51.69
$30,000 to $39,999	93.00	86.65	79.08	78.04
$40,000 to $49,999	106.14	103.17	92.67	79.95
$50,000 to $69,999	123.10	131.34	108.63	109.76
$70,000 and over	221.53	214.10	202.21	188.08
Total	99.33	100.08	94.67	91.35

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-14.7303	-16.7635	-17.3233
	Upper	20.68796	19.19548	19.66247
$5,000 to $9,999	Lower	-6.44596	-9.81051	-1.22785
	Upper	15.58092	15.60024	21.95916
$10,000 to $14,999	Lower	-5.89487	-4.78915	-6.62941
	Upper	20.23392	10.56602	14.19715
$15,000 to $19,999	Lower	-15.5944	-11.8371	-10.0371
	Upper	16.34712	20.13437	18.37902
$20,000 to $29,999	Lower	-8.64379	-12.6793	-1.73473
	Upper	14.48129	15.73884	26.14086
$30,000 to $39,999	Lower	-17.9583	-14.8136	-12.992
	Upper	30.6662	29.94874	15.08389
$40,000 to $49,999	Lower	-16.2225	-5.31572	-2.82749
	Upper	22.16009	26.31899	28.26245
$50,000 to $69,999	Lower	-6.77119	7.073142	-13.1558
	Upper	23.24557	38.34778	15.42429
$70,000 and over	Lower	-15.7164	-8.74204	-4.17472
	Upper	30.57763	32.52114	32.44477
Total	Lower	-6.24914	-1.59453	-3.36654
	Upper	7.741803	12.41107	10.01428

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-11.839	-13.8281	-14.304
	Upper	17.79667	16.26005	16.64323
$5,000 to $9,999	Lower	-4.64785	-7.73616	0.664969
	Upper	13.7828	13.5259	20.06635
$10,000 to $14,999	Lower	-3.76191	-3.53566	-4.92928
	Upper	18.10096	9.312533	12.49702
$15,000 to $19,999	Lower	-12.987	-9.22715	-7.71741
	Upper	13.73964	17.52446	16.05934
$20,000 to $29,999	Lower	-6.75603	-10.3595	0.540825
	Upper	12.59352	13.41898	23.8653
$30,000 to $39,999	Lower	-13.989	-11.1596	-10.7001
	Upper	26.69685	26.29467	12.79198
$40,000 to $49,999	Lower	-13.0892	-2.73329	-0.28953
	Upper	19.02682	23.73657	25.7245
$50,000 to $69,999	Lower	-4.32085	9.626174	-10.8227
	Upper	20.79522	35.79475	13.09123
$70,000 and over	Lower	-11.9373	-5.37362	-1.18537
	Upper	26.79852	29.15272	29.45542
Total	Lower	-5.10702	-0.45121	-2.27422
	Upper	6.599685	11.26776	8.921972

Table H4, Mean Expenditures By Income Class, Computer Owners, Rec. CPI

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$72.04	$43.59	$51.11	$48.23
$5,000 to $9,999	40.78	51.45	41.48	54.60
$10,000 to $14,999	75.94	58.43	36.02	42.10
$15,000 to $19,999	48.22	42.31	35.27	30.82
$20,000 to $29,999	38.06	46.36	48.79	32.34
$30,000 to $39,999	55.30	50.01	53.85	39.33
$40,000 to $49,999	49.81	52.47	53.74	51.76
$50,000 to $69,999	69.17	70.25	61.57	61.50
$70,000 and over	116.85	88.26	81.43	75.75
Total	75.70	66.21	61.15	56.60

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-7.848	-13.0623	-20.3488
	Upper	64.73969	28.10291	26.10754
$5,000 to $9,999	Lower	-19.002	-16.2756	-13.7006
	Upper	40.3374	36.21591	39.95405
$10,000 to $14,999	Lower	-39.4728	3.059312	-14.6446
	Upper	74.49038	41.7615	26.79456
$15,000 to $19,999	Lower	-12.158	-8.88562	-11.6501
	Upper	23.97629	22.96368	20.54609
$20,000 to $29,999	Lower	-7.31846	-11.588	4.758819
	Upper	23.93131	16.4392	28.13995
$30,000 to $39,999	Lower	-8.03917	-9.25938	2.630955
	Upper	18.61833	16.93044	26.39987
$40,000 to $49,999	Lower	-9.92832	-10.9539	-9.66421
	Upper	15.25612	13.48127	13.60997
$50,000 to $69,999	Lower	-9.29554	-1.7224	-10.1136
	Upper	11.44676	19.08097	10.26071
$70,000 and over	Lower	10.41522	-4.87672	-3.94873
	Upper	46.76478	18.53183	15.29978
Total	Lower	1.488421	-0.54016	-0.21185
	Upper	17.49364	10.64996	9.311824

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-1.92248	-9.70186	-16.5565
	Upper	58.81416	24.74248	22.31518
$5,000 to $9,999	Lower	-14.158	-11.9905	-9.32066
	Upper	35.49337	31.93089	35.57407
$10,000 to $14,999	Lower	-30.1696	6.218674	-11.2618
	Upper	65.18727	38.60214	23.41178
$15,000 to $19,999	Lower	-9.20826	-6.28568	-9.02188
	Upper	21.02655	20.36373	17.91783
$20,000 to $29,999	Lower	-4.76746	-9.30003	6.667482
	Upper	21.38031	14.15127	26.23128
$30,000 to $39,999	Lower	-5.86305	-7.12144	4.571274
	Upper	16.44221	14.79249	24.45955
$40,000 to $49,999	Lower	-7.87244	-8.95918	-7.76428
	Upper	13.20024	11.48656	11.71003
$50,000 to $69,999	Lower	-7.60229	-0.02416	-8.45037
	Upper	9.753512	17.38274	8.597505
$70,000 and over	Lower	13.38253	-2.96582	-2.37743
	Upper	43.79747	16.62093	13.72847

Table H-4 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$84.94	$90.48	$100.36	$99.91
$5,000 to $9,999	89.08	96.13	94.59	80.23
$10,000 to $14,999	93.98	91.70	80.34	81.24
$15,000 to $19,999	103.50	98.37	87.29	80.24
$20,000 to $29,999	82.10	89.63	96.62	81.87
$30,000 to $39,999	117.30	111.25	99.17	94.78
$40,000 to $49,999	118.60	123.36	101.79	92.05
$50,000 to $69,999	134.13	151.72	122.39	119.84
$70,000 and over	242.15	225.58	207.39	200.06
Total	152.69	153.27	135.90	130.56

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-25.6487	-26.6814	-40.6905
	Upper	36.7311	46.43246	41.59493
$5,000 to $9,999	Lower	-48.1807	-51.8993	-20.5253
	Upper	62.26924	54.96736	49.24565
$10,000 to $14,999	Lower	-31.3993	-16.6887	-31.5336
	Upper	35.95182	39.4196	33.34741
$15,000 to $19,999	Lower	-43.416	-38.8939	-29.543
	Upper	53.66396	61.04744	43.64806
$20,000 to $29,999	Lower	-11.823	-17.9913	-10.0314
	Upper	26.88833	31.95977	39.53452
$30,000 to $39,999	Lower	-40.4575	-30.1853	-17.0499
	Upper	52.5493	54.34647	25.82677
$40,000 to $49,999	Lower	-25.2925	-1.90488	-9.17046
	Upper	34.80469	45.04469	28.6506
$50,000 to $69,999	Lower	-2.9015	8.202327	-14.8484
	Upper	38.07753	50.4485	19.95129
$70,000 and over	Lower	-13.2537	-7.65472	-12.6294
	Upper	46.40436	44.0363	27.28277
Total	Lower	-12.1028	5.423442	-4.41051
	Upper	13.24633	29.31073	15.09323

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-20.5565	-20.7129	-33.9733
	Upper	31.63887	40.46398	34.87775
$5,000 to $9,999	Lower	-39.1644	-43.1755	-14.8297
	Upper	53.25292	46.24355	43.55006
$10,000 to $14,999	Lower	-25.9012	-12.1084	-26.2372
	Upper	30.45377	34.83933	28.05101
$15,000 to $19,999	Lower	-35.4911	-30.7354	-23.5682
	Upper	45.73907	52.88897	37.67328
$20,000 to $29,999	Lower	-8.66291	-13.9137	-5.98521
	Upper	23.72822	27.88213	35.48832
$30,000 to $39,999	Lower	-32.8651	-23.2847	-13.5497
	Upper	44.95691	47.44592	22.32663
$40,000 to $49,999	Lower	-20.3866	1.927741	-6.08303
	Upper	29.8988	41.21207	25.56316
$50,000 to $69,999	Lower	0.443724	11.65099	-12.0076
	Upper	34.7323	46.99984	17.1105
$70,000 and over	Lower	-8.38366	-3.43504	-9.37127
	Upper	41.53431	39.81663	24.02464
Total	Lower	-10.0335	7.373425	-2.81837
	Upper	11.17701	27.36074	13.50109

Table H5, Mean Expenditures By Income Class, Computer Owners, F/E CPI

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$74.51	$44.56	$51.66	$48.23
$5,000 to $9,999	42.18	52.60	41.92	54.60
$10,000 to $14,999	78.55	59.74	36.41	42.10
$15,000 to $19,999	49.87	43.25	35.65	30.82
$20,000 to $29,999	39.37	47.40	49.32	32.34
$30,000 to $39,999	57.20	51.13	54.43	39.33
$40,000 to $49,999	51.52	53.65	54.32	51.76
$50,000 to $69,999	71.55	71.82	62.24	61.50
$70,000 and over	120.86	90.23	82.31	75.75
Total	78.30	67.69	61.81	56.60

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-7.54905	-13.7825	-19.9302
	Upper	67.44338	27.98095	26.79482
$5,000 to $9,999	Lower	-20.0396	-16.1127	-14.1943
	Upper	40.87168	37.45477	39.55026
$10,000 to $14,999	Lower	-40.0848	3.646032	-15.1253
	Upper	77.71019	43.00682	26.49577
$15,000 to $19,999	Lower	-11.9973	-8.57087	-11.3682
	Upper	25.23856	23.77657	21.02727
$20,000 to $29,999	Lower	-8.0557	-12.3246	5.19106
	Upper	24.12507	16.15951	28.76343
$30,000 to $39,999	Lower	-7.65162	-9.99778	3.12093
	Upper	19.79627	16.59891	27.07502
$40,000 to $49,999	Lower	-10.811	-11.7657	-9.1348
	Upper	15.06072	13.11073	14.24331
$50,000 to $69,999	Lower	-10.4063	-0.98215	-9.5139
	Upper	10.94305	20.14804	10.9933
$70,000 and over	Lower	11.89746	-4.00763	-3.11306
	Upper	49.36864	19.84513	16.2261
Total	Lower	2.362002	0.180146	0.419292
	Upper	18.86361	11.56536	10.00391

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-1.42722	-10.3733	-16.1159
	Upper	61.32155	24.57168	22.98054
$5,000 to $9,999	Lower	-15.0673	-11.7398	-9.80698
	Upper	35.89933	33.08192	35.16295
$10,000 to $14,999	Lower	-30.4689	6.859158	-11.7277
	Upper	68.09427	39.7937	23.09813
$15,000 to $19,999	Lower	-8.95766	-5.93026	-8.72365
	Upper	22.19889	21.13596	18.38274
$20,000 to $29,999	Lower	-5.4287	-9.99941	7.115335
	Upper	21.49807	13.83427	26.83915
$30,000 to $39,999	Lower	-5.41097	-7.82662	5.076366
	Upper	17.55563	14.42775	25.11958
$40,000 to $49,999	Lower	-8.69902	-9.73495	-7.22638
	Upper	12.94874	11.08	12.33489
$50,000 to $69,999	Lower	-8.66353	0.742765	-7.83984
	Upper	9.200247	18.42312	9.319247
$70,000 and over	Lower	14.95633	-2.06047	-1.53436
	Upper	46.30977	17.89796	14.64739

Table H-5 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$87.86	$92.50	$101.44	$99.91
$5,000 to $9,999	92.15	98.28	95.62	80.23
$10,000 to $14,999	97.21	93.75	81.20	81.24
$15,000 to $19,999	107.05	100.57	88.24	80.24
$20,000 to $29,999	84.92	91.64	97.66	81.87
$30,000 to $39,999	121.33	113.74	100.24	94.78
$40,000 to $49,999	122.67	126.11	102.89	92.05
$50,000 to $69,999	138.74	155.11	123.72	119.84
$70,000 and over	250.47	230.62	209.63	200.06
Total	157.94	156.69	137.37	130.56

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-27.4601	-28.1427	-39.8491
	Upper	36.74866	46.0215	42.92501
$5,000 to $9,999	Lower	-50.5375	-51.8045	-19.7395
	Upper	62.79973	57.12176	50.50666
$10,000 to $14,999	Lower	-31.2003	-16.0159	-32.5006
	Upper	38.11323	41.10681	32.5761
$15,000 to $19,999	Lower	-43.3593	-38.5237	-28.8987
	Upper	56.32373	63.18476	44.8926
$20,000 to $29,999	Lower	-13.223	-19.2817	-9.19975
	Upper	26.65169	31.33491	40.79347
$30,000 to $39,999	Lower	-40.0985	-29.6655	-16.0723
	Upper	55.27968	56.65287	26.99511
$40,000 to $49,999	Lower	-27.4892	-0.69466	-8.16254
	Upper	34.36346	47.14497	29.84512
$50,000 to $69,999	Lower	-4.65468	9.88134	-13.6216
	Upper	37.39301	52.90166	21.37285
$70,000 and over	Lower	-10.8148	-5.34156	-10.5004
	Upper	50.52616	47.31706	29.64115
Total	Lower	-11.7733	7.160436	-2.99729
	Upper	14.27415	31.48282	16.62059

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-22.2186	-22.0885	-33.092
	Upper	31.50713	39.96728	36.16795
$5,000 to $9,999	Lower	-41.2855	-42.9125	-14.0051
	Upper	53.54771	48.22982	44.77228
$10,000 to $14,999	Lower	-25.542	-11.3529	-27.1882
	Upper	32.45499	36.44373	27.26372
$15,000 to $19,999	Lower	-35.2219	-30.221	-22.8749
	Upper	48.18634	54.88203	38.86882
$20,000 to $29,999	Lower	-9.96791	-15.1497	-5.11867
	Upper	23.39662	27.20294	36.71239
$30,000 to $39,999	Lower	-32.3125	-22.6191	-12.5566
	Upper	47.49371	49.60647	23.4794
$40,000 to $49,999	Lower	-22.44	3.210614	-5.05988
	Upper	29.31426	43.2397	26.74245
$50,000 to $69,999	Lower	-1.22222	13.3932	-10.7649
	Upper	33.96055	49.38979	18.51616
$70,000 and over	Lower	-5.80734	-1.04289	-7.22352
	Upper	45.51873	43.0184	26.36429
Total	Lower	-9.64699	9.145937	-1.39583
	Upper	12.14782	29.49732	15.01913

Table H6, Mean Expenditures By Income Class, Computer Owners, GDP Deflator

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$73.61	$44.30	$51.52	$48.23
$5,000 to $9,999	41.67	52.28	41.81	54.60
$10,000 to $14,999	77.60	59.39	36.31	42.10
$15,000 to $19,999	49.27	43.00	35.55	30.82
$20,000 to $29,999	38.89	47.12	49.18	32.34
$30,000 to $39,999	56.50	50.82	54.28	39.33
$40,000 to $49,999	50.89	53.33	54.17	51.76
$50,000 to $69,999	70.68	71.39	62.06	61.50
$70,000 and over	119.39	89.69	82.08	75.75
Total	77.35	67.28	61.64	56.60

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-7.75747	-13.5808	-20.0383
	Upper	66.3703	28.02381	26.61708
$5,000 to $9,999	Lower	-19.5927	-16.1638	-14.0666
	Upper	40.82441	37.1118	39.65461
$10,000 to $14,999	Lower	-39.9904	3.479607	-15.001
	Upper	76.41667	42.66359	26.57296
$15,000 to $19,999	Lower	-12.1568	-8.66318	-11.441
	Upper	24.70012	23.55127	20.90283
$20,000 to $29,999	Lower	-7.70118	-12.1178	5.079341
	Upper	24.16359	16.24401	28.60222
$30,000 to $39,999	Lower	-7.90905	-9.78977	2.994289
	Upper	19.27133	16.69834	26.90045
$40,000 to $49,999	Lower	-10.3935	-11.5372	-9.27163
	Upper	15.25755	13.2203	14.07954
$50,000 to $69,999	Lower	-9.86187	-1.19379	-9.6689
	Upper	11.28364	19.84912	10.80389
$70,000 and over	Lower	11.15915	-4.25694	-3.32907
	Upper	48.24189	19.47581	15.9866
Total	Lower	1.89902	-0.02548	0.256142
	Upper	18.22823	11.30729	9.824983

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-1.70622	-10.1845	-16.2297
	Upper	60.31906	24.62752	22.80848
$5,000 to $9,999	Lower	-14.6607	-11.8148	-9.68123
	Upper	35.8924	32.76277	35.2692
$10,000 to $14,999	Lower	-30.4878	6.6783	-11.6072
	Upper	66.91405	39.4649	23.17917
$15,000 to $19,999	Lower	-9.14811	-6.03343	-8.80071
	Upper	21.69139	20.92152	18.26252
$20,000 to $29,999	Lower	-5.09998	-9.80255	6.999577
	Upper	21.56239	13.92876	26.68199
$30,000 to $39,999	Lower	-5.69024	-7.62748	4.945812
	Upper	17.05253	14.53605	24.94893
$40,000 to $49,999	Lower	-8.29957	-9.51621	-7.36541
	Upper	13.16358	11.19928	12.17333
$50,000 to $69,999	Lower	-8.13571	0.524003	-7.99765
	Upper	9.557478	18.13133	9.13264
$70,000 and over	Lower	14.18631	-2.31957	-1.75228
	Upper	45.21472	17.53845	14.40981

Table H-6 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$86.79	$91.95	$101.16	$99.91
$5,000 to $9,999	91.02	97.69	95.35	80.23
$10,000 to $14,999	96.02	93.19	80.98	81.24
$15,000 to $19,999	105.75	99.97	88.00	80.24
$20,000 to $29,999	83.89	91.09	97.39	81.87
$30,000 to $39,999	119.85	113.06	99.97	94.78
$40,000 to $49,999	121.18	125.36	102.60	92.05
$50,000 to $69,999	137.05	154.18	123.37	119.84
$70,000 and over	247.43	229.24	209.05	200.06
Total	156.02	155.76	136.99	130.56

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-26.635	-27.7335	-40.0665
	Upper	36.95892	46.15207	42.58105
$5,000 to $9,999	Lower	-49.5526	-51.8464	-19.9426
	Upper	62.88571	56.52294	50.18058
$10,000 to $14,999	Lower	-31.4956	-16.2126	-32.2505
	Upper	37.16069	40.63682	32.77543
$15,000 to $19,999	Lower	-43.6496	-38.6404	-29.0652
	Upper	55.20794	62.59256	44.57079
$20,000 to $29,999	Lower	-12.5374	-18.9188	-9.4147
	Upper	26.94041	31.52236	40.46796
$30,000 to $39,999	Lower	-40.5344	-29.8225	-16.325
	Upper	54.11911	56.0106	26.69302
$40,000 to $49,999	Lower	-26.4538	-1.04039	-8.42306
	Upper	34.81004	46.5588	29.53626
$50,000 to $69,999	Lower	-3.72489	9.404804	-13.9387
	Upper	37.99066	52.21638	21.0053
$70,000 and over	Lower	-12.2115	-6.00358	-11.0507
	Upper	48.57717	46.39383	29.03141
Total	Lower	-12.6483	6.666529	-3.36261
	Upper	13.17357	30.87163	16.22571

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-21.4436	-21.702	-33.3197
	Upper	31.76758	40.1206	35.83431
$5,000 to $9,999	Lower	-40.3739	-42.9999	-14.2182
	Upper	53.70707	47.67647	44.45624
$10,000 to $14,999	Lower	-25.891	-11.5718	-26.9423
	Upper	31.55609	35.99605	27.46719
$15,000 to $19,999	Lower	-35.5796	-30.3765	-23.0541
	Upper	47.13794	54.32864	38.55969
$20,000 to $29,999	Lower	-9.31473	-14.8011	-5.34265
	Upper	23.71773	27.40471	36.39591
$30,000 to $39,999	Lower	-32.8076	-22.8157	-12.8133
	Upper	46.39229	49.00381	23.18134
$40,000 to $49,999	Lower	-21.4527	2.84526	-5.32434
	Upper	29.80891	42.67315	26.43754
$50,000 to $69,999	Lower	-0.31953	12.89963	-11.0861
	Upper	34.58531	48.72156	18.15273
$70,000 and over	Lower	-7.24918	-1.72624	-7.77871
	Upper	43.61483	42.11649	25.7594
Total	Lower	-10.5404	8.642455	-1.76356
	Upper	11.06566	28.8957	14.62666

Table H7, Mean Expenditures By Income Class, Non-Computer Owners, Rec. CPI

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$26.51	$21.28	$15.99	$12.92
$5,000 to $9,999	9.44	10.00	8.83	7.50
$10,000 to $14,999	12.88	15.31	16.06	8.60
$15,000 to $19,999	17.11	18.16	16.45	17.08
$20,000 to $29,999	23.86	24.86	28.06	16.94
$30,000 to $39,999	32.58	33.94	32.30	24.91
$40,000 to $49,999	38.04	41.16	44.82	33.75
$50,000 to $69,999	46.27	50.28	49.94	33.59
$70,000 and over	72.26	59.22	49.14	51.80
Total	27.43	27.47	26.72	20.31

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-4.94483	-3.05113	-4.84397
	Upper	15.39366	13.64615	10.988
$5,000 to $9,999	Lower	-3.72599	-3.48673	-3.17144
	Upper	4.842461	5.810979	5.831542
$10,000 to $14,999	Lower	-2.83521	-5.48253	2.356169
	Upper	7.684479	6.995418	12.57587
$15,000 to $19,999	Lower	-4.3668	-4.95636	-7.98346
	Upper	6.458596	8.37805	9.240079
$20,000 to $29,999	Lower	-5.39042	-3.36613	5.614048
	Upper	7.374408	9.776411	16.63814
$30,000 to $39,999	Lower	-6.99446	-8.87093	-1.80271
	Upper	9.724986	12.16589	16.57275
$40,000 to $49,999	Lower	-15.2534	-17.5887	-4.84314
	Upper	21.48645	24.91688	26.97478
$50,000 to $69,999	Lower	-9.72223	-15.9005	2.097785
	Upper	17.73749	16.57182	30.59434
$70,000 and over	Lower	-10.1234	-11.4292	-12.2809
	Upper	36.20989	31.58638	17.6135
Total	Lower	-3.84437	-3.38577	3.158446
	Upper	3.92262	4.868724	9.668653

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-3.28455	-1.68809	-3.55156
	Upper	13.73338	12.28311	9.695599
$5,000 to $9,999	Lower	-3.02653	-2.72773	-2.43651
	Upper	4.142995	5.051983	5.096604
$10,000 to $14,999	Lower	-1.97646	-4.46392	3.19043
	Upper	6.825729	5.97681	11.7416
$15,000 to $19,999	Lower	-3.4831	-3.86783	-6.57745
	Upper	5.57489	7.289527	7.834076
$20,000 to $29,999	Lower	-4.34839	-2.29327	6.513974
	Upper	6.332382	8.70355	15.73821
$30,000 to $39,999	Lower	-5.62961	-7.15364	-0.30267
	Upper	8.360133	10.4486	15.07271
$40,000 to $49,999	Lower	-12.2543	-14.1188	-2.24576
	Upper	18.48728	21.44704	24.37739
$50,000 to $69,999	Lower	-7.48062	-13.2497	4.424034
	Upper	15.49588	13.92102	28.26809
$70,000 and over	Lower	-6.34111	-7.91775	-9.84052
	Upper	32.42758	28.07491	15.17314

Table H-7 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$37.31	$37.54	$33.81	$22.02
$5,000 to $9,999	17.59	22.24	22.02	12.18
$10,000 to $14,999	34.70	26.25	28.24	20.13
$15,000 to $19,999	35.99	35.17	30.87	25.97
$20,000 to $29,999	57.15	48.69	43.86	28.43
$30,000 to $39,999	74.52	66.18	58.39	59.26
$40,000 to $49,999	91.09	78.21	75.68	57.73
$50,000 to $69,999	101.71	93.59	75.75	79.98
$70,000 and over	138.97	158.06	169.63	119.81
Total	59.82	55.61	51.80	41.15

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-16.1467	-13.6058	-2.4709
	Upper	16.61216	21.06658	26.0461
$5,000 to $9,999	Lower	-2.70027	-9.13481	1.608798
	Upper	12.00007	9.57179	18.05913
$10,000 to $14,999	Lower	-4.62427	-5.55869	-1.35611
	Upper	21.52373	9.536182	17.56784
$15,000 to $19,999	Lower	-11.3233	-8.53397	-6.39105
	Upper	12.97121	17.13309	16.18489
$20,000 to $29,999	Lower	-5.51962	-9.23657	2.479155
	Upper	22.42365	18.90466	28.37554
$30,000 to $39,999	Lower	-12.5769	-12.2845	-17.9702
	Upper	29.24358	27.87292	19.70745
$40,000 to $49,999	Lower	-10.6843	-21.3762	-3.87564
	Upper	36.42683	26.44006	39.78061
$50,000 to $69,999	Lower	-13.133	0.904098	-13.8377
	Upper	29.36807	34.77809	22.29774
$70,000 and over	Lower	-20.6259	-35.8186	9.388542
	Upper	58.79521	58.96635	90.26501
Total	Lower	-2.87972	-2.85938	4.968758
	Upper	11.29771	10.48928	16.32917

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-13.4725	-10.7754	-0.14298
	Upper	13.93797	18.23618	23.71818
$5,000 to $9,999	Lower	-1.50025	-7.60774	2.951683
	Upper	10.80004	8.04472	16.71625
$10,000 to $14,999	Lower	-2.48974	-4.32645	0.188703
	Upper	19.3892	8.303948	16.02303
$15,000 to $19,999	Lower	-9.34012	-6.4387	-4.54812
	Upper	10.98799	15.03782	14.34196
$20,000 to $29,999	Lower	-3.23853	-6.93933	4.593145
	Upper	20.14257	16.60742	26.26155
$30,000 to $39,999	Lower	-9.16295	-9.00633	-14.8945
	Upper	25.82967	24.59476	16.63172
$40,000 to $49,999	Lower	-6.83851	-17.4729	-0.31186
	Upper	32.58102	22.53669	36.21683
$50,000 to $69,999	Lower	-9.66352	3.669322	-10.8879
	Upper	25.89859	32.01286	19.34791
$70,000 and over	Lower	-14.1426	-28.0811	15.9907
	Upper	52.31185	51.2288	83.66285
Total	Lower	-1.72238	-1.76969	5.896139
	Upper	10.14037	9.399595	15.40179

<u>Table H8, Mean Expenditures By Income Class, Non-Computer Owners, F/E CPI</u>

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$27.42	$21.76	$16.16	$12.92
$5,000 to $9,999	9.76	10.22	8.93	7.50
$10,000 to $14,999	13.33	15.65	16.24	8.60
$15,000 to $19,999	17.70	18.57	16.63	17.08
$20,000 to $29,999	24.68	25.41	28.36	16.94
$30,000 to $39,999	33.70	34.70	32.64	24.91
$40,000 to $49,999	39.35	42.08	45.30	33.75
$50,000 to $69,999	47.86	51.40	50.48	33.59
$70,000 and over	74.74	60.54	49.67	51.80
Total	28.37	28.08	27.01	20.31

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-4.80443	-2.90284	-4.70309
	Upper	16.12388	14.10318	11.19306
$5,000 to $9,999	Lower	-3.94057	-3.43905	-3.09905
	Upper	4.855166	6.018881	5.950288
$10,000 to $14,999	Lower	-3.07648	-5.7509	2.484757
	Upper	7.724477	6.927259	12.79487
$15,000 to $19,999	Lower	-4.69261	-4.83391	-8.19329
	Upper	6.4198	8.711288	9.093972
$20,000 to $29,999	Lower	-5.83564	-3.72533	5.873291
	Upper	7.290408	9.631941	16.98609
$30,000 to $39,999	Lower	-7.5758	-8.62692	-1.52877
	Upper	9.584364	12.74003	16.99761
$40,000 to $49,999	Lower	-16.0968	-18.3992	-4.48308
	Upper	21.55486	24.85795	27.58453
$50,000 to $69,999	Lower	-10.5591	-15.5757	2.525925
	Upper	17.64143	17.41332	31.24682
$70,000 and over	Lower	-9.58706	-11.0493	-12.9061
	Upper	37.99316	32.78971	17.17551
Total	Lower	-3.69947	-3.1311	3.420944
	Upper	4.278651	5.263281	9.984417

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-3.096	-1.5146	-3.40545
	Upper	14.41545	12.71493	9.895418
$5,000 to $9,999	Lower	-3.22255	-2.66698	-2.36033
	Upper	4.137147	5.246804	5.211566
$10,000 to $14,999	Lower	-2.19477	-4.71594	3.326399
	Upper	6.842766	5.892308	11.95323
$15,000 to $19,999	Lower	-3.78547	-3.72818	-6.78209
	Upper	5.512665	7.605557	7.682767
$20,000 to $29,999	Lower	-4.76413	-2.63494	6.780458
	Upper	6.218893	8.541551	16.07892
$30,000 to $39,999	Lower	-6.17497	-6.88268	-0.01642
	Upper	8.183534	10.99579	15.48526
$40,000 to $49,999	Lower	-13.0232	-14.868	-1.86532
	Upper	18.48126	21.32675	24.96676
$50,000 to $69,999	Lower	-8.25701	-12.8827	4.870488
	Upper	15.33934	14.72034	28.90225
$70,000 and over	Lower	-5.70296	-7.47064	-10.4505
	Upper	34.10906	29.21101	14.71987

Table H-8 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$38.59	$38.38	$34.18	$22.02
$5,000 to $9,999	18.19	22.73	22.26	12.18
$10,000 to $14,999	35.89	26.83	28.54	20.13
$15,000 to $19,999	37.23	35.95	31.20	25.97
$20,000 to $29,999	59.11	49.78	44.33	28.43
$30,000 to $39,999	77.08	67.66	59.02	59.26
$40,000 to $49,999	94.21	79.96	76.50	57.73
$50,000 to $69,999	105.20	95.68	76.57	79.98
$70,000 and over	143.75	161.59	171.47	119.81
Total	61.87	56.85	52.36	41.15

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-16.6223	-13.4201	-2.21965
	Upper	17.0431	21.8271	26.52649
$5,000 to $9,999	Lower	-3.00166	-9.02175	1.779119
	Upper	12.08657	9.976096	18.36525
$10,000 to $14,999	Lower	-4.45044	-5.9504	-1.09424
	Upper	22.56145	9.365832	17.91695
$15,000 to $19,999	Lower	-11.188	-8.31377	-6.11628
	Upper	13.7377	17.81663	16.57802
$20,000 to $29,999	Lower	-5.07198	-8.82526	2.838994
	Upper	23.72723	19.72053	28.96475
$30,000 to $39,999	Lower	-12.0556	-11.813	-18.6755
	Upper	30.88579	29.09586	19.14923
$40,000 to $49,999	Lower	-9.97753	-20.8334	-3.20983
	Upper	38.48445	27.7551	40.7524
$50,000 to $69,999	Lower	-12.3795	1.895639	-14.7441
	Upper	31.42186	36.33015	21.56513
$70,000 and over	Lower	-22.8797	-38.314	10.93611
	Upper	58.5618	58.06841	92.38796
Total	Lower	-2.26845	-2.29228	5.491472
	Upper	12.31226	11.28673	16.9272

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-13.8741	-10.5427	0.126969
	Upper	14.29491	18.94978	24.17986
$5,000 to $9,999	Lower	-1.76997	-7.47091	3.133089
	Upper	10.85488	8.425251	17.01128
$10,000 to $14,999	Lower	-2.24539	-4.7001	0.457697
	Upper	20.3564	8.115527	16.36501
$15,000 to $19,999	Lower	-9.15325	-6.18067	-4.26369
	Upper	11.70295	15.68354	14.72542
$20,000 to $29,999	Lower	-2.72103	-6.495	4.971708
	Upper	21.37627	17.39026	26.83204
$30,000 to $39,999	Lower	-8.55022	-8.4735	-15.5877
	Upper	27.38036	25.75636	16.0615
$40,000 to $49,999	Lower	-6.02145	-16.867	0.378923
	Upper	34.52837	23.78869	37.16365
$50,000 to $69,999	Lower	-8.80392	4.70662	-11.7801
	Upper	27.84623	33.51917	18.60111
$70,000 and over	Lower	-16.2315	-30.4461	17.58524
	Upper	51.91351	50.20046	85.73883
Total	Lower	-1.07819	-1.18379	6.425001
	Upper	11.122	10.17824	15.99367

Table H9, Mean Expenditures By Income Class, Non-Comp. Owners, GDP Deflator

Panel A, Mean CD Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$27.09	$21.63	$16.12	$12.92
$5,000 to $9,999	9.64	10.16	8.90	7.50
$10,000 to $14,999	13.16	15.56	16.19	8.60
$15,000 to $19,999	17.49	18.46	16.58	17.08
$20,000 to $29,999	24.38	25.26	28.29	16.94
$30,000 to $39,999	33.29	34.49	32.55	24.91
$40,000 to $49,999	38.87	41.82	45.18	33.75
$50,000 to $69,999	47.28	51.09	50.34	33.59
$70,000 and over	73.83	60.18	49.53	51.80
Total	28.02	27.91	26.94	20.31

95% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-4.90984	-2.946	-4.73949
	Upper	15.82152	13.97673	11.14003
$5,000 to $9,999	Lower	-3.84694	-3.45365	-3.11776
	Upper	4.877274	5.961239	5.919577
$10,000 to $14,999	Lower	-2.96309	-5.67591	2.451523
	Upper	7.74885	6.948707	12.73825
$15,000 to $19,999	Lower	-4.54272	-4.87025	-8.13902
	Upper	6.4794	8.618628	9.131722
$20,000 to $29,999	Lower	-5.62737	-3.62382	5.806283
	Upper	7.379904	9.675962	16.89612
$30,000 to $39,999	Lower	-7.30359	-8.69906	-1.59957
	Upper	9.718514	12.57973	16.88776
$40,000 to $49,999	Lower	-15.7325	-18.173	-4.57613
	Upper	21.64648	24.88191	27.42686
$50,000 to $69,999	Lower	-10.1652	-15.6729	2.415274
	Upper	17.79945	17.17801	31.07811
$70,000 and over	Lower	-9.93732	-11.161	-12.7444
	Upper	37.24648	32.45552	17.2887
Total	Lower	-3.84348	-3.20471	3.35309
	Upper	4.067043	5.152121	9.90278

90% Confidence Intervals

		98-99 CD	99-00 CD	00-01 CD
Less than $5,000	Lower	-3.21748	-1.56456	-3.4432
	Upper	14.12916	12.59528	9.843744
$5,000 to $9,999	Lower	-3.13476	-2.68508	-2.38001
	Upper	4.165094	5.192677	5.181836
$10,000 to $14,999	Lower	-2.08865	-4.64532	3.291255
	Upper	6.874406	5.918127	11.89851
$15,000 to $19,999	Lower	-3.64296	-3.76912	-6.72917
	Upper	5.579635	7.517495	7.721865
$20,000 to $29,999	Lower	-4.56555	-2.53812	6.711577
	Upper	6.318086	8.590266	15.99083
$30,000 to $39,999	Lower	-5.91403	-6.96202	-0.0904
	Upper	8.328954	10.84269	15.37859
$40,000 to $49,999	Lower	-12.6811	-14.6583	-1.96364
	Upper	18.59514	21.36722	24.81437
$50,000 to $69,999	Lower	-7.88233	-12.9912	4.755097
	Upper	15.51662	14.4963	28.73828
$70,000 and over	Lower	-6.08558	-7.60043	-10.2928
	Upper	33.39474	28.89499	14.83701

Table H-9 continued; Panel B, Mean Movie Ticket Expenditures

Income Class	1998	1999	2000	2001
Less than $5,000	$38.12	$38.15	$34.08	$22.02
$5,000 to $9,999	17.97	22.60	22.20	12.18
$10,000 to $14,999	35.45	26.67	28.46	20.13
$15,000 to $19,999	36.77	35.74	31.11	25.97
$20,000 to $29,999	58.39	49.49	44.21	28.43
$30,000 to $39,999	76.14	67.26	58.86	59.26
$40,000 to $49,999	93.07	79.49	76.29	57.73
$50,000 to $69,999	103.92	95.11	76.36	79.98
$70,000 and over	142.00	160.63	170.99	119.81
Total	61.12	56.51	52.21	41.15

95% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-16.6554	-13.4769	-2.28458
	Upper	16.71617	21.61618	26.40227
$5,000 to $9,999	Lower	-2.85498	-9.05662	1.735105
	Upper	12.11165	9.863499	18.2861
$10,000 to $14,999	Lower	-4.57201	-5.84025	-1.16191
	Upper	22.12969	9.417166	17.82667
$15,000 to $19,999	Lower	-11.3289	-8.37902	-6.18729
	Upper	13.40124	17.62656	16.47636
$20,000 to $29,999	Lower	-5.34679	-8.94523	2.74599
	Upper	23.1572	19.49322	28.81241
$30,000 to $39,999	Lower	-12.4124	-11.951	-18.4931
	Upper	30.17362	28.755	19.29349
$40,000 to $49,999	Lower	-10.4232	-20.9944	-3.3819
	Upper	37.59086	27.38753	40.50112
$50,000 to $69,999	Lower	-12.8651	1.613099	-14.5098
	Upper	30.4881	35.8974	21.75448
$70,000 and over	Lower	-21.7855	-37.6124	10.53614
	Upper	59.03972	58.34148	91.83903
Total	Lower	-2.61588	-2.45486	5.356355
	Upper	11.83179	11.06226	16.77258

90% Confidence Intervals

		98-99 Movie	99-00 Movie	00-01 Movie
Less than $5,000	Lower	-13.9312	-10.6122	0.057206
	Upper	13.99196	18.75144	24.06048
$5,000 to $9,999	Lower	-1.63322	-7.51212	3.086206
	Upper	10.88988	8.319	16.935
$10,000 to $14,999	Lower	-2.39228	-4.59474	0.388179
	Upper	19.94996	8.171663	16.27658
$15,000 to $19,999	Lower	-9.31007	-6.25611	-4.33719
	Upper	11.38246	15.50365	14.62626
$20,000 to $29,999	Lower	-3.01993	-6.62373	4.87386
	Upper	20.83034	17.17171	26.68454
$30,000 to $39,999	Lower	-8.93601	-8.62806	-15.4085
	Upper	26.69721	25.43206	16.20887
$40,000 to $49,999	Lower	-6.50369	-17.0448	0.200387
	Upper	33.67134	23.43799	36.91883
$50,000 to $69,999	Lower	-9.32607	4.411818	-11.5494
	Upper	26.94906	33.09868	18.79413
$70,000 and over	Lower	-15.1876	-29.7794	17.17311
	Upper	52.44174	50.50851	85.20206
Total	Lower	-1.43648	-1.35142	6.288292
	Upper	10.65239	9.95882	15.84065

Appendix I, Alternative WLS Specifications For The Micro-Level CEX Data

This appendix includes the regression results from alternative WLS specifications used to analyze the micro-level CEX data. For the natural log of both CD and movie expenditures, we run alternate specifications of (77) for years 1998 and 2001, as well as for the pooled data. On the pooled data, we adjusted all figures to 2001 dollars using the CPI for all items less food and energy. The alternate specifications modify only the independent variables of (77) as follows,

$$\beta_1 + \beta_2 \ln y + \beta_3 COMP + \beta_4 AGECAT_1 + \beta_5 AGECAT_2 + \beta_6 AGECAT_3 + FMSZ \quad \text{(I77)}$$

and,

$$\beta_1 + \beta_2 \ln y + \beta_3 COMP + \beta_4 AGECAT_2 + \beta_5 AGECAT_3 + \beta_6 AGECAT_4 + FMSZ \quad \text{(I78)}$$

where the interaction variables originally specified in (77) are separated. The age category variables consist of four dummy variables grouped by age of the CU reference person (the CEX variable name is *ref_age*) as follows: under 31, between 31 and 55, between 56 and 65, and over 65. The variable *fmsz* simply restructures the CEX variable *fam_size*, and is designed so that all CUs consisting of 6 or more people are placed into the largest family size. The results from these regressions, presented in Tables I1 through I12, do not materially change the results presented in the main body of the text.

Table I1, Alternate WLS Specifications for CD Exp., Oldest CUs As Reference Category (1998)

No. Of Observations		Overall Fit	
Unweighted:	4,407	F Value:	34.6998
Weighted:	79,003,370	Prob > F:	0.0000
Sum of Squares		R^2:	0.0775
Model:	4,912,251		
Error:	58,454,000		
Total:	63,366,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.6831	0.1706	0.0000
lny	0.2021	0.0168	0.0000
COMP	0.1201	0.0307	0.0003
$AGECAT_1$	0.0172	0.1413	0.9039
$AGECAT_2$	-0.0324	0.1336	0.8097
$AGECAT_3$	-0.1633	0.1404	0.2509
FMSZ	-0.0506	0.0126	0.0002

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	1.3964	1.9699
lny	0.1739	0.2304
COMP	0.0686	0.1716
$AGECAT_1$	-0.2203	0.2546
$AGECAT_2$	-0.2568	0.1921
$AGECAT_3$	-0.3992	0.0725
FMSZ	-0.0719	-0.0294

Table I2, Alternate WLS Specifications for CD Exp., Youngest CUs As Reference Category (1998)

No. Of Observations		Overall Fit	
Unweighted:	4,407	F Value:	34.6998
Weighted:	79,003,370	Prob > F:	0.0000
Sum of Squares		R^2:	0.0775
Model:	4,912,251		
Error:	58,454,000		
Total:	63,366,000		

Independent Variable	*b*	*SE*	*p value*	*Independent Variable*	*Lower 95%*	*Upper 95%*
Intercept	1.7003	0.1575	0.0000	Intercept	1.4357	1.9649
lny	0.2021	0.0168	0.0000	lny	0.1739	0.2304
COMP	0.1201	0.0307	0.0003	COMP	0.0686	0.1716
$AGECAT_2$	-0.0495	0.0452	0.2790	$AGECAT_2$	-0.1254	0.0264
$AGECAT_3$	-0.1805	0.0578	0.0032	$AGECAT_3$	-0.2776	-0.0834
$AGECAT_4$	-0.0172	0.1413	0.9039	$AGECAT_4$	-0.2546	0.2203
FMSZ	-0.0506	0.0126	0.0002	FMSZ	-0.0719	-0.0294

Table I3, Alternate WLS Specifications for Movie Exp., Oldest CUs As Reference Category (1998)

No. Of Observations		Overall Fit	
Unweighted:	7,515	F Value:	60.3502
Weighted:	135,412,496	Prob > F:	0.0000
Sum of Squares		R^2:	0.1109
Model:	16,502,000		
Error:	132,290,000		
Total:	148,790,000		

Independent Variable	*b*	*SE*	*p value*	*Independent Variable*	*Lower 95%*	*Upper 95%*
Intercept	0.9472	0.1549	0.0000	Intercept	0.6868	1.2075
lny	0.2862	0.0148	0.0000	lny	0.2614	0.3110
COMP	0.1356	0.0281	0.0000	COMP	0.0883	0.1829
$AGECAT_1$	-0.1615	0.0990	0.1099	$AGECAT_1$	-0.3279	0.0048
$AGECAT_2$	-0.2448	0.0978	0.0161	$AGECAT_2$	-0.4092	-0.0804
$AGECAT_3$	-0.1510	0.0903	0.1018	$AGECAT_3$	-0.3028	0.0008
FMSZ	0.0015	0.0099	0.8811	FMSZ	-0.0152	0.0182

Table I4, Alternate WLS Specifications for Movie Exp., Youngest CUs As Reference Category (1998)

No. Of Observations		Overall Fit	
Unweighted:	7,515	F Value:	60.3502
Weighted:	135,412,496	Prob > F:	0.0000
Sum of Squares		R^2:	0.1109
Model:	16,502,000		
Error:	132,290,000		
Total:	148,790,000		

Independent Variable	*b*	*SE*	*p value*	*Independent Variable*	*Lower 95%*	*Upper 95%*
Intercept	0.7856	0.1346	0.0000	Intercept	0.5594	1.0118
lny	0.2862	0.0148	0.0000	lny	0.2614	0.3110
COMP	0.1356	0.0281	0.0000	COMP	0.0883	0.1829
$AGECAT_2$	-0.0833	0.0263	0.0028	$AGECAT_2$	-0.1274	-0.0391
$AGECAT_3$	0.0105	0.0558	0.8510	$AGECAT_3$	-0.0832	0.1043
$AGECAT_4$	0.1615	0.0990	0.1099	$AGECAT_4$	-0.0048	0.3279
FMSZ	0.0015	0.0099	0.8811	FMSZ	-0.0152	0.0182

Table I5, Alternate WLS Specifications for CD Exp., Oldest CUs As Reference Category (2001)

No. Of Observations		Overall Fit	
Unweighted:	5,283	F Value:	44.7904
Weighted:	74,053,310	Prob > F:	0.0000
Sum of Squares		$R^{2:}$	0.0828
Model:	5,027,888		
Error:	55,670,000		
Total:	60,698,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.3759	0.1591	0.0000
lny	0.2263	0.0169	0.0000
COMP	0.0744	0.0359	0.0441
$AGECAT_1$	0.1332	0.1038	0.2061
$AGECAT_2$	-0.0263	0.1057	0.8045
$AGECAT_3$	-0.1093	0.1062	0.3090
FMSZ	-0.0256	0.0109	0.0231

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	1.0553	1.6965
lny	0.1922	0.2605
COMP	0.0021	0.1467
$AGECAT_1$	-0.0760	0.3424
$AGECAT_2$	-0.2393	0.1867
$AGECAT_3$	-0.3233	0.1047
FMSZ	-0.0475	-0.0037

Table I6, Alternate WLS Specifications for CD Exp., Youngest CUs As Reference Category (2001)

No. Of Observations		Overall Fit	
Unweighted:	5,283	F Value:	44.7904
Weighted:	74,053,310	Prob > F:	0.0000
Sum of Squares		$R^{2:}$	0.0828
Model:	5,027,888		
Error:	55,670,000		
Total:	60,698,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.5091	0.1420	0.0000
lny	0.2263	0.0169	0.0000
COMP	0.0744	0.0359	0.0441
$AGECAT_2$	-0.1595	0.0310	0.0000
$AGECAT_3$	-0.2425	0.0459	0.0000
$AGECAT_4$	-0.1332	0.1038	0.2061
FMSZ	-0.0256	0.0109	0.0231

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	1.2230	1.7952
lny	0.1922	0.2605
COMP	0.0021	0.1467
$AGECAT_2$	-0.2220	-0.0971
$AGECAT_3$	-0.3351	-0.1499
$AGECAT_4$	-0.3424	0.0760
FMSZ	-0.0475	-0.0037

Table I7, Alternate WLS Specifications for Movie Exp., Oldest CUs As Reference Category (2001)

No. Of Observations		Overall Fit	
Unweighted:	8,722	F Value:	44.7904
Weighted:	121,959,282	Prob > F:	0.0000
Sum of Squares		$R^{2:}$	0.1169
Model:	16,403,000		
Error:	123,870,000		
Total:	140,270,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.0112	0.1207	0.0000
lny	0.2768	0.0143	0.0000
COMP	0.1686	0.0274	0.0000
$AGECAT_1$	-0.1689	0.0944	0.0804
$AGECAT_2$	-0.2148	0.0918	0.0239
$AGECAT_3$	-0.2190	0.0956	0.0269
FMSZ	0.0257	0.0117	0.0342

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	0.7678	1.2545
lny	0.2479	0.3057
COMP	0.1134	0.2239
$AGECAT_1$	-0.3591	0.0213
$AGECAT_2$	-0.3999	-0.0298
$AGECAT_3$	-0.4116	-0.0263
FMSZ	0.0020	0.0493

Table I8, Alternate WLS Specifications for Movie Exp., Youngest CUs As Reference Category (2001)

No. Of Observations		Overall Fit	
Unweighted:	8,722	F Value:	87.6908
Weighted:	121,959,282	Prob > F:	0.0000
Sum of Squares		R^2:	0.1169
Model:	16,403,000		
Error:	123,870,000		
Total:	140,270,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	0.8423	0.1277	0.0000
lny	0.2768	0.0143	0.0000
COMP	0.1686	0.0274	0.0000
$AGECAT_2$	-0.0459	0.0324	0.1633
$AGECAT_3$	-0.0501	0.0463	0.2861
$AGECAT_4$	0.1689	0.0944	0.0804
FMSZ	0.0257	0.0117	0.0342

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	0.5849	1.0996
lny	0.2479	0.3057
COMP	0.1134	0.2239
$AGECAT_2$	-0.1112	0.0194
$AGECAT_3$	-0.1435	0.0434
$AGECAT_4$	-0.0213	0.3591
FMSZ	0.0020	0.0493

Table I9, Alternate WLS Specifications for CD Exp., Oldest CUs As Reference Category (Pooled)

Real Expenditures Using the CPI for All Items Less Food and Energy

No. Of Observations		Overall Fit	
Unweighted:	20,431	F Value:	82.2162
Weighted:	299,809,303	Prob > F:	0.0000
Sum of Squares		R^2:	0.0726
Model:	17,406,000		
Error:	222,250,000		
Total:	239,660,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.5556	0.1033	0.0000
lny	0.2095	0.0109	0.0000
COMP	0.0573	0.0181	0.0028
$AGECAT_1$	0.1201	0.0656	0.0738
$AGECAT_2$	0.0253	0.0583	0.6666
$AGECAT_3$	-0.0646	0.0731	0.3820
FMSZ	-0.0314	0.0069	0.0000

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	1.3474	1.7638
lny	0.1876	0.2314
COMP	0.0208	0.0937
$AGECAT_1$	-0.0120	0.2522
$AGECAT_2$	-0.0922	0.1428
$AGECAT_3$	-0.2119	0.0828
FMSZ	-0.0454	-0.0175

Table I10, Alternate WLS Specifications for CD Exp., Youngest CUs As Reference Category (Pooled)

Real Expenditures Using the CPI for All Items Less Food and Energy

No. Of Observations		Overall Fit	
Unweighted:	20,431	F Value:	82.2162
Weighted:	299,809,303	Prob > F:	0.0000
Sum of Squares		R^2:	0.0726
Model:	17,406,000		
Error:	222,250,000		
Total:	239,660,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.6757	0.1035	0.0000
lny	0.2095	0.0109	0.0000
COMP	0.0573	0.0181	0.0028
$AGECAT_2$	-0.0948	0.0227	0.0001
$AGECAT_3$	-0.1846	0.0278	0.0000
$AGECAT_4$	-0.1201	0.0656	0.0738
FMSZ	-0.0314	0.0069	0.0000

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	1.4671	1.8843
lny	0.1876	0.2314
COMP	0.0208	0.0937
$AGECAT_2$	-0.1406	-0.0490
$AGECAT_3$	-0.2407	-0.1286
$AGECAT_4$	-0.2522	0.0120
FMSZ	-0.0454	-0.0175

Table I11, Alternate WLS Specifications for Movie Exp., Oldest CUs As Reference Category (Pooled)

Real Expenditures Using the CPI for All Items Less Food and Energy

No. Of Observations		Overall Fit	
Unweighted:	33,509	F Value:	147.2030
Weighted:	493,159,323	Prob > F:	0.0000
Sum of Squares		$R^{2:}$	0.1108
Model:	61,521,000		
Error:	493,840,000		
Total:	555,360,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.1168	0.0915	0.0000
lny	0.2780	0.0098	0.0000
COMP	0.1372	0.0161	0.0000
$AGECAT_1$	-0.2440	0.0456	0.0000
$AGECAT_2$	-0.2908	0.0478	0.0000
$AGECAT_3$	-0.1709	0.0525	0.0022
FMSZ	0.0120	0.0062	0.0579

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	0.9323	1.3013
lny	0.2583	0.2976
COMP	0.1048	0.1696
$AGECAT_1$	-0.3359	-0.1521
$AGECAT_2$	-0.3871	-0.1945
$AGECAT_3$	-0.2766	-0.0651
FMSZ	-0.0004	0.0244

Table I12, Alternate WLS Specifications for Movie Exp., Youngest CUs As Reference Category (Pooled)

Real Expenditures Using the CPI for All Items Less Food and Energy

No. Of Observations		Overall Fit	
Unweighted:	33,509	F Value:	147.2030
Weighted:	493,159,323	Prob > F:	0.0000
Sum of Squares		$R^{2:}$	0.1108
Model:	61,521,000		
Error:	493,840,000		
Total:	555,360,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	0.8728	0.0878	0.0000
lny	0.2780	0.0098	0.0000
COMP	0.1372	0.0161	0.0000
$AGECAT_2$	-0.0468	0.0167	0.0076
$AGECAT_3$	0.0731	0.0343	0.0386
$AGECAT_4$	0.2440	0.0456	0.0000
FMSZ	0.0120	0.0062	0.0579

Independent Variable	*Lower 95%*	*Upper 95%*
Intercept	0.6959	1.0497
lny	0.2583	0.2976
COMP	0.1048	0.1696
$AGECAT_2$	-0.0805	-0.0131
$AGECAT_3$	0.0040	0.1423
$AGECAT_4$	0.1521	0.3359
FMSZ	-0.0004	0.0244

Appendix J, WLS Results Accounting For Internet Subscriptions

Only starting in 2001 does the Consumer Expenditure data include variables relating to CUs Internet subscriptions. In 2001, the annual mean expenditure on both CDs and movie tickets is higher for computer owning CUs with Internet subscriptions versus those computer owning CUs without Internet subscriptions. Table J1 shows that, for 2001, the annual mean CD expenditure was $68.90 for those CUs with an Internet subscription, versus $54.48 for those without an Internet subscription (but with a computer). The results also show that the annual mean movie ticket expenditures were $149.31 for those with an Internet subscription versus $129.25 for those without an Internet subscription.

Additionally, Table J1 demonstrates that these differences hold for most income classes, and Table J2 shows that the annual mean wage and salary income is $60,522 for CUs with an Internet subscription, versus $53,050 for those without an Internet subscription. These differences also seem to hold for before and after tax income as well, although the sample size for Internet subscribers is considerably lower than for non-subscribers.

This higher income among computer owners with an Internet subscription suggests that higher income CUs do spend more on entertainment goods than lower income CUs. Once the 2002 CEX micro data are released (scheduled for the first quarter of 2004), we will be able to examine the change in the annual mean CD and movie expenditures for these two groups of CUs, a test which should provide better information regarding the impact of file sharing on CD sales. For now, we are constrained to examining 2001 relationships for Internet subscribers, something we accomplish by modifying our primary OLS regression model (77).

Taking into account Internet and high-speed access subscribers, we use two additional dummy variables to modify (77) as follows,

$$\ln ENT\exp = \beta_1 + \beta_2 \ln y + \beta_3 COMP + \beta_4 INT_1 + \beta_5 INT_2 + \beta_6 INT_3 + \beta_7 NET + \beta_8 HSP \quad \text{(J77)}$$

where all but the last two independent variables in (J77) are the same as those presented in section 6.4.1. In (J77), however, an indicator variable is included for those CUs with an Internet subscription (*NET*), and those with high-speed Internet access (*HSP*). For both dummy variables, those CUs *with* subscriptions are set equivalent to one.

The results from the regressions using the log of CD and movie expenditures in 2001, respectively, as the dependent variable in model (J77), are presented in Tables J3 and J4. These results show that the coefficient on *NET* is positively related to the log of CD expenditures and statistically significant at the 1 percent level. Additionally, the coefficient on *HSP*, is not statistically significant at even the 10 percent level. When the log of movie expenditures serves as the dependent variable, the coefficient on *NET* is also positive, and it is statistically significant at the 5 percent level. Just as when the log of CD expenditures is used as the dependent variable, the coefficient on *HSP* is not statistically significant at even the 10 percent level when serving as a regressor for the log of movie expenditures.

Since we only have data on Internet users for 2001, it seems best to reexamine this issue when additional years of data are available rather than to make broad conclusions about the relationship between CD expenditures and Internet subscriptions. Nonetheless, it does appear that Internet subscribers are more likely to spend more on both CDs and movie tickets than consumers who do not own a computer.

Table J1, Internet Users' Expenditures Vs. Non-Internet Users Expenditures, 2001

Mean CD and Movie Expenditures

		Internet CD exp	No Internet CD exp	Internet Movie exp	No Internet Movie exp
Less than $5,000		$13.34	$41.91	$198.17	$106.62
	n	*2*	*77*	*9*	*171*
$5,000 to $9,999		$61.66	$58.80	$86.81	$68.25
	n	*7*	*74*	*12*	*119*
$10,000 to $14,999		$66.16	$42.36	$62.59	$83.39
	n	*7*	*96*	*16*	*156*
$15,000 to $19,999		$21.51	$32.14	$76.93	$82.41
	n	*6*	*92*	*18*	*168*
$20,000 to $29,999		$29.50	$31.19	$99.48	$79.72
	n	*34*	*249*	*62*	*427*
$30,000 to $39,999		$82.31	$33.06	$108.41	$92.58
	n	*52*	*293*	*69*	*539*
$40,000 to $49,999		$55.18	$51.02	$79.65	$91.75
	n	*53*	*348*	*68*	*550*
$50,000 to $69,999		$60.25	$59.66	$121.92	$120.59
	n	*103*	*620*	*153*	*1,046*
$70,000 and over		$88.93	$72.93	$222.61	$195.85
	n	*222*	*1,311*	*361*	*2,227*
Total		$68.90	$54.48	$149.31	$129.25
	n	*486*	*3,160*	*768*	*5,403*

Table J2, Internet Users' Income Vs. Non-Internet Users Income, 2001

Mean Income for those with computer and internet subscription

wage and salary	$60,522
before tax income	$66,883
after tax income	$61,267
Number of Observations	1,384

Mean Income for those with computer and no internet subscription

wage and salary	$53,050
before tax income	$58,638
after tax income	$54,739
Number of Observations	10,665

Table J3, WLS Results on 2001 CD Expenditures, CUs With Internet Access

Panel A With High Speed Dummy

No. Of Observations		Overall Fit	
Unweighted:	4,297	F Value:	18.0166
Weighted:	59,900,964	Prob > F:	0.0000
Sum of Squares		R^2:	0.0581
Model:	2,622,999		
Error:	42,485,000		
Total:	45,108,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.7889	0.1989	0.0000
lny	0.1862	0.0217	0.0000
COMP	0.0687	0.0404	0.0959
NETACC	0.0960	0.0346	0.0082
HIGHSPD	-0.1069	0.0877	0.2292
INT_1	0.0015	0.0167	0.9308
INT_2	-0.0217	0.0106	0.0468
INT_3	-0.0548	0.0187	0.0053

Independent Variable	*Lower 90%*	*Upper 90%*	*Lower 95%*	*Upper 95%*	*Lower 99%*	*Upper 99%*
Intercept	1.4548	2.1231	1.3881	2.1898	1.2535	2.3244
lny	0.1498	0.2227	0.1425	0.2299	0.1278	0.2446
COMP	0.0009	0.1366	-0.0127	0.1502	-0.0400	0.1775
NETACC	0.0378	0.1541	0.0262	0.1657	0.0027	0.1892
HIGHSPD	-0.2542	0.0404	-0.2835	0.0698	-0.3429	0.1291
INT_1	-0.0266	0.0295	-0.0322	0.0351	-0.0434	0.0464
INT_2	-0.0396	-0.0039	-0.0431	-0.0003	-0.0503	0.0069
INT_3	-0.0862	-0.0234	-0.0924	-0.0172	-0.1051	-0.0045

Panel B Without High Speed Dummy

No. Of Observations		Overall Fit	
Unweighted:	4,297	F Value:	21.1401
Weighted:	59,900,964	Prob > F:	0.0000
Sum of Squares		R^2:	0.0578
Model:	2,606,259		
Error:	42,502,000		
Total:	45,108,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.7957	0.1998	0.0000
lny	0.1854	0.0218	0.0000
COMP	0.0668	0.0403	0.1047
NETACC	0.0876	0.0323	0.0096
INT_1	0.0013	0.0166	0.9364
INT_2	-0.0218	0.0106	0.0454
INT_3	-0.0543	0.0187	0.0057

Independent Variable	*Lower 90%*	*Upper 90%*	*Lower 95%*	*Upper 95%*	*Lower 99%*	*Upper 99%*
Intercept	1.4600	2.1314	1.3931	2.1984	1.2578	2.3336
lny	0.1488	0.2221	0.1415	0.2294	0.1268	0.2441
COMP	-0.0010	0.1346	-0.0145	0.1481	-0.0418	0.1754
NETACC	0.0332	0.1419	0.0224	0.1527	0.0005	0.1746
INT_1	-0.0266	0.0293	-0.0322	0.0349	-0.0435	0.0461
INT_2	-0.0396	-0.0040	-0.0431	-0.0005	-0.0503	0.0067
INT_3	-0.0857	-0.0229	-0.0920	-0.0166	-0.1047	-0.0040

Table J4, WLS Results on 2001 Movie Expenditures, CUs With Internet Access

Panel A With High Speed Dummy

No. Of Observations		Overall Fit	
Unweighted:	7,254	F Value:	68.5984
Weighted:	101,028,430	Prob > F:	0.0000
Sum of Squares		R^2:	0.0906
Model:	9,976,064		
Error:	100,150,000		
Total:	110,130,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.1807	0.1251	0.0000
lny	0.2450	0.0146	0.0000
COMP	0.1515	0.0275	0.0000
NETACC	0.0830	0.0378	0.0333
HIGHSPD	-0.0745	0.0844	0.3824
INT_1	0.0124	0.0168	0.4644
INT_2	0.0247	0.0107	0.0263
INT_3	0.0133	0.0186	0.4789

Independent Variable	*Lower 90%*	*Upper 90%*	*Lower 95%*	*Upper 95%*	*Lower 99%*	*Upper 99%*
Intercept	0.9705	1.3910	0.9285	1.4329	0.8438	1.5176
lny	0.2205	0.2695	0.2157	0.2744	0.2058	0.2842
COMP	0.1054	0.1977	0.0962	0.2069	0.0776	0.2255
NETACC	0.0195	0.1464	0.0069	0.1590	-0.0187	0.1846
HIGHSPD	-0.2163	0.0674	-0.2446	0.0956	-0.3018	0.1528
INT_1	-0.0158	0.0406	-0.0214	0.0462	-0.0328	0.0576
INT_2	0.0066	0.0427	0.0030	0.0463	-0.0042	0.0536
INT_3	-0.0180	0.0446	-0.0243	0.0509	-0.0369	0.0635

Panel B Without High Speed Dummy

No. Of Observations		Overall Fit	
Unweighted:	4,297	F Value:	82.6264
Weighted:	59,900,964	Prob > F:	0.0000
Sum of Squares		R^2:	0.0905
Model:	9,961,664		
Error:	100,170,000		
Total:	110,130,000		

Independent Variable	*b*	*SE*	*p value*
Intercept	1.1838	0.1248	0.0000
lny	0.2446	0.0145	0.0000
COMP	0.1503	0.0276	0.0000
NETACC	0.0755	0.0353	0.0378
INT_1	0.0124	0.0169	0.4657
INT_2	0.0246	0.0107	0.0266
INT_3	0.0136	0.0187	0.4709

Independent Variable	*Lower 90%*	*Upper 90%*	*Lower 95%*	*Upper 95%*	*Lower 99%*	*Upper 99%*
Intercept	0.9740	1.3935	0.9322	1.4354	0.8477	1.5199
lny	0.2202	0.2690	0.2154	0.2739	0.2055	0.2837
COMP	0.1040	0.1966	0.0947	0.2059	0.0760	0.2245
NETACC	0.0163	0.1348	0.0044	0.1466	-0.0194	0.1705
INT_1	-0.0159	0.0407	-0.0216	0.0464	-0.0330	0.0578
INT_2	0.0066	0.0427	0.0030	0.0462	-0.0043	0.0535
INT_3	-0.0178	0.0450	-0.0241	0.0513	-0.0368	0.0640

Appendix K, Test For Structural Break (Computer Ownership)

When a regressor for the log of CD expenditures, the parameter estimate for computer ownership (*COMP*) declines through the four-year period (from .1169 in 1998 to .0708 in 2001). Alternatively, when a regressor for the log of movie expenditures, the parameter estimate increases through the four-year period (.1293 versus .1638). To test for a statistically significant difference in the parameter estimate from 1998 to 2001, we used the difference-in-difference method as described in section 6.3.7 of the text. These tests showed there was no statistically significant difference in the parameter estimate for *COMP* from 1998 to 2001 whether serving as a regressor for the log of CD or movie ticket expenditures. The same tests were performed after eliminating multiple CU households from the data, but the results were unchanged (these results are available from the author).

Table K1, Test For Structural Break, Real CD Expenditures Adjusted With CPI

No. Of Observations		Overall Fit	
Unweighted:	9,690	F Value:	75.2846
Weighted:	153,056,681	Prob > F:	0.0000
Sum of Squares		R^2:	0.0771
Model:	9,570,894		
Error:	114,590,000		
Total:	124,160,000		

Independent Variable	b	SE	p value
Intercept	1.6729	0.1428	0.0000
lny	0.2043	0.0149	0.0000
COMP	0.1154	0.0305	0.0005
INT_1	-0.0384	0.0133	0.0059
INT_2	-0.0418	0.0078	0.0000
INT_3	-0.0780	0.0136	0.0000
Y01	-0.0430	0.0313	0.1772
CMPINT	-0.0450	0.0303	0.1448

Independent Variable	Lower 90%	Upper 90%	Lower 95%	Upper 95%
Intercept	1.4330	1.9127	1.3852	1.9606
lny	0.1793	0.2293	0.1744	0.2343
COMP	0.0641	0.1667	0.0539	0.1769
INT_1	-0.0607	-0.0161	-0.0651	-0.0117
INT_2	-0.0548	-0.0287	-0.0574	-0.0261
INT_3	-0.1008	-0.0552	-0.1054	-0.0506
Y01	-0.0957	0.0097	-0.1062	0.0202
CMPINT	-0.0960	0.0059	-0.1061	0.0161

Table K2, Test For Structural Break, Real CD Expenditures Adjusted With GDP Deflator

No. Of Observations		Overall Fit	
Unweighted:	9,690	F Value:	75.2846
Weighted:	153,056,681	Prob > F:	0.0000
Sum of Squares		R2:	0.0768
Model:	9,529,204		
Error:	114,590,000		
Total:	124,120,000		

Independent Variable	b	SE	p value
Intercept	1.6631	0.1426	0.0000
lny	0.2043	0.0149	0.0000
COMP	0.1154	0.0305	0.0005
INT_1	-0.0384	0.0133	0.0059
INT_2	-0.0418	0.0078	0.0000
INT_3	-0.0780	0.0136	0.0000
Y01	-0.0333	0.0313	0.2934
CMPINT	-0.0450	0.0303	0.1448

Independent Variable	Lower 90%	Upper 90%	Lower 95%	Upper 95%
Intercept	1.4236	1.9027	1.3758	1.9505
lny	0.1793	0.2293	0.1744	0.2343
COMP	0.0641	0.1667	0.0539	0.1769
INT_1	-0.0607	-0.0161	-0.0651	-0.0117
INT_2	-0.0548	-0.0287	-0.0574	-0.0261
INT_3	-0.1008	-0.0552	-0.1054	-0.0506
Y01	-0.0858	0.0193	-0.0963	0.0298
CMPINT	-0.096	0.0059	-0.1061	0.0161

Table K3, Test For Structural Break, Real Movie Expenditures Adjusted With CPI

No. Of Observations		Overall Fit	
Unweighted:	16,237	F Value:	96.9749
Weighted:	257,371,779	Prob > F:	0.0000
Sum of Squares		R2:	0.1125
Model:	32,565,000		
Error:	256,810,000		
Total:	289,380,000		

Independent Variable	b	SE	p value
Intercept	0.9030	0.1089	0.0000
lny	0.2749	0.0112	0.0000
COMP	0.1253	0.0276	0.0000
INT_1	-0.0045	0.0110	0.6877
INT_2	-0.0008	0.0072	0.9094
INT_3	0.0078	0.0121	0.5251
Y01	0.0019	0.0286	0.9471
CMPINT	0.0436	0.0409	0.2920

Independent Variable	Lower 90%	Upper 90%	Lower 95%	Upper 95%
Intercept	0.7201	1.0859	0.6836	1.1224
lny	0.2561	0.2937	0.2523	0.2974
COMP	0.0789	0.1717	0.0696	0.1810
INT_1	-0.0230	0.0141	-0.0267	0.0178
INT_2	-0.0130	0.0113	-0.0154	0.0137
INT_3	-0.0126	0.0281	-0.0166	0.0322
Y01	-0.0461	0.0499	-0.0557	0.0595
CMPINT	-0.0251	0.1122	-0.0388	0.1259

Table K4, Test For Structural Break, Real Movie Expenditures Adjusted With GDP Deflator

No. Of Observations		Overall Fit	
Unweighted:	16,237	F Value:	96.9749
Weighted:	257,371,779	Prob > F:	0.0000
Sum of Squares		R2:	0.1129
Model:	32,685,000		
Error:	256,810,000		
Total:	289,500,000		

Independent Variable	b	SE	p value
Intercept	0.8941	0.1087	0.0000
lny	0.2749	0.0112	0.0000
COMP	0.1253	0.0276	0.0000
INT_1	-0.0045	0.0110	0.6877
INT_2	-0.0008	0.0072	0.9094
INT_3	0.0078	0.0121	0.5251
Y01	0.0108	0.0286	0.7076
CMPINT	0.0436	0.0409	0.2920

Independent Variable	Lower 90%	Upper 90%	Lower 95%	Upper 95%
Intercept	0.7114	1.0768	0.6750	1.1133
lny	0.2561	0.2937	0.2523	0.2974
COMP	0.0789	0.1717	0.0696	0.1810
INT_1	-0.0230	0.0141	-0.0267	0.0178
INT_2	-0.0130	0.0113	-0.0154	0.0137
INT_3	-0.0126	0.0281	-0.0166	0.0322
Y01	-0.0372	0.0588	-0.0468	0.0683
CMPINT	-0.0251	0.1122	-0.0388	0.1259

Vita

Norbert Michel was born in Metairie Louisiana in 1971 and graduated from Holy Cross High School in 1990. Michel earned his BBA from Loyola New Orleans in 1994.