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Internet Exchanges for Used Digital Goods

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Smith, Michael D. and Telang, Rahul, "Internet Exchanges for Used Digital Goods" (2008). *Heinz Research.* Paper 60.
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Research Note: Internet Exchanges for Used Digital Goods:

Empirical Analysis and Managerial Implications

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This Version: January 2008

Available from http://ssrn.com/abstract=1086358

Acknowledgements: The authors thank participants at the 2004 Workshop on Information Systems and Economics and the 2006 INFORMS Annual Conference for valuable comments on this research. We thank Al Greco for helpful assistance in obtaining industry data. We also thank David Dewey, Samita Dhanasobhon, Steve Gee, Stoyan Arabadjiyski, Sumiko Hossain, Jae Hong Park, Nat Luengnaruemitchai, and Sriram Gollapalli for outstanding research assistance. Both authors acknowledge the National Science Foundation for generous financial support provided through CAREER award IIS-0448516 (Smith) and CAREER award CNS-0546009 (Telang).

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Electronic copy available at: http://ssrn.com/abstract=1086358

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ABSTRACT

In spite of industry concerns, prior work has shown that Internet used book markets do not significantly cannibalize new book sales. In this research note we analyze similar data from markets for CDs and DVDs, goods that because of their digital characteristics may be more susceptible to cannibalization than books are.

We find that the cross price elasticity of new product demand with respect to used product prices is far higher for CDs (0.157) and DVDs (0.514) than it is for books (0.088). These higher cross price elasticities translate into higher levels of cannibalization: 24% of used CDs and 86% of used DVDs directly cannibalize new product sales. This compares to a 16% cannibalization rate for used book sales. Cannibalization is a concern to the music and movie industries because used sales generate no direct revenue to studios or royalties to artists.

From a managerial perspective, while the digital characteristics of these products may be driving increased levels of cannibalization in traditional channels, digital distribution may provide a solution to the cannibalization threat posed by secondary markets. While the first sale doctrine allows consumers to resell copyrighted physical media, the dominant legal view is that the first sale doctrine does not apply to products that are distributed digitally. Thus, one benefit of the transition from a physical to a digital distribution model is that it would also allow movie and music companies to transition away from secondary markets for used products, and the associated cannibalization effects.

Keywords: *Information Goods, Price elasticity, Digital distribution, First sale doctrine, Used Products, Electronic Markets*

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1. Introduction

The emergence of simultaneous on-line markets for used and new copyrighted products raises important questions for creative artists and other copyright holders. While used markets for these information-based products have always existed, the unique characteristics of electronic markets for used products may exacerbate cannibalization concerns. Specifically, electronic markets for used products typically provide consumers with increased product variety, lower product costs, and lower search and transactions costs to locate products than comparable brick-and-mortar used markets do.

Used product sales are a concern to sellers of information goods because revenues and royalties only accrue to copyright holders and artists on new product sales. Copyright holders, and book publishers in particular, have raised strenuous concerns about emergence of these side-by-side new and used online markets. For example, in an open letter to Jeff Bezos dated April 9, 2002, the Author's Guild and American Association of Publishers state "Amazon's [used book] sales can have a significantly deleterious effect on new book sales. If your aggressive promotion of used book sales becomes popular among Amazon's customers, this service will cut significantly into sales of new titles, directly harming authors and publishers."

In spite of these concerns, prior work (Ghose, Smith, and Telang 2006; hereafter GST), has shown that there is relatively little cannibalization of new book sales by used book markets: only 16% of used book sales at Amazon.com directly cannibalize new book sales. In this research note we report on new analysis of the cannibalization threat from used products in the CD and DVD markets.

Cannibalization from used CD and DVD markets is an important topic for research for two reasons. First, CDs and DVDs are important from an economic perspective. In 2004, CD and DVD sales generated $12.1 billion (RIAA 2006) and $24.2 billion (MPAA 2006) in revenue respectively, compared to $32.7 billion for books (Book Industry Study Group 2006). Second, CDs and DVDs have a strong "digital" component to the product bundle, and consumers may perceive used digital products differently than they do used physical products.

To analyze the cannibalization risk from used CD and DVD markets, we use a new dataset documenting new and used product prices and sales for Amazon's used markets for CDs and DVDs. Our CD and DVD data are collected in the same time period and following the same methodology as GST's study, allowing easy comparison between the results. Our data show that the cross price elasticity of demand for new products with respect to used prices is substantially higher for CDs (0.157) and DVDs (0.514) than GST's prior results for books (0.088). This means that changes in used prices result in larger changes in the number of sales of new CDs and DVDs than they do for sales of new books. In terms of cannibalization, these higher elasticities mean that 24% of used CDs and 86% of used DVDs sold at Amazon.com directly cannibalize new product sales. This suggests that CD and DVD producers would benefit more strongly by eliminating secondary used markets for their products than book publishers would.

However, in spite of potential concerns about cannibalization on secondary markets, sellers of copyrighted products have few options to shut down markets for used physical products. This is because the first sale doctrine in the Copyright Act of 1976 (17 U.S.C. §109) allows consumers who have purchased a copyrighted physical products to resell these products without obtaining permission from, or paying royalties to, the copyright holder. This is what allows individual con-

sumers to resell their legally owned books, CDs, and DVDs in secondary markets; and what allows Amazon and other retailers to operate and profit from such secondary markets.

For sellers of digital products, it is important to note that the first sale doctrine only covers "material objects" (17 U.S.C. §101). The dominant legal view is that digital downloads are not material objects and therefore not covered under the first sale doctrine (see for example Hyde 2001 and reports by the U.S. Patent and Trademark Office (Lehman 1995) and the U.S. Copyright Office (Peters 2001)).[1] Because of this, one benefit to record and movie studios of moving to a digital distribution model is that it may effectively foreclose on secondary markets for digital goods.

Thus, the results in this research note may be important for record companies and television and movie studios exploring new digital distribution models, while at the same time attempting to placate their existing physical distribution partners (see for example Arango (2006) for an example of Wal-Mart's threats to retaliate against movie studios adopting a digital distribution model).

The remainder of this research note proceeds as follows. In Section 2 we summarize the relevant theory pertaining to the impact of used prices on new product sales. In Section 3 we describe our data. We present our results in Section 4, and discuss the implications of our findings in Section 5.

2. Theory

While copyright holders and their agents have argued that used product markets do significant harm to new product sales, prior work has shown that the actual degree of harm is critically de-

[1] An application of this legal view is eBay's restrictions on selling digitally delivered goods by anyone other than the "owner of the underlying intellectual property" (http://pages.ebay.com/help/policies/downloadable.html), and eBay's related decision to not allow the resale of music purchased through the iTunes Music Store (see for example Hansen 2003).

pendent on the cross-price elasticity between new good demand and used good prices. Specifically, following the economic literature on secondary markets (e.g., Miller 1974, Swan 1980, Waldman 1997, Hendel and Lizzeri 1999) GST showed that the change in the copyright owner's profit from the establishment of a used good market is given by (page 8):

$$p_S^U - p_S = D_N^U w^U - D_N w = \underbrace{(D_N^U - D_N)\, w}_{\text{Substitution effect}} + \underbrace{(w^U - w)\, D_N^U}_{\text{Price increase effect}} \tag{1}$$

where p_S and p_S^U represent the profit to the copyright owner before and after the establishment of the used market respectively, D_N and D_N^U represent the quantity of products demanded before and after the establishment of the used product market, and w and w^U represent the wholesale price before and after the introduction of the used product market.[2]

GST also showed that, under the standard definition of elasticity ($\eta = \frac{\Delta Q}{\Delta P}\frac{P}{Q}$), the substitution effect can be measured as:

$$D_N^U - D_N = \Delta Q = D_N \times \eta \times \left(\frac{P_N^U - P_U}{P_N^U} \right) \tag{2}$$

where η is the cross-price elasticity of new book demand with respect to used book prices, and P_N^U and P_U are the new product price after introduction of the used good market and the used good price respectively. The goal of the remainder of this research note is to measure the substi-

[2] It is important to note that equation (1) shows that retailer profits cannot increase unless the introduction of used product markets is accompanied by a countervailing increase in wholesale prices. Discussions with executives at two major movie studios revealed that nominal wholesale prices for DVDs have been stable over the past 10 years (and if anything have declined on a CPI-adjusted basis). Available evidence from the music industry suggests that, if anything, wholesale prices have declined since the introduction of Internet used markets (see Smith 2003 for example).

tution effect of used markets for CDs and DVDs, and compare the substitution effects for these products to the impact from used book markets previously studied.

3. Data

Our data set is compiled from publicly available information on new and used CD and DVD prices and sales at Amazon.com. The data is gathered using automated java programs to access and parse HTML and XML pages downloaded from Amazon's website. To facilitate easy comparison of results, our sampling strategy and timeframe replicate the sampling strategy and timeframe for the second sample of book data collected by GST.

Specifically, our data span the period of April 15, 2004 through July 18, 2004 and tracks 120 CDs and 120 DVDs which comprise equal representations of four categories: Amazon current bestsellers, Amazon 2002 bestsellers, new and upcoming products, and products selected at random from Amazon's web pages. Current best sellers are included because of their popularity, high sales, and their relevance for distributor price discrimination strategies (higher discounts for new CDs and DVDs). Recent bestsellers are included because they should have a larger base of copies in circulation than other titles, potentially increasing the number of used copies for sale. New and upcoming products allow us to observe the development of used markets starting with the initial release of the product, and random products provide broader coverage over the market.

Table 1: Summary Statistics (CDs and DVDs)

	CDs (9,061 observations)				***DVDs (8,937 observations)***			
Variable	*Mean*	*S.D.*	*Min.*	*Max.*	*Mean*	*S.D.*	*Min.*	*Max.*
Rank	36,595	92,344	1	500,198	5,512	8,977	1	42,445
Amazon Price	16.00	11.28	2.98	119.49	28.57	22.97	7.98	159.99
Days Since Release	796.3	1708.7	0	23,392	389.1	396.6	0	1,737
Used Price	9.10	9.28	0.55	99.99	17.16	19.45	0.85	149.99
Condition	2.62	0.84	2	5	2.52	2.14	2	5
Rating	3.67	2.00	0	5	3.34	2.14	0	5

For each of these titles, we collected data on the characteristics of each product, Amazon's price for new copies of the product, and the Amazon sales rank (a statistic of quantity sold as described below). We also collected the number of used products offered for sale, and their associated prices, conditions (like new, very good, good, acceptable), and seller ratings (0-5 stars).

Summary statistics for these data are provided in Table 1. Used price is the lowest used price offered for each product in each time period. Condition and rating are the product condition and retailer rating respectively for the lowest priced used product in each time period. The condition variable is coded as follows: 2 = like new condition, 3 = very good condition, 4 = good condition, 5 = acceptable condition.

4. Results

4.1. Sales Rank to Quantity Calibration

Our first empirical analysis is to determine the slope parameter in the mapping between sales rank and sales at Amazon.com. Two groups of authors have used different techniques to map the sales rank at Amazon.com to the quantity of products sold. Brynjolfsson, Hu, and Smith (2003) obtained data from an undisclosed book publisher mapping Amazon's sales rank to the number of copies the publisher sold to Amazon. The data include 321 books with sales ranks ranging from 238 to 961,367. The authors fit this data to a Pareto curve specification allowing them to map sales rank to quantity sold as:

$$Quantity = \beta_1 \cdot Rank^{\beta_2} \tag{3}$$

Goolsbee and Chevalier (2002) obtain similar coefficient estimates using an experiment. The authors first obtain a book with a known number of weekly sales and purchase several copies of the book in rapid succession from Amazon.com, tracking the Amazon sales rank before and shortly

shortly after their purchase. They then fit a Pareto curve through the two resulting points. As noted in Brynjolfsson, Hu, and Smith (2003), these different methodological approaches yield remarkably similar empirical estimates.

Lacking publisher data on CD and DVD sales, we use Chevalier and Goolsbee's method to compute the slope parameter for the sales-rank mapping at Amazon.com. Specifically, on July 1, 2004 we purchased 7 (new) copies of a low selling CD and 7 (new) copies of a low selling DVD in the space of about an hour. We then repeated this experiment on July 8, 2004 with a different CD and DVD.[3]

The first and second DVDs ranks changed from 42,135 and 29,274 to 1,521 and 1,052. The first and second CDs increased in rank from 205,511 and 65,107 to 1,039 and 576. The resulting slope (β_2) parameters are -1.01 for CDs and -1.61 for DVDs. We note that the slope for DVDs is very similar to the slope parameter reported by Smith and Telang (2007) for similar experiments conducted in February 2006.

4.2. Estimation

With the data collected above — imputed quantity sold, new and used good prices, and used good quality — we estimate the following empirical model

$$Log(Rank_{bt}) = c + \alpha Log(P_{A_{bt}}) + \Gamma' Log(P_{M_{bt}}) + \Omega' X + \varepsilon_{bt} \tag{4}$$

where, b and t index product and date. This model is similar to other papers in the literature including GST and Chevalier and Goolsbee (2002). The dependant variable is the log of rank. The independent variables are Amazon price (P_A), the lowest used price listed at Amazon (P_M), and a

[3] Note that these experiments were conducted before Amazon began including used and marketplace sales in their sales rank calculations on October 14, 2004 (GST, p. 11).

vector of other control variables *(X)*. Our control variables include the log of the time since the CDs or DVDs were released, the condition of the lowest priced good, and the seller rating for the lowest priced used good. As in GST, we use the lowest priced used product as our reference price variable because this is the used price displayed on Amazon's new product page and thus is likely the strongest driver of new product cannibalization.

However, there are two econometric issues raised by this estimation technique. The first is the possibility that prices and quantity (rank) are endogenously determined in our setting. However, as noted in GST, we believe this is not problematic in our setting because the structure of the music and movie industries are such that price and quantity are not jointly determined in the traditional economic sense. As with books, CDs and DVDs are typically printed in large quantities prior to going to market (and reprinted as needed), and are made available to Amazon at a marginal cost that is independent of per-product sales levels.[4] This means that the number of products Amazon can sell is predetermined (and virtually unlimited) at the point in time Amazon sets its price. Effectively, Amazon faces a vertical supply curve. Moreover, analysis of Amazon's product-level price changes suggests that Amazon is experimenting with price changes — possibly to determine product-level price sensitivity.[5] For products in our sample, Amazon frequently makes price changes in even dollar increments for a few days, before changing price back to the original price. Such price experiments would result in changes in demand that would be exogenous to the demand system, allowing Amazon (and in this case academic researchers) to observe the price sensitivity the company faces on an individual product basis.

[4] Amazon does receive volume-based discounts from its distributors. However, these volume-based discounts are based on total sales as opposed to sales at the individual product-level.
[5] This is consistent with anecdotal evidence of Amazon's use of price experiments to determine consumer price sensitivity. See Streifeld (2001) and Weigend (2003) for example.

The second concern is that the used book prices are endogenous. Note that we control for time affects by including a "time since released" variable in the paper. In Figure 1, we show the minimum used book price movements for three randomly selected CD titles. On the x-axis we plot the date (normalized to 0 for the first day of collection), and on y-axis we plot the minimum used prices offered in the marketplace. Notice that prices go up and down and remain steady fairly arbitrary. In particular, note that prices go up as well as down. Thus, the relative random movements of used prices, along with our inclusion of a dummy variable for time effects, reassure us that used book prices are not endogenous in our model.

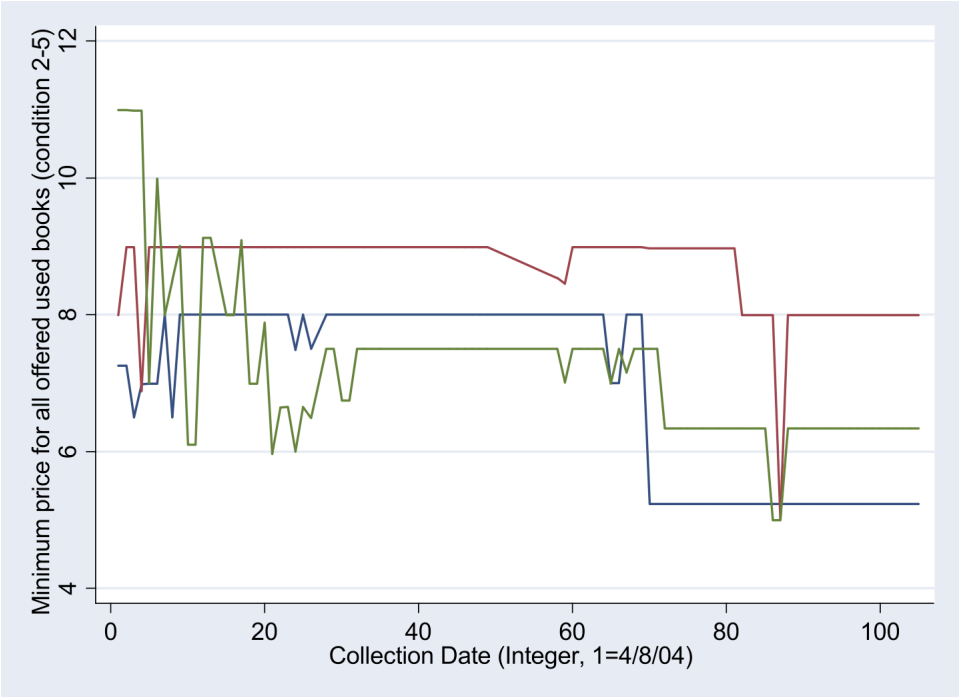

Figure 1: Used Price Movement for 3 random titles

We present the estimates for our model in Table 2 for CDs (column 1) and DVDs (column 2), along with the analogous results from GST for books (column 3). The coefficients on new and used CD and DVD prices have the expected sign and are highly significant: An increase in Amazon's price leads to an increase in sales rank and a decrease in sales. Likewise, an increase in

used price leads to a decrease in Amazon's new sales rank and an increase in new quantity sold. Model fit is similar to, but slightly higher than, those obtained by GST. Because the dependent variable in these regressions is the natural log of sales rank, to convert these coefficients to elasticities, we must first multiply the coefficient by the respective sales-rank slope parameters derived above. These results of this conversion are shown in the first two rows of Table 3.

Table 2: Model Estimates, CDs and DVDs

	CDs		DVDs		Books[6]	
Ln(Amazon Price)	1.630**	(0.153)	1.143**	(0.093)	1.347**	(0.048)
Ln(Min. Used Price)	-0.155**	(0.034)	-0.181**	(0.030)	-0.105**	(0.010)
Ln(Days Since Release)	1.210**	(0.026)	0.918**	(0.020)	1.140**	(0.015)
Condition	-0.027**	(0.010)	0.003	(0.013)	0.008	(0.004)
Rating	-0.034**	(0.004)	0.016**	(0.004)	0.003	(0.003)
Pseudo R^2	0.235		0.289		0.229	

The dependent variable is ln(Amazon Sales Rank). Condition is coded as 2 ("like new"), 3 ("very good"), 4 ("good"), and 5 ("acceptable). Rating is coded as 1-5 stars. Standard errors are listed in parenthesis. ** denotes significance at 0.01. All models used product-level fixed effects.

With respect to our parameter of interest, we note that the new sales of CDs, and particularly DVDs, are substantially more sensitive to changes in used good prices than are books: a 1% decrease in the price of used goods results in a 0.157% and 0.514% decrease in the sales of new CDs and DVDs respectively (compared to a 0.089% decrease in the sales of books).

From this knowledge, we can re-write equation (2) to obtain the proportion of used sales that directly cannibalize new product sales as:

$$\Delta Q_U\% = \frac{\Delta Q}{D_U} = \frac{D_N^U}{D_U}\frac{\eta \cdot \Delta P\%}{(1-\eta \cdot \Delta P\%)} \tag{5}$$

[6] Book results are from GST, Table 2, Column 3. We use the specification from Column 3 as a point of comparison because it yielded the highest R^2 in GST's analysis and because collinearity between the number of used products for sale and the used price prevented separate identification of these two variables for DVDs.

where $\Delta P\% = \frac{P_N^U - P_U^U}{P_N^U}$, D_U is the total number of used products demanded, D_N^U is the number of new goods demanded after the introduction of Amazon's used product markets, new and used prices are defined as above, and η is the cross price elasticity of new CD and DVD sales with respect to used good prices.

Table 3: Own and Cross Price Elasticity Estimates

	CDs	DVDs	Books
Own Price Elasticity	-1.624	-1.879	-1.173
Cross Price Elasticity	0.157	0.514	0.088
% Used Cannibalization	24.1%	86.0%	15.8%
% New Sales Decrease	6.8%	20.5%	4.5%

To evaluate new product cannibalization (equation 5), we use the CD and DVD elasticity values (η) calculated in Table 3. We calculate the average discount of the lowest priced used product off Amazon's new product price ($\Delta P\%$) using the price information from Table 1 as 43.1% and 39.9% for CDs and DVDs respectively. Finally, following GST, we calculate the ratio of new to used sales ($\frac{D_N^U}{D_U}$) based on Milliot (2002), who reports that used products make up about 23% of *total* sales across Amazon's product categories, and thus $\frac{D_N^U}{D_U}$=3.35.[7]

Using these figures, we calculate that 24% of used CD sales directly cannibalize new CD sales, while the remaining 76% of used sales are sales that would not have otherwise occurred. More strikingly, we find that 86% of used DVD sales directly cannibalize new sales. As a point of comparison GST found that 16% of used book sales at Amazon cannibalize new sales.

[7] I.e. .23 * (used sales + new sales) = used sales. Therefore, new sales / used sales = (1 – 0.23) / 0.23 = 3.35

As another point of comparison, we can calculate the decrease in new product sales resulting from the presence of used markets as follows:

$$\Delta Q_N\% = \frac{\Delta Q}{D_N} = \eta \cdot \Delta P\% \tag{6}$$

The results of these calculations (fourth row of Table 3) show that CD sales are 7% lower and DVD sales are 20.5% lower at Amazon as a result of the introduction of used markets. Again, as a point of comparison, using analogous calculations, GST found that used book sales at Amazon are 4.5% lower as a result of the introduction of used markets.

These findings suggest that used sales of DVDs, and to a lesser degree CDs, pose a larger cannibalization threat to new products than used book sales do. We discuss the implications of these findings below.

5. Discussion

The introduction of Internet markets for new and used goods has rekindled the debate regarding the impact of used product sales on authors, artists, publishers and recording studio. Publishers have been particularly vocal in their concerns about used product markets, arguing that Internet used product markets would significantly cannibalize new product sales.

In prior work we found that, in contrast to these concerns, only 16% of used book sales at Amazon directly cannibalized new book sales. This relatively low level of cannibalization is consistent with the hypothesis that used and new markets for books are relatively separate. Those consumers interested in buying new books are typically not dissuaded from a new purchase by lower priced used books.

However, the present results show that used markets are a more serious problem for sellers of information goods such as music and movies. Our results show that 24% of used CD sales directly cannibalize new sales and 86% of used DVD sales directly cannibalize new sales. These findings raise two important questions for producers and regulators. First, why is cannibalization so much higher in used CD and DVD markets than it is for books? Second, how should movie and music companies respond to this threat?

With respect to the first question, there are several notable differences between the characteristics of books and CDs/DVDs that may be driving consumer behavior in these markets. First, the content on CDs and DVDs is digital and separable from the medium. The digital characteristics of CDs and DVDs may cause consumers to be less sensitive to their condition — making used markets a more viable alternative to new markets. So long as the CD or DVD is not damaged to the point where its digital content cannot be read, a "used" 0 or 1 looks and sounds the same as a new 0 or 1.[8]

Likewise, because of their digital characteristics, CD and DVD content can be easily copied from the medium with no discernable loss in quality,[9] allowing (unscrupulous) consumers to reintroduce the original product to the used market while retaining the content. In comparison, large scale copying of the content of books is substantially more costly and time consuming.

[8] Note that we are not arguing that CDs and DVDs are entirely digital products. The covers and liner notes to these products are certainly important physical aspects of the product bundle. We are only arguing that they have significant digital components, which may distinguish them from purely physical products such as printed books.
[9] There were no CDs in 2004 that contained copy protection technology, and DVD copy protection is easily broken by software programs commonly available on the Internet.

Similarly, because of the digital nature of CDs and DVDs, it is possible that professional pirates are providing a significant amount of content on the secondary market by (illegally) providing multiple "bootleg" copies of CDs and DVDs for sale.[10]

The second question raised by our study is: how should movie and music producers respond to the threat raised by Internet markets for used products? In the case of books, while publishers raised serious concerns regarding Internet markets for used products, they had few legal options to shut down these marketplaces. The resale of copyrighted physical products is allowed under the first sale doctrine of U.S. copyright law, and this doctrine applies to physical products such as books, CDs, and DVDs.

However, producers of copyrighted products may be able to shut down used markets by adopting a digital distribution strategy. While the law is still evolving in this area, the dominant view in the legal community is that the first sale doctrine does not apply to digital media (e.g., Hyde (2001), Lehman (1995), and Peters (2001)). Therefore, media companies may be able to effectively eliminate secondary markets for digitally downloaded products. Our results suggest that in the absence of a used product market, many consumers who otherwise would have purchased used products will purchase new products, increasing direct revenue to music and movie studios. Digital distribution may also have other benefits for CD and DVD manufacturers. First, copy protection for digital media is typically much stronger than those for physical media. Second, digital downloads provide consumers with immediate gratification that is not commonly available for physical products.

[10] We note that many of the used product descriptions on Amazon's market specifically state "not a bootleg," which suggests the presence of a significant number of bootleg products.

It is important to note that our study is not without limitations. Our results only cover Amazon's used market. While Amazon is the dominant online seller of new CDs and DVDs in the United States, it faces strong competition from eBay and Half.com in used product markets. Given this, future studies may wish to consider the impact of other used marketplaces such as eBay or Half.com on the sales of new products. Finally, our results represent only a snapshot in time and may be influenced by the relative development of digital distribution and piracy for music and movies. It would be useful for future research to validate our results as both digital piracy networks and digital distribution strategies evolve.

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