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The Effects of Revenue-Sharing Contracts on Welfare in Vertically-Separated Markets: Evidence from the Video Rental Industry

by

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Abstract

In this study I analyze the implications of contractual innovation in vertically-separated industries, using the example of the video rental industry. Prior to 1998, video stores obtained inventory from movie distributors using simple linear pricing contracts. In 1998, revenue-sharing contracts, which include inventory restrictions, were widely adopted. I investigate the effect of using revenue-sharing contracts on firms' profits and consumer welfare, relative to linear pricing contracts. I analyze a new panel dataset of home video retailers that includes information on individual retailers' contract and inventory choices, weekly rentals and sales, and contract terms (prices and quantity restrictions) for 1,114 movie titles and 6,594 retailers in the U.S during each week of 1998 and 1999. A structural econometric model of firms' behavior is developed and estimated, and counterfactual experiments are performed. The results indicate that total upstream and downstream profits increase by three to six percent, and consumers benefit substantially when revenue-sharing contracts are adopted. I also examine the effects of the observed quantity restrictions. I find that these restrictions serve to increase profits for upstream firms and decrease profits for downstream firms, relative to revenue-sharing contracts without inventory restrictions.

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1 Introduction

Coordinating inventory decisions between manufacturers and retailers can be a challenge in industries where both firms are separately maximizing profits. In particular, conditions in the retail market may cause output to be reduced below the level that would be chosen by a vertically-integrated firm. Revenue-sharing contracts, in which the retailer pays the manufacturer a fee per unit of inventory and a percentage of the revenue generated from the inventory, allow firms greater flexibility for solving this problem than simple linear pricing (that is, a fixed fee per unit of inventory only). This study examines the effect of the recent widespread adoption of revenue-sharing contracts in the vertically-separated video rental industry. I present a theoretical model of firm behavior and consumer demand that incorporates the institutional details of the contracting environment, including the presence of inventory restrictions in revenue-sharing contracts. The structural model is estimated using a new dataset on video retailers in the US. Using the estimated demand system, I conduct counter-factual experiments to analyze the implications of the adoption of revenue-sharing contracts in this industry, including the use of inventory restrictions.

Prior to 1998, video stores obtained inventory from movie distributors using fixed-fee contracts, consisting of a single wholesale price per unit of inventory (typically around $65 per tape). In 1998, revenue-sharing contracts, consisting of an upfront fee per unit of inventory and a revenue split paid on the basis of rental revenue, were widely adopted by the largest chains in the industry. These contracts typically charge between $0 and $8 per unit of inventory with the retailer keeping between 40 and 60 percent of rental revenues. Movie distributors and the large chains (most notably Blockbuster, Inc.) directly negotiate revenue-sharing agreements covering most titles distributed by the upstream firm.[1] Smaller chains and independent retailers do not have access to directly negotiate such bilateral agreements. However, a third party aggregates the demand of these independent retailers and negotiates and monitors revenue-sharing agreements with movie distributors on their behalf. Retailers participate by paying a relatively small sign-up fee and purchasing the necessary computer and modem technology. Although the bilateral revenue-sharing agreements between the distributors and the largest chains usually apply to all "rental-

[1] Parts of Blockbuster's revenue-sharing contracts were filed as part of the firm's September, 1999 initial public offering on the New York Stock Exchange. The first contract is dated November 1997, and four similar contracts follow in the spring of 1998. These contracts may be viewed at http://www.freeedgar.com.

priced" titles released by the distributor, the contracts available to independent retailers allow retailers to choose between revenue-sharing and fixed-fee terms on a title-by-title basis. Empirically, retailers choose revenue-sharing terms for approximately half of all movie titles for which both fixed-fee and revenue-sharing terms are offered, excluding direct-to-video releases.

When choosing a contract for a title, retailers each face the same price under fixed-fee terms, and also face the same upfront fee and revenue split under revenue-sharing terms. No inventory restrictions apply to fixed-fee contracts, but the upstream firm can and does set inventory restrictions as part of the revenue-sharing contracts. Furthermore, while fixed-fee prices, upfront fees and revenue splits tend to vary only across three broad box-office categories, inventory restrictions vary across products within box-office categories, and across store size. Stores must adhere to both minimum and maximum inventory restrictions in order to participate in revenue-sharing agreements. These inventory restrictions are often binding for retailers: 37 percent of titles on revenue-sharing are purchased at the minimum inventory level, and 7 percent of titles are purchased at the maximum level.

The typical analysis of revenue sharing in vertically-separated markets focuses on the usefulness of this contract for alleviating understocking or double-marginalization problems that may exist under fixed-fee contracts.[2] Thus, the existence of both inventory minimums and maximums, and the fact that these restrictions are so often binding, presents a puzzle for the standard analysis. Inventory minimums and maximums are the only terms in the contract that vary across retailers for a given movie, suggesting that these terms play an important role in discriminating between downstream firms. I develop a theoretical model of firm behavior that incorporates the details of the institutional setting and rationalizes the use of inventory restrictions. Multiple, heterogeneous downstream markets exist, which differ in both their demand conditions and their competitive conditions. In the presence of such heterogeneous downstream markets, the upstream firm would like to charge different prices to retailers located in different markets, but is constrained to offer the same upfront fees and revenue-splits to all retailers. Inventory restrictions help the upstream firm to

[2]See, for example, Dana and Spier (2001) and Cachon and Lariviere (2000), which both examine revenue-sharing contracts in the video rental industry. Other issues addressed in the empirical literature on the determinants of contractual form include issues concerning moral hazard (for example, Shepard (1993), Slade (1996), Lafontaine (1992) and Corts (1999)), and the effects of transactions costs and the role of risk (for example, Allen and Leuck (1993, 1992)). For a summary of the empirical literature on contractual relations between manufacturers and retailers, see Lafontaine and Slade (1997).

accomplish some of this discrimination be setting quantity restrictions instead. The model offers specific predictions linking retailers' contract and inventory choices to the competitive conditions and demand conditions in their market.

The empirical model uses observed variation in firms' competitive conditions and contract and inventory choices across different geographic markets and products to identify the expected demand conditions facing each firm. I employ a new dataset that includes information on individual retailers' contract and inventory choices, weekly rentals and sales, and contract terms (prices and quantity restrictions) for 1,114 movie titles for 6,594 retailers in the U.S during the 104-week period from 1998 through 1999. I observe all retailers that have used a revenue-sharing contract at least once between July, 1997 and December, 1999, with the exception of Blockbuster Video and Hollywood Video. The included firms represent approximately 30 percent of all U.S. video rental retailers. Using these data, I estimate the structural model to generate predicted demand conditions.

Based on the estimated demand conditions, I conduct several counter-factual experiments. The results of these experiments indicate that total upstream and downstream profits increase by approximately three to six percent and consumers benefit substantially when revenue-sharing contracts are adopted. Empirically, small retailers adopt these contracts more extensively than large retailers, and I estimate that the benefits to small retailers from this contractual form are more substantial than the gains to large retailers.[3] I also examine the effects of inventory restrictions. I find that these restrictions serve to increase profits for upstream firms and decrease profits for downstream firms, relative to revenue-sharing contracts without quantity restrictions.

This paper complements two previous theoretical studies that have examined the adoption of revenue-sharing in the video rental industry. Dana and Spier (2001) consider the usefulness of revenue-sharing with perfectly competitive retailers in a single downstream market under two sets of demand conditions. In the first case, demand is uncertain and prices are sticky. In the second case, demand is known but declining in a predictable way over time, and prices are flexible. The authors derive optimal revenue-sharing terms, which differ according to the assumed demand conditions. The paper is motivated by the contracts between Blockbuster Video and several major studios, in which Blockbuster Video agrees to accept all titles under revenue-sharing terms. Thus it is reasonable that an implication of

[3]For example, I predict that profits of the smallest retailers increase by approximately nine percent, while those of the largest retailers increase by only three percent for one class of movie titles.

their study is that both upstream and downstream firms will prefer revenue-sharing terms to fixed-fee terms for all titles. In another paper, Cachon and Lariviere (2000) compare revenue sharing to other methods of coordinating inventory in vertically-separated industries, such as buy-back and quantity-flexibility contracts. They also consider two possibilities in which revenue-sharing may not work as well. First, they conjecture that administrative costs may prove too high to implement revenue-sharing in some settings. Second, they note that the increased potential for reduced sales effort under revenue-sharing terms may make revenue-sharing a poor contractual form in some industries. Neither of these issues seems critical to the video rental industry, and the authors identify the video rental industry as a prime candidate for the successful use of revenue-sharing contracts.

The rest of the paper proceeds as follows. First, I discuss some of the institutional details of the video rental industry. Section 3 describes the data used in the analysis and summarizes the data. The theoretical model of firm behavior is presented in section 4, along with a discussion of alternative specifications in section 5. The estimation methodology is described in section 6. Section 7 provides results from the estimation procedures, and section 8 presents the results of counter-factual experiments. The final two sections present results of various robustness tests and conclude.

2 The Home Video Industry and Contract Forms

The home video industry grew quickly throughout the 1980's to become the largest source of domestic revenue for movie studios.[4] In 1999, the $16 billion industry accounted for 55% of studios' domestic revenues, compared to 22% generated by theatrical revenues, and 23% from all other forms of media, such as the sales of pay-per-view, cable, and broadcast television rights. Currently, there are approximately 20,000 home video retailer outlets. These outlets are split evenly between independently-owned small chains of retailer locations and large chains of several hundred stores, such as Blockbuster, Inc. and Hollywood Video.[5]

The traditional method of distributing motion pictures on videocassette occurs via a fixed-fee transfer in the form of a linear price paid to the distribution arm of a movie studio by home video retailers.[6] Price typically does not vary by title, with distributors typically

[4] VSDA white paper, 1996, pg. 12.

[5] VSDA 1998 and 1999 annual reports. Revenue splits reported in 1998 annual report, pg. 18.

[6] The distribution arm of a movie studio is the upstream firm in this context. For the remainder of the paper, I refer to the upstream firm as the distributor.

charging between $65 and $70 per tape, regardless of the identity of the movie.[7] According to industry sources, the marginal cost of producing, packaging and shipping a pre-recorded videocassette tape is around two dollars.

In addition to this traditional fixed-fee or linear pricing, revenue-sharing contracts have existed for about ten years, but were only used on a very small scale until recently. In 1998, revenue-sharing became a widely-used contractual arrangement for both large chains and independent stores. The distributor typically negotiates revenue-sharing contracts separately with large chains, such as Blockbuster, Inc., and with Rentrak, which is a private company that administers revenue-sharing arrangements for a large clientele of smaller chains and independent video rental outlets. Blockbuster, Inc. initially proposed revenue-sharing agreements to the major distributors in late 1997. Other retail firms soon followed Blockbuster's lead, signing up with Rentrak in large numbers throughout 1998. Although Blockbuster reported that revenue sharing accounted for 90 percent of their revenue in 2000, the typical independent retailer reports using revenue-sharing terms through Rentrak for roughly 28 percent of titles, and 25 percent of revenue.[8]

Under the typical revenue-sharing arrangement, the retailer pays an upfront fee of $3 to $8 per unit of inventory. In return, the retailer must share rental receipts with the distributor, and adhere to inventory restrictions. For movies with large theatrical box-office receipts, the retailer retains about 45 percent of rental revenue, and receives some portion of the eventual sale of the pre-viewed cassette. Although the upfront fee and revenue-splits vary across three broad box-office categories, they do not vary by title.[9] Retailers must choose between fixed-fee and revenue-sharing terms for a given title before it is released on video. Once the retailer chooses a contractual form, she must accept the same contractual form for all tapes purchased for that title. Thus, the retailer makes two decisions for each title: first, she chooses a contract form. Second, she chooses the number of tapes to purchase. This inventory choice may be constrained under revenue-sharing terms. I discuss the nature of these restrictions in greater detail later.

[7]Exceptions to this rule are titles priced for "sell-through." In this case, titles are priced to encourage direct sales to consumers, and price does vary by title. Prices obtained through interviews with studio executives. Other volume discounts or price breaks through "copy-depth" programs may apply. Such copy-depth programs were most widely used in 2000, and were less common in 1998 and 1999. I do not observe these discounts, and assume that retailers pay the full wholesale price before discounts.

[8]Blockbuster, Inc. data reported in *Weekly Variety*, October 12-18 1998, p. 18. Rentrak figures compiled by author.

[9]The only observed variation in these fees that exists within a box-office category is variation across distributors.

Distributors also face some restrictions when setting contractual terms. Anti-trust concerns prevent distributors from offering different prices to different buyers. Section 2 of the Clayton Act, as amended by the 1936 Robinson-Patman Act, makes price discrimination of this type illegal. Note that the Robinson-Patman Act does not, however, speak to quantity requirements in any way. For this reason, I assume that the upstream firm must offer the same contractual terms (wholesale prices, upfront fees, and revenue-splits) to all downstream retailers. This assumption is borne out empirically.

In addition to setting contractual terms, the distributor can in theory choose whether or not to offer both contractual forms. In particular, one might expect that the upstream firm might choose to only offer revenue-sharing terms, since revenue sharing is a more flexible contractual arrangement. However, revenue sharing requires extensive computer monitoring of millions of transactions. As recent technological advances have made revenue-sharing a feasible contractual option, both upstream and downstream firms have widely adopted these contracts and approximately 10,000 firms had access to revenue-sharing contracts in 2000.[10] However, the remaining 10,000 retailers in the industry are either not technologically equipped to participate in this form of distribution, or may not qualify for credit terms with Rentrak. Thus, if fixed-fee contracts are withdrawn, distributors lose access to half of all retail outlets, and may also face potential foreclosure charges for excluding retailers from acquiring inventory. One might expect that the upstream firm would therefore restrict fixed-fee contracts to downstream firms that do not have the ability to participate in revenue-sharing contracts. This is not possible because the Copyright Act of 1976 states that the owner of a lawful copy can "sell or otherwise dispose of" the copy. This is commonly referred to as the Right of First Sale Doctrine, and allows the owner of a lawful copy to rent, lease, lend or resell a legally owned copy of a work. Thus, retailers with the ability to participate in revenue-sharing agreements cannot be excluded from choosing fixed-fee terms when ordering inventory for particular titles (although they are limited to a single contractual form for any given title). Thus, downstream firms can discipline the upstream firm by opting to take fixed-fee terms when revenue-sharing splits are not satisfactory. Finally, the empirical evidence before and after the introduction of revenue sharing suggests that fixed-fee terms continue to be offered to all firms, and that fixed-fee prices do not change after the introduction of revenue sharing.

[10] Stores using Rentrak account for over 6,000 stores, with an additional 4,000 stores belonging to Blockbuster, Inc. and other large chains also wired for revenue sharing.

3 Motivation and Data Summary

In this section, I describe a new dataset on firms in the video rental industry. This description is followed by some summary statistics on revenue-sharing and fixed-fee contracts, paying attention to differences in firms' choices and outcomes across the two contractual forms.

3.1 Data Description

The data for this study are provided by Rentrak Corporation. The use of revenue-sharing contracts requires extensive computer monitoring of transactions in order to enforce the revenue-sharing payments. Independent retailers, as well as many large retail chains, rely on Rentrak as a central source for the provision of these monitoring services. Rentrak also negotiates contractual terms with upstream firms on their clients' behalf. Over 10,000 retailers used Rentrak between 1998 and 1999, accounting for over half of all retailers in the industry. Blockbuster Video and Hollywood Video comprise about 4,000 of these retailers, and I do not observe their transactions.[11] I observe 6,594 retailers, ranging in size from single-store locations to a chain with 1,147 locations. Of these 6,594 retail locations, I am able to match 5,895 stores with local demographic and phone book data.

For these 5,895 stores, I observe transaction data for 104 weeks between January, 1998 and December, 1999. These stores represent about 30 percent of all stores in the industry. I discard observations for titles released after July 1999, so that rental activity for each title is tracked for at least 6 months. The data may be organized according to the frequency with which I observe each variable. At the store level, I observe location at the county, zip code, and Designated Market Area (DMA) level.[12] I observe total annual and monthly store revenue, and the size of a store's chain. Total monthly store revenue is broken out among rentals and sales for adult, game, DVD, and regular titles. I also observe the date the store joined the Rentrak database, and the date the store left Rentrak, if applicable. Entry into the database is common over the two-year period, and typically represents the choice of an existing retailer to join Rentrak, rather than entry into the industry. The vast majority of store exits (over 90 percent) represent store closure, or exit from the industry.

[11] Blockbuster Video does not release their data, and only process some titles through Rentrak's system. Hollywood Video recently settled a lawsuit with Rentrak involving a dispute over data integrity.

[12] Designated Market Areas organize the United States according to the coverage areas of broadcast television.

For each title, I observe the number of titles released in the same month under different contract types, and a box-office category. The box-office categories are denoted as A, B, C, or D. Titles in the A category have theatrical box-office revenues of more than $40 million, and titles in the B and C categories have theatrical box-office revenues of $15 - $40 million and $1 - $15 million, respectively. Titles in the D category do not have a theatrical release, and are "direct-to-video" titles, such as instructional or exercise videos. Many of the D titles are only bought by a single retailer, and I exclude these titles in the analysis. The dataset includes a total of 74 A titles, 72 B titles, and 1,312 C titles. The analysis is conducted using the 1,114 A, B, or C titles in the data that offered both revenue-sharing and fixed-fee pricing contracts. According to their box office classifications, 23 of these titles are A titles, 35 are B titles, and 1,056 are C titles.

At the store-title level, I observe the type of contract chosen by the retailer (when more than one option is available) and the number of tapes purchased.[13] Transactions are recorded weekly for each store-title combination. Thus, transactions data are store-title-week triples. These data provide average weekly prices and total weekly quantities of rental transactions for all titles over the two year period. The same information is provided for the sales of each title.

The Rentrak dataset is an especially rich source of information on firm behavior. However, Rentrak cannot provide information on local competitive conditions facing each store in the database. In order to observe (or at least proxy) for local competitive conditions, I use Yellow Pages listings for all video retail stores in the United States, including Blockbuster stores, for 1998 and 1999. From these data, I identify the number of competing video retail stores (and the number of Blockbuster stores separately) within the same zip code of each observed store in the Rentrak database. This additional information helps to distinguish between the competitive conditions facing different observed retailers. Finally, I utilize US Census data on the demographic characteristics of each zip code. Demographic data include the number of people, median income, and marginal distributions of race, education, age, gender, employment, family status, and the level of urbanization in each zip code. These three data sources are merged by zip code. When estimating the model, I define a local market as a zip code area and use the merged data to characterize local market conditions. Clearly, zip code areas are designed to provide convenient local areas for the purposes of

[13] Fixed-fee contracts are offered on all titles, although some distributors do not offer revenue-sharing terms until after 1999. Titles for which only fixed-fee terms are offered are not currently used in the analysis.

delivering mail, rather than as definitions of local markets. However, zip code areas appear to be a reasonable demarcation between markets in this setting: the average zip code area contains approximately 24,000 people and 2.6 video retail stores. Larger areas, such as 4-digit zip code areas or Metropolitan Statistical Areas (MSA's) are also feasible ways of attaching local demographic and business listing information, but clearly seem too large a market for most video store customers.

3.2 Summary Statistics

Tables 1 - 3 and 4 - 6 examine differences between titles taken by stores on revenue-sharing versus fixed-fee contracts for A, B, and C titles, respectively. Tables 1 - 3 examine differences between stores that choose different pricing contracts for the same title. Tables 4 - 6 examine differences between titles on fixed-fee versus revenue-sharing terms within a store.

Differences Between Stores for the Same Title

The first panel of Tables 1 - 3 shows differences in store and market characteristics between stores accepting fixed-fee contracts and stores accepting revenue-sharing contracts for the same title. Table 1 provides information for the 23 A titles released during 1998 and 1999 for which stores had a choice of contract. Tables 2 - 3 provide information for the 35 B titles and 1,056 C titles respectively. Stores accepting fixed-fee contracts tend to be correlated with demographic variables associated with higher levels of rental demand. For example, stores on fixed-fee contracts tend to be located in zip code areas with slightly larger populations and fewer households that consist of a married couple with children, which is a less active rental population. Differences in demographics are not strongly significant across the two groups of stores, although the difference is positive for all demographic variables associated with more active demand for video renting (and negative for 'Percent Married with Children'), and consistent across all three categories of titles.

Competitive conditions do not differ significantly, except in the case of B titles, where stores accepting fixed-fee contracts tend to face fewer competitors. There are no significant differences in the presence of competing Blockbuster retailers between the groups of stores.[14] Store size differs significantly between the two groups. Stores choosing revenue-sharing are significantly smaller than those accepting fixed-fee, and they carry a greater variety of

[14]However, stores facing competiton from a Blockbuster Video retailer are more likely to face binding maximum quantity constraints and are less likely to face binding minimum quantity constraints.

titles. Other characteristics of the stores, such as stores' overall mix of business across rentals of "normal" titles, rentals of adult titles or video games, or sales of tapes, do not differ significantly across contract choice, with the exception that stores accepting revenue-sharing contracts on B titles are more likely to generate significant revenues from rentals of adult titles.[15]

The second panel of Tables 1 - 3 shows differences in inventories, rental activity, and profits for the two groups of stores. Inventories are significantly different between the two groups. Stores choosing revenue-sharing contracts purchase approximately twice as much inventory as their fixed-fee counterparts for the same title. However, rental activity is not significantly different despite the larger inventory levels. Neither retailer nor distributor profits are significantly different between the two groups of stores, except in the case of C titles, where retailers actually appear to be losing money on average under fixed-fee terms, and distributors appear to be better off under fixed-fee terms.

Differences Between Titles Within a Store

Table 4 provides information on the A titles taken by each store. Tables 5 and 6 provide information for the B and C titles taken by the stores, respectively. The first panel of Tables 4 - 6 shows differences in the revenue-sharing contract terms for titles taken under fixed-fee terms, and titles taken under revenue-sharing terms within each store. If a revenue-sharing contract is taken by the retailer, these are the actual terms of the contract. If a fixed-fee contract is accepted, then the retailer is assumed to pay a fixed-price of \$65 per tape with no inventory restrictions. In this case, the revenue-sharing terms reflect the terms a retailer would have faced if he had accepted revenue-sharing terms. There is little variation in both the upfront fee and the portion of revenue kept by the retailer within each of the three movie categories. The variation that does exist is variation across studios: in particular, one studio charges an upfront fee of \$10.30 rather than \$8.30 for A and B titles. Much larger variation is seen for minimum and maximum inventory requirements. The A and B titles that are taken on revenue-sharing terms display lower minimum inventory requirements and higher maximum inventory requirements, although the differences are not significant. The inventory restrictions are often binding under revenue-sharing terms: between 34 and 43 percent of titles are taken at the minimum inventory level, and between seven and 13 percent of titles are taken at the maximum inventory level.

[15]The individual titles included in this dataset do not include adult titles, although I do observe total monthly revenues across these broad categories.

The last three rows of the top panel of Tables 4 - 6 give additional information about the time at which a title was released. For example, "No. A Titles Released" reflects the total number of A titles released in the same month as the observed A title. I also observe the number of A, B, and C titles released under revenue-sharing terms, or at sell-through pricing levels in each month. These variables provide characteristics of titles, although these are characteristics that are endogenously chosen by the upstream firm based on its expectations about (time-varying) demand. Summarizing this information across stores according to the pricing contract they accepted indicates that stores tend to choose fixed-fee contracts on titles released in months with a higher total number of title releases, the exception being A titles released in months with many sell-through priced title releases.

The second panel of Tables 4 - 6 shows differences in inventories, rental activity, and profits for the two groups of titles. Inventories are approximately three times higher for titles taken on revenue-sharing terms. Rentals are also higher for revenue-sharing titles, but by a smaller amount than the increase in inventory, roughly 1.5 times. Two prices are reported: first, I report the average price of renting each title regardless of the length of the rental period. Second, I report the average price divided by the average number of days in the rental period. Data on the number of days in a rental period are reported by stores, but the reporting method is not consistent across stores, and the data provide only a very noisy measure of the length of the rental period. Nevertheless, I compare the measure of price per day for the two groups of titles taken by each store. Using this measure of price, stores set lower prices for titles on revenue-sharing contracts than for titles on fixed-fee contracts. Although the difference is not statistically significant, the absolute difference in price per day for the two groups of titles is greater than the difference in total price; stores often charge the same amount for a rental under the two contractual arrangements, but allow for a longer rental term for titles under revenue-sharing contracts. Both retailer and distributor profits are higher for titles under revenue-sharing terms than titles under fixed-fee contracts.[16]

[16]Another reason that retailers might choose revenue-sharing contracts has to do with risk. Perhaps retailers choose revenue-sharing terms on titles for which demand is more variable. The ex-post implication of the risk-reduction story is a small standard deviation for titles taken on fixed-fee terms, relative to titles taken on revenue-sharing terms within a store. This is present in the data; I allow for some retailer uncertainty in the section on robustness check of the results. Note, however, that more risk is borne by the upstream firm under revenue-sharing terms, which may not always be desirable. Retailers hold a portfolio of many hundreds of movies from all studios, while an individual studio's portfolio consists of only a few movies each year.

If the contractual form associated with different store-title pairs were randomly assigned, then computing the effect of revenue-sharing contracts would be straightforward, given the level of detail in the dataset. One could estimate the average effect of revenue sharing on retailer and distributor profits simply as the difference between average firm profits under fixed-fee terms and average firm profits under revenue-sharing terms. Of course, contractual form is not randomly assigned; retailers optimally choose contracts on the basis of some unobserved heterogeneity. Thus, a simple difference between the average "accounting" profits for firms that chose fixed fee and firms that chose revenue sharing is a biased estimate of the effect of the contractual change. Furthermore, simply computing the difference in profits for the two groups of store-title pairs does not help us to understand why some retailers are constrained by inventory minimums or maximums, or why upstream firms set these inventory restrictions.

4 A Theoretical Model of Firm Behavior

In this section, I develop a theoretical model of firm behavior that incorporates the details of the contractual environment facing video retailers, and rationalizes the use of inventory restrictions. Using the data described above, I estimate the parameters of this model in the next section. The primary motivation for developing the theoretical model is two-fold. First, simple accounting measures of the effect of revenue-sharing contracts are biased because of the endogeneity problems discussed above. An important role of the theoretical model is to provide a complete description of the data generating process, including a role for unobserved heterogeneity in firms' contract choices. Second, the data on their own do not shed light on the reasons for implementing inventory restrictions in revenue-sharing contracts. The second role of the theoretical model is to clarify the purpose of inventory restrictions. The variation in these restrictions across store size and products, and the lack of variation in the upfront fee and revenue-split, suggests that upstream firms pay considerable attention to setting these restrictions.

4.1 A Single Downstream Market

To simplify discussion of the model, I first consider a monopolistic upstream firm producing one product that is sold in a single downstream market. I extend the model to many downstream markets in the next section. Each unit of inventory of a particular title is

produced at a small constant marginal cost. I specify a linear demand function for rentals in the market as

$$Q = V - \eta p \tag{1}$$

where V is a measure of the title's appeal in this market, p is the market price, and Q is the quantity of rentals in the market. I discuss alternative functional forms in a later section.

Let the marginal cost of producing a unit of inventory be denoted as l. Then the maximum industry profit in the absence of price discrimination (and the profit achieved by a vertically-integrated firm) is

$$\max_{\{Q,C\}} \pi^{VI} = pQ - lC = \left(\frac{V}{\eta}Q - \frac{1}{\eta}Q^2\right) - lC \tag{2}$$

where the market-clearing price, p, is given by the inverse demand function, Q is the market supply of rentals, and C is inventory. The relationship between inventory and the quantity of rentals is a challenging modeling issue. In this "base" model, I assume that rentals and inventory are related as follows:

$$Q = \min(V - \eta p, \tau C) \tag{3}$$

where the quantity of rentals is limited by a technological constraint on the number of rentals produced per unit of inventory, τ. Thus, for a given τ, the firm's inventory decision determines the maximum number of rentals produced. In order to minimize cost, the firm will not carry extra inventory, and Q will exactly satisfy the equation $Q = \tau C$. Clearly, there are several alternative assumptions one might make about this relationship; I believe this assumption is a good approximation to reality for this industry.[17] Under this assumption, one can re-write industry profits in equation 2 as a function of C, and first-order conditions give the inventory level, C^*, that maximizes industry profits:

$$C^* = \frac{1}{2\tau}\left(V - \frac{l\eta}{\tau}\right). \tag{4}$$

[17] In particular, one might worry that the relationship between inventory and rentals results from a more sophisticated model of rental activity in which retailers choose not only inventory and price, but also stock-out rates and the length of the rental period. The current model is equivalent to viewing one unit of inventory (a video tape) as a box containing τ rentals. Generalizations of the relationship between inventory and rentals, and the robustness of the empirical results to these assumptions, are discussed in later sections.

In a vertically-separated industry, however, a single firm does not directly choose inventory for the industry. Instead, the upstream firm sets contractual forms and terms, and downstream firms choose inventory based on these terms. Under fixed-fee terms, the upstream firm sets a wholesale price, F. Under revenue-sharing terms, the upstream firm sets two contractual terms: a revenue-sharing component, y, and an upfront fee per tape, u.

4.1.1 Retailers' Profit Maximization

In a vertically separated industry, downstream firms observe the contractual terms set by the upstream firm, (F, u, y), select the optimal contract, and choose inventory to maximize retailer profit. I assume that retailers observe market demand and compete with (N-1) identical retailers in a Cournot fashion.[18] The same relationship between inventory and the quantity of rentals is assumed to hold for all retailers, so that τ is assumed constant across retailers and markets. Total revenues for retailer i are given by:

$$q_i p = (\tau c_i) p = (\tau c_i) \frac{1}{\eta} \left(V - \tau \sum_{k=1}^{N} c_k \right).$$

Retailer i maximizes profits by choosing a contractual form and inventory level, c_i. The indicator variable RS takes the value one if a revenue-sharing contract is chosen, and zero if a fixed-fee contract is chosen. Thus, for a given title, retailer i chooses RS_i and c_i to solve the problem

$$\max_{\{RS_i, c_i\}} RS_i \pi_i^{RS}(c_i) + (1 - RS_i) \pi_i^{FF}(c_i). \tag{5}$$

Given the optimal inventory decision of the retailer under each contractual form, one can compute retailer profits under both contracts. The retailer then chooses the contractual form and inventory decision that maximizes profits. Profits under the fixed-fee contract for retailer i are

$$\pi_i^{FF}(c_i) = \frac{V\tau}{\eta} c_i - \frac{\tau^2}{\eta} c_i \sum_{k=1}^{N} c_k - F c_i$$

where F is the fixed-fee or wholesale price per tape set by the upstream firm. Under revenue-sharing terms, retailer i's profits are

[18] One could also introduce uncertainty into demand. I check the robustness of the results to the presence of uncertainty on the parameter linking rentals to inventory (τ) in a later section.

$$\pi_i^{RS}(c_i) = y\left(\frac{V\tau}{\eta}c_i - \frac{\tau^2}{\eta}c_i\sum_{k=1}^{N}c_k - uc_i\right)$$

where y is the percentage of revenue (less costs) remaining with the retailer, and u is the upfront fee paid by the retailer to the manufacturer per unit of inventory under revenue-sharing terms.[19] I assume the downstream firm incurs no cost to produce τ rentals from each unit of inventory.

Solving for the equilibrium choice of c_i, in which firms that choose the same contract also choose the same level of inventory, yields

$$c_i^* = \frac{1}{(N+1)\tau}\left(V + N_{RS}\frac{u\eta}{\tau} + N_{FF}\frac{F\eta}{\tau} - N\frac{w\eta}{\tau}\right) \tag{6}$$

where N_{RS} denotes the number of competing firms choosing a revenue-sharing contract and N_{FF} denotes the number of competing firms choosing a fixed-fee contract; note that $N = N_{RS} + N_{FF} + 1$. The cost per tape for firm i is given by w_i which equals F when a fixed-fee contract is chosen and equals u when firm i chooses a revenue-sharing contract. In this equilibrium, firms only differ in their inventory choice if they also differ in their contract choice.

Given the equilibrium choice for the level of inventory in equation 6, it is possible to solve for the equilibrium choice of contract. Depending on the value of the demand parameters and the number of downstream firms, it may be the case that: 1) only equilibria in which all firms choose the same contractual form exist (symmetric); 2) only equilibria in which firms do not all choose the same contract exist (asymmetric); or 3) both symmetric and asymmetric equilibria in firms' choices of contracts exist.

In the case in which firms play either a symmetric pure-strategy revenue-sharing contract equilibrium or a symmetric pure-strategy fixed-fee contract equilibrium, equation 6 reduces to $c_{i,FF}^*$ and $c_{i,RS}^*$ respectively, with total inventory in the market given by

$$C_{FF}^* \equiv Nc_{i,FF}^* = \frac{N}{(N+1)\tau}\left(V - \frac{F\eta}{\tau}\right) \qquad C_{RS}^* \equiv Nc_{i,RS}^* = \frac{N}{(N+1)\tau}\left(V - \frac{u\eta}{\tau}\right). \tag{7}$$

[19] Revenue-sharing contracts are often written as if revenue payments are made on the basis of revenue, not revenue less costs. However, retailers are typically allowed to cover costs by selling inventory at the end of the pre-determined rental period, or by keeping all revenues from rentals generated after the rental period if the tape is not sold. These activities are not explicitly modeled here. Instead, I model the revenue-sharing payments as being applied to revenues after costs have been covered.

Retailers choose the pricing contract that maximizes their profits. Solving the retailer's profit equation in the "symmetric contract" equilibria, one finds that retailers choose fixed-fee terms whenever V exceeds V^*, defined as

$$V^*(\tau, \eta, F, u, y) = \frac{\eta(F - yu + \sqrt{y}(F - u))}{(1 - y)\tau}. \tag{8}$$

The retailer's contractual choice depends critically on the relative contract terms, F, u, y, and the demand conditions, η and τ. Importantly, for a given set of contractual terms, firms with higher draws of V accept fixed-fee terms, while firms with low draws of V accept revenue sharing. A higher fixed-fee price, F, or a shorter technological "lifespan" of a unit of inventory, τ, increases V^*, implying that retailers in markets with higher draws of V will still accept revenue-sharing contracts. On the other hand, increasing the upfront fee, u, or decreasing the percentage of revenues kept by the retailer, y, reduces V^*. Although the contract choice is presented here in terms of the demand parameter V, one could rewrite equation 8 in terms of τ and view the contract choice decision as depending on the lifespan of a unit of inventory, τ. Viewed in this manner, firms choose revenue-sharing contracts when the lifespan of a unit of inventory is short. I will address this further in a later section.

4.1.2 The Upstream Firm's Profit-Maximization

The upstream firm takes the retailers' decisions as given and maximizes profit for a particular title according to the following relationship:

$$\max_{\{F,u,y\}} \sum_{k=1}^{N} \left[\rho(F, u, y)\pi_s^{RS}(u, y) + (1 - \rho(F, u, y))\pi_s^{FF}(F)\right] T_i + \pi_s^{FF}(F)(1 - T_i) \mid \tau, \eta, N, V, T \tag{9}$$

where the probability that retailer i chooses revenue sharing is ρ, and the probability that retailer i chooses fixed fee is $(1 - \rho)$. The term T_i is an indicator for whether or not the retailer is technologically equipped to implement revenue-sharing contracts.[20] If the firm cannot implement revenue sharing, they can only choose fixed-fee terms. The upstream firm's profit when retailers choose revenue sharing is denoted by π_s^{RS} and its profit when retailers choose fixed fee is given by π_s^{FF}.

[20]Empirically, this is equivalent to whether or not a retailer is signed up with Rentrak. Exclusion from Rentrak could result from the lack of computer hardware or software, or because a retailer is denied credit with Rentrak.

In order for the upstream firm to induce the downstream retailers to stock the same level of inventory as a vertically-integrated firm, it would need to set (u, y) such that C^*_{RS} from equation 7 equals C^*_{VI} from equation 4. The upfront fee that achieves this result is given by:

$$u_{VI} = \frac{(N-1)\tau V}{2N\eta} + \frac{(N+1)l}{2N} \tag{10}$$

The ability of the upstream firm to tax profits through y implies that the optimal $u^* = u_{VI}$ for any value of y. Setting retailers' portion of revenue, y, equal to zero satisfies a zero-profit condition for the downstream firms. However, setting y equal to zero will also induce them to reject revenue-sharing terms in favor of a fixed-fee contract. Thus, one expects the upstream firm to set $y > 0$, such that the downstream retailers are at least as well off as they would have been under fixed-fee terms.[21] Both the upstream and downstream firms benefit from revenue sharing because revenue sharing allows the firms to attain the maximum level of industry profits. Thus, all firms can be made better off by these terms.

4.2 Many Downstream Markets

In the previous section, it is shown that revenue sharing eliminates the double-marginalization problem by transferring inventory at $u^* = u_{VI}$ (given by equation 10) and taxing subsequent revenues. When the downstream market is perfectly competitive, the upstream firm captures all rents under either contractual form. A situation in which fixed-fee pricing does not induce efficient inventory holdings in perfectly competitive downstream markets occurs when multiple, heterogeneous downstream markets exist, but the upstream firm is not allowed to charge different wholesale prices across markets. Consider the upstream firm's profit-maximization problem in the absence of revenue sharing when M downstream markets exist. The profit function is:

$$\pi_s^{FF}(F) = (F-l)\sum_{m=1}^{M} \frac{N_m}{(N_m+1)\tau}\left(V_m - \frac{F\eta}{\tau}\right) \tag{11}$$

First order conditions for equation 11 give the optimal wholesale price:

[21] Under fixed-fee pricing, the upstream firm's optimal wholesale price is $F^* = \frac{\tau V}{2\eta} + \frac{l}{2}$ and y is, by definition, equal to zero.

$$F^* = \frac{\tau \sum_{m=1}^{M} \frac{N_m V_m}{(N_m+1)}}{2\eta \sum_{m=1}^{M} \frac{N_m}{(N_m+1)}} + \frac{l}{2} \tag{12}$$

The studio would like to charge a different F_m^* for each of the M markets, but is constrained to charge the same price to all retailers. The optimal F^* in equation 12 is a weighted average of the set of F_m^* that would be charged in each market if perfect price discrimination were possible, where the weights assigned to the individual markets depend on their competitive conditions.

When multiple markets exist, it is possible that some markets understock and some markets overstock inventory, relative to the efficient, vertically-integrated firm's inventory choice. For example, consider two markets with many firms ($N_1 \to \infty$ and $N_2 \to \infty$). Market 1 has $V_1 = V_l$ and market 2 has $V_2 = V_h$, where $V_h > V_l$, and the marginal cost of producing a unit of inventory is zero. The upstream firm has set F^* as above, so

$$F^* = \frac{\tau(V_l + V_h)}{4\eta}$$

The vertically-integrated firm chooses to stock

$$c_1^{VI} = \frac{1}{2}V_l \qquad\qquad c_2^{VI} = \frac{1}{2}V_h$$

The vertically-separated firms choose

$$c_1^{VS} = \frac{1}{4}(3V_l - V_h) \qquad\qquad c_2^{VS} = \frac{1}{4}(3V_h - V_l)$$

Firms in the low-value market, market 1, understock because F^* is relatively too high, while firms in the high-value market, market 2, overstock because F^* is relatively too low.

Under revenue-sharing terms, $u^* = u_{VI}$. However, setting u^* optimally still depends on V and N in the downstream market. Recall u^* from equation 10:

$$u^* = u_{VI} = \frac{(N-1)\tau V}{2N\eta} + \frac{(N+1)l}{2N}$$

With multiple downstream markets, u^* is optimally set at

$$u^* = \frac{\tau \sum_{m=1}^{M} \frac{(N_m-1)V_m}{N_m}}{2\eta} + \frac{l \sum_{m=1}^{M} \frac{(N_m+1)}{N_m}}{2} \tag{13}$$

Note that u^* is a weighted average of the set of optimal u_m^* that the upstream firm would like to charge in each individual downstream market. Similarly, y^* will be set to induce retailers in some "average" market to accept revenue sharing.

Equation 13 illustrates the potential for both under- and over-stocking in individual markets under revenue sharing, relative to the vertically-integrated firm's choice of inventory in each market. Individual markets are differentiated by two features: their size (V_m) and their competitive conditions (N_m). Empirically, the size of a market could depend upon the number of customers in the market as well as the appeal of the product in that market. The competitive conditions are given by the number of (identical) retailers in a market, and I assume the retailers compete in a Cournot fashion.

In order to understand the role of quantity restrictions used in revenue-sharing contracts, I examine three cases. In the first case, V varies across markets, but the number of firms in a market is held constant, so $N_m = \overline{N} \ \forall \ m$. This example is similar to the first model of Dana and Spier (2001), in which variation in market conditions is generated by uncertainty in the demand conditions in a perfectly-competitive market, rather than by the existence of multiple, heterogeneous markets. In this case, I find that revenue sharing helps, but cannot achieve the maximum level of industry profits when N is finite and demand conditions are not perfectly elastic. A single pair of quantity requirements (a single minimum and maximum for all markets) can increase the upstream firm's profits. In the second case, V is the same across markets, so $V_m = \overline{V} \ \forall \ m$, but the number of downstream firms varies across markets. Again, it is shown that revenue-sharing is an improvement over fixed-fee contracts, but does not achieve the maximum potential level of industry profits. A single pair of quantity requirements can be difficult to implement in this case. In the third and final case, both V and N vary across markets. In this case, revenue-sharing also increases the upstream firm's profits, but still results in over- and under-stocking.[22] Stipulating minimum and maximum purchase requirements allows the upstream firm to further increase profits. In addition, the upstream firm now benefits by conditioning quantity requirements on store size. I discuss all three cases in Appendix A. I show that the use of quantity restrictions can reduce such inefficiencies in inventory levels.[23]

[22]For the remainder of the paper, over- and under-stocking refer to inventory choices relative to the vertically-integrated firm's choice of inventory, which maximizes industry profits.

[23]This may seem to raise the question of why we do not see quantity restrictions imposed under fixed, linear pricing contracts. The salient impediment to imposing quantity restrictions in the fixed-fee contract is a practical one: retailers on fixed-fee contracts have the flexibility to resell inventory to other retailers, and

5 Alternative Specifications of Consumer Demand: Price, Availability, Functional Form and Equilibrium Assumptions

The model of firm behavior presented here has focused on the use of contracts between upstream and downstream firms, and not on developing a complete method for analyzing the nature of consumer demand in retail markets or especially retail markets for rental goods. Understanding how to estimate consumer demand in these markets, including the trade-offs between price and availability in the downstream market, is clearly an important issue. However, the focus here is on understanding the nature and effects of contractual arrangements between firms in vertically-separated markets, and not on developing a framework for modeling retail demand *perse*. Nevertheless, one worries whether or how the determinants of contractual arrangements between upstream and downstream firms may be misstated if consumer demand is misspecified. In this section, I consider three potentially important complications for consumer demand; a later section will also examine the robustness of the empirical results to alternative specifications and assumptions.

5.1 Measuring Price in the Rental Market

An implication of the theoretical model presented here is that under revenue-sharing contractual terms, retailers should set lower prices than under fixed-fee contracts. As mentioned in the discussion of Tables 4 - 6, there may be multiple dimensions of price in this market. In particular, the retailer may adjust both the price of a rental and/or the length of the rental period. In the empirical results that follow, I model the decision of a retailer as a decision over the total price (i.e., he chooses the product of price per day and number of days, but he does not choose both variables separately.) Thus, estimates of welfare gains that are generated from price falls stand in for expected drops in the price of a rental as well as expected increases in the length of the rental period.

5.2 Availability and the τ Parameter

An issue that is related to the different components of price is the treatment of the lifespan of a unit of inventory, denoted by the parameter τ. With respect to the model outlined above,

inventory under these contracts is not monitored or controlled by the upstream firm in any way. One of the principle advantages of revenue sharing is precisely the ability to monitor inventory and fine-tune retailers' inventory choices in doing so.

two points should be made. First, one can easily consider the retailer's problem in terms of both τ and V within the current model. For example, see the contract choice equation 8 above, which can be re-written as $V\tau = \frac{\eta(F-yu+\sqrt{y}(F-u))}{(1-y)}$. Thus, one can allow the retailer's decision to be made on both τ and V, allowing simultaneously for both heterogeneity in demand conditions and uncertainty (from the retailer's point of view) in τ. I provide results from estimating the model under these assumptions in the section on robustness tests.[24]

Second, one could explicitly allow for different intensities of inventory use under the two contractual forms. Indeed, although a technological limit to the lifespan of a unit of inventory certainly exists (tapes do break after a number of viewing), one worries that retailers also influence the number of rentals per tape by endogenously choosing availability, the length of the rental period, late fees, etc.[25] When advertising the benefits of revenue-sharing contracts, Rentrak often highlights the ability to satisfy demand more quickly using a larger inventory. In addition to the results of "base" model, I also provide results that incorporate different τ's under the two contractual forms as a robustness test for this effect. [26] Additional methodological advances for estimating demand systems in which both price and availability are strategic variables of the retailer (i.e., allowing for the simultaneous choice of both inventory and τ) are left for future work.

5.3 Functional Form and Equilibrium Assumptions

One advantage of using linear demand of the form $Q = V - \eta p$ as in equation 1 is that analytical solutions for retailers' inventory and contract choices are readily available. Generalizations of the demand curve are easily generated that have straightforward analytical

[24] A complication arises when allowing for uncertainty in τ in estimation. For store-title pairs on revenue-sharing contracts for which quantity restrictions are binding, equations 8 becomes a more complicated function of V and τ, as outlined in Appendix B. I provide further discussion of this issue in the section on robustness tests.

[25] For example, one might worry that a retailer chooses high copy-depth and low τ for an action movie because he expects that demand is very sensitive to early availability, but he chooses low copy-depth and high τ for a romantic drama, perceiving the renters of that movie to be less sensitive to early availability. His problem is then more closely related to the literature on variable proportions, where the firm varies the intensity of use for different substitutable inputs (here, time vs. inventory). Note however, that allowing for variation in V (rather than τ) has the attractive feature that the observed quantity restrictions make sense even when all downstream markets are perfectly competitive.

[26] A related issue is the question of whether additional inventory can stimulate demand directly, perhaps by reducing stock-outs or through a signalling mechanism (i.e., consumers observe larger inventory holdings for a title and infer that it is a higher-quality movie.) If inventory does in fact stimulate demand, my estimates of demand elasticity will be overestimated. In other work, I document that this effect is relatively small: on the order of a two to three percent increase in demand for one additional tape, evaluated at the mean level of inventory for A and B titles (Mortimer (2001)).

solutions for retailers' inventory and contract choices when quantity restrictions do not bind; however, such generalizations typically do not have analytical solutions when quantity restrictions are binding. In the empirical estimation that follows, I use the base model to generate moment conditions that relate observed contract and inventory choices to the underlying parameters of the model. Nevertheless, I considered two alternative functional forms that do have analytical solutions (under non-binding quantity restrictions). These are $Q = V(1 - \eta p)$ and $Q = V_1(V_2 - \eta p)$. The first specification allows for rotations of the demand curve rather than shifts (as in the base model). The second specification allows for both shifts and rotations of the demand curve. I had difficulty estimating these functions forms, and in particular, I could find no convincing source of variation in the data that might separately identify the two types of demand movements.[27] Regarding the possibility of multiple equilibria with respect to retailers' contract choices, the base model assumes that unobserved retailers choose the same contract as the observed retailer in a given market. In other words, the base model assumes symmetric contract choice equilibria for the purposes of estimation.[28]

6 Estimation

This section describes the estimation procedures and relates them to the behavioral model. The behavioral model gives specific predictions linking firms' contract and inventory choices to the competitive conditions and demand conditions in their markets. Specifically, these predictions relate the technology parameter (τ) and demand parameters (η and the parameters of the probability density function of V) to firms' contract and inventory choices. I use four principal equations from the behavioral model to generate a set of moment conditions that summarize the relationships between predicted parameter values and observed contract and inventory choices at the store-title level. Empirically, I define a market as a zip code area, with approximately 24,000 people and 2.6 video retail stores in the average

[27] An alternative functional form would be a demand curve with constant elasticity, such as $Q = Kp^{\frac{1}{\rho}}$. I do not estimate this because it constrains my estimate of elasticity to be at least one and does not generalize the model or reduce the computational burden in any obvious way.

[28] The estimated parameter values do lie in a part of the parameter space that admits symmetric contract choice equilibria, although they do not always like in a part of the parameter space that admits *only* symmetric contract choice equilibria. One could estimate parameter values based on other equilibrium assumptions (for example, one could estimate probabilities of alternative equilibria, or impose the assumption that unobserved retailers choose a different contract than the observed retailer), but the assumption of the base model seems the most intuitive.

market.[29]

My sample covers approximately 30 percent of all video retailers in the U.S.; in a typical market, I observe 0.8 of 2.6 stores.[30] As in the behavioral model, I assume that the unobserved downstream retailers in a market are identical to the observed firm, and that they choose the same contract as the observed firm in my sample.[31] Data include the quantity and price of rentals (q and p), contract choice (RS), inventory (c), cost per unit of inventory (the upfront fee under revenue-sharing terms, u, or the wholesale price under fixed-fee terms, F), revenue splits (y), the number of retailers in each market (N), and a set of demographic and store characteristics (X). I do not observe actual prices paid under fixed-fee terms, which could reflect additional volume discounts or bonus inventory from "copy-depth" programs.[32] I denote the full set of data as $Z = (q, p, RS, c, u, F, y, N, X)$, where an observation is a store-title pair. Price is calculated as the average price over all weeks and quantity is given by the total number of rentals over all weeks. The parameter vector to be estimated is denoted by $\theta = (\tau, \eta, \beta, \sigma_v, \sigma_\epsilon)$.

I construct six moment conditions using four equations from section 4 describing firm behavior. Specifically, I construct moment conditions from the technology equation, the demand equation, retailers' contract choice equations, and retailers' inventory equations. I estimate a set of parameters using generalized method of moments (GMM) to solve:

$$\hat{\theta} = \text{argmin} \left(\sum_i \psi(\theta, Z_i) \right)' \quad A \quad \left(\sum_i \psi(\theta, Z_i) \right).$$

where $\psi(\theta, Z_i)$ is the set of moment conditions and A is a weight matrix. The first moment

[29] Imposing this market definition allows me to observe the number of competitors faced by different retailers. I discuss more flexible specifications later in this section that would allow me to relax this assumption.

[30] Unfortunately, I do not observe characteristics of the unobserved stores (except for an indicator if it is a Blockbuster Video store). In the "baseline" analysis, I assume that the unobserved stores are identical to the observed store in my dataset. Occasionally, my sample includes two stores in the same zipcode area. In these cases, I allow for different unobservable demand components for each store, so that the market demand estimated for each store is correlated only through observable market characteristics. I also condition on store observables such as store size and the mix of a store's product across movie types.

[31] One could consider generalizing the model to allow for alternative equilibria in which the unobserved retailers in a market choose different contracts than the observed firm. As noted in the theoretical section, multiple equilibria in the choice of contracts may exist. The issue of multiple equilibria arises in other literatures as well, such as the entry literature, for example. The view here is that the best approximation of the characteristics and decisions of the unobserved firms in the market are the characteristics and decisions of the observed firm.

[32] I estimate the model under alternative reasonable fixed-fee pricing assumptions, and the results do not change significantly. These alternative include giving retailers a twenty percent discount, or charging \$70 rather than \$65 per tape.

condition is given by $E(q-\tau c)=0$ and is generated from the technology equation (equation 3) of the behavioral model. The second moment condition is associated with the demand equation (equation 1) from the behavioral model. Market level quantity, Q in equation 1, is calculated empirically as the number of firms (N) multiplied by the observed quantity of the representative store in the dataset (q). The intercept of demand, V, varies across markets and across titles within a market according to the behavioral model. I allow for both observed and unobserved demand shifters to affect the estimate of V. I assume that V is distributed lognormal $(X'\beta, \sigma_v^2)$ with expectation $g_0(X,\theta) = e^{(X'\beta+\sigma_v^2/2)}$ and variance $e^{(2X'\beta+\sigma_v^2)}(e^{\sigma_v^2}-1)$. Thus, the second moment condition is $E(\eta p_i + N_i q_i - g_0(X_i,\theta)) = 0$.

The remaining four moment conditions use the retailers' supply and profit equations (equations 5 and 6 respectively) to compute the conditional expectations of retailers' inventory and contract choices. First, consider the conditional expectation of RS, which is the probability that revenue-sharing terms are chosen by a retailer for a particular title. The retailer profit equation predicts that retailers with high market valuations for a title will not choose revenue-sharing terms. Specifically, retailers with $V > V^*(\tau,\eta,F,u,y)$ will choose fixed-fee terms (see equation 8). Thus, the third moment condition is given by $E(RS - \int_0^{V^*(\tau,\eta,F,u,y)} \frac{1}{\sqrt{2\pi}\sigma_v V} \exp -[(\ln V - X'\beta)^2]/(2\sigma_v^2)\, dV) = 0$, and comes directly from the retailer's profit equation in the behavioral model.

Finally, retailers' inventory decisions are predicted by equation (6). The conditional expectation of c again involves the unobserved V, so these three moment conditions are based on the expectation of the lognormal distribution of V. The functions $g_1(X,\theta)$ and $g_2(X,\theta)$ give the expectation of V after conditioning on market and store characteristics and the observed contract choice, RS. The empirical moment conditions are written as $[(c - \frac{1}{(N+1)\tau}(g_1(X,\theta) - \frac{\eta u}{\tau}))X\ RS]$ and $[(c - \frac{1}{(N+1)\tau}(g_2(X,\theta) - \frac{\eta F}{\tau}))X\ (1-RS)]$.

If only one pricing contract were available, calculating the expectation of V for each moment condition would be straightforward, based on the assumption of a lognormal distribution for V. Conditional on retailers having a choice of contracts, however, the distribution of V is truncated from below for titles taken on fixed-fee terms, and truncated from above for titles taken on revenue-sharing terms. The truncation point is equal to $V^*(\tau,\eta,F,u,y)$, which gives the conditional expectation of V in the fourth and fifth moment conditions respectively as

$$\begin{aligned} g_1(X,\theta) &= E(V \mid RS=1,X) = E(V \mid V<V^*,X) \\ &= \exp(X'\beta+\sigma_v^2/2)\tfrac{\Phi((\ln V^*-X'\beta)/\sigma_v)-\sigma_v)}{\Phi((\ln V^*-X'\beta)/\sigma_v)} \end{aligned} \tag{14}$$

$$\begin{aligned} g_2(X,\theta) &= E(V \mid RS=0,X) = E(V \mid V>V^*,X) \\ &= \exp(X'\beta+\sigma_v^2/2)\tfrac{1-\Phi((\ln V^*-X'\beta)/\sigma_v)-\sigma_v)}{1-\Phi((\ln V^*-X'\beta)/\sigma_v)} \end{aligned}$$

where Φ denotes the standard normal cumulative density function.

The last moment condition uses the second moment of the empirical distribution of inventory (i.e., it equates the observed c_i^2 and $E(c_i^2 \mid X,\theta)$.) I allow for dispersion in the relationship between the quantity of rentals and inventory by admitting measurement error in the observed inventory choices. That is, I observe c where

$$c = c^* + \epsilon \tag{15}$$

and $\epsilon \mid c^* \sim N(0,\sigma_\epsilon^2)$. The measurement error affects the calculation of this last moment condition, since one must now account for the variance of the measurement error.[33] Finally, I denote the conditional expectation of V^2 as $g_3(X,\theta)$, where $g_3(X,\theta) = \exp(2X'\beta - 2\sigma_v^2)$. Thus, the final moment condition is calculated empirically as $c^2 - \frac{1}{(N+1)^2\tau^2}(g_3(X,\theta) - \frac{2\eta w}{\tau}g_0(X,\theta) + \left(\frac{\eta w}{\tau}\right)^2) - \sigma_\epsilon^2$ where the payment per unit of inventory, $w = uRS + F(1-RS)$. Formally, the moment conditions are:

$$\psi(\theta,Z_i) \equiv \begin{pmatrix} q_i - \tau c_i \\ \eta p_i - g_0(X_i,\theta) + N_i q_i \\ RS_i - \int_0^{V^*(\tau,\eta,F,u,y)} \frac{1}{\sqrt{2\pi}\sigma V}\exp -[(\ln V - X_i\beta)^2]/(2\sigma_v^2)\,dV \\ (c_i - \frac{1}{(N_i+1)\tau}(g_1(X_i,\theta) - \frac{\eta u}{\tau}))X_i\ RS_i \\ (c_i - \frac{1}{(N_i+1)\tau}(g_2(X_i,\theta) - \frac{\eta F}{\tau}))X_i\ (1-RS_i) \\ c_i^2 - \frac{1}{(N_i+1)^2\tau^2}(g_3(X_i,\theta) - \frac{2\eta w}{\tau}g_0(X_i,\theta) + \left(\frac{\eta w}{\tau}\right)^2) - \sigma_\epsilon^2 \end{pmatrix} \tag{16}$$

The weight matrix A is not chosen to minimize variance according to Hansen (1982). As reported in the section on robustness tests, the results change only slightly when Hansen's estimate of A is used. Here, A is chosen to ensure that the parameters τ and η exactly satisfy the first two moment conditions. Thus, the estimation of these parameters is not

[33] The introduction of measurement error allows for dispersion in the number of rentals per tape (τ), but requires that the source of this dispersion is exogenous to retailers' decisions. See the discussion of the τ parameter in the previous section and related robustness tests.

affected by any misspecification of the additional moment conditions generated from the retailers' first order conditions. All standard errors adjust for correlations within stores and titles, essentially allowing for store and title random effects. The construction of the weight matrix and the calculation of standard errors for the estimated parameter values are both discussed in Appendix B.

Two additional issues are worthy of discussion. First, in the structural model of firm behavior, I assume Cournot competition between identical firms. Empirically, the measure of competition is the number of video retailers listed in the phone book for a (zip code area) market. In addition to adjusting for observable differences in the total number of video retailers across markets, I also allow the demand facing an individual retailer to be affected separately by the presence of a local Blockbuster Video. Based on the facts of this industry, I believe this captures the most important effects of competition across markets, while limiting the computational burden.[34]

The second issue is the fact that inventory restrictions are binding for many of the observed store-title pairs taken under revenue-sharing terms. The truncation point given by $V^*(\tau, \eta, F, u, y)$ in equation 8 applies when inventory is chosen optimally. Thus, when a retailer is constrained by inventory minimums or maximums for a particular title, the implied truncation point changes. I incorporate the correct truncation point in these cases, and provide further detail on the truncation adjustments in Appendix B. I also address the sensitivity of the results to the truncation adjustment in a later section.

7 Estimation Results

The GMM estimation is conducted separately for A, B, and C titles. Table 7 gives the estimated parameters of the distribution of V using demographic and store characteristics. Column 1 gives results from estimating the model for A titles. These indicate that store characteristics, and store size in particular, are correlated with V. Comparisons across the three types of movies indicate that store size has a relatively larger effect for B and C titles

[34] Clearly, one might worry that observing the number of video retailers in a market is not perfectly informative of the competitive conditions in a market. For example, one may worry that despite observing the number of firms in a market, unobservable heterogeneity in the strength of competition across markets may still play an important role in firms' decisions. Introducing unobservable heterogeneity into the model may be accomplished by re-writing the moment conditions as a function of R_i and specifying $R_i = N_i + \zeta_i$. Allowing for two dimensions of unobservable heterogeneity in the moment conditions (V_i and R_i) is computationally more intensive, but is conceptually the same problem as the one solved here.

than for A titles. Exposure to greater numbers of customers in the store may have a relatively larger effect for these types of titles than for A titles, which receive more extensive national advertising at both the theatrical and video release. Demographic characteristics are only weakly correlated with the estimate of $E(V)$, although it is shown in later specifications that greater numbers of people are associated with larger demand for all movie types, median income is negatively correlated with demand, and areas that are more suburban appear to have greater demand for A titles (as opposed to B and C titles, which are more likely to be 'art-house' types of movies).

Additional store characteristics include indicators for whether or not a store receives more than five percent of its total revenues from rentals of games, rentals of adult titles, or sales of tapes (rather than rentals). The effects of these variables on demand is generally not significant, although stores that derive more than five percent of their revenues from rentals of adult product tend to have lower demand for B titles, and stores deriving more than five percent of their revenues from rentals of games are correlated with lower demand for A titles and higher demand for C titles.

Although I do not have data from Blockbuster Video stores, I can identify how many Blockbuster Video stores exist in any given zip code market. The results in Table 7 as well as later specifications indicate that the presence of a Blockbuster store in a retailer's market has a positive effect on $E(V)$. Industry sources often identify the positive effect as the result of spillovers from Blockbuster's extensive advertising campaigns; Blockbuster increased advertising significantly with the introduction of its own revenue-sharing agreements in early 1998. This positive correlation may also reflect endogenous location decisions by Blockbuster.

The behavioral model excludes cross-title demand elasticities and assumes that firms' profits are additively separable across products. I include three variables that capture changes in the availability of product released by studios over time. These are: the total number of A, B, or C movies released in the same month as a given title, as well as the total number of such titles released under revenue-sharing contracts, and the total number of such titles released under "sell-through" pricing contracts.[35] The results indicate that,

[35] As noted earlier, "sell-through" titles are priced to encourage direct sales to consumers (typically in the range of $20.00-$25.00). Examples of such titles are children's videos (i.e., *Disney* titles), and very successful teen- or comedy-oriented titles, such as *E.T., Something About Mary,* or *Blair Witch Project.* Video retailers often benefit from sell-through pricing, since they are also able to purchase tapes cheaply.

especially for A titles, an additional release in the same month under either revenue-sharing or sell-through pricing terms is correlated with lower demand for a title.

Finally, the price coefficient η from Table 7 indicates that a \$1.00 increase in the price of a rental would result in roughly 256 fewer rentals over the life of a movie for A titles, 213 fewer rentals for B titles, and 47 fewer rentals for C titles in the average market. Based on the observed average number of rentals and observed average price, the estimated η yields price elasticities for the average market demand curve of roughly -0.7 for A titles, and -0.5 for B and C titles. Price elasticities less than unity result from the fact that the first-order conditions of the upstream firm (the movie studio) are not used in estimation. Such price elasticities are possible when downstream firms compete in a Cournot game without imposing upstream monopoly. The fact that the elasticities are low is an indication that video retailing is a relatively competitive industry.

8 Counterfactual Experiments and Welfare Analysis

Based on the parameter values in Table 7, I conduct several counterfactual experiments. Table 8 presents results for A, B, and C titles from three such exercises. First, I consider the effect of introducing revenue-sharing in its current form, relative to the situation in which firms only use a fixed-fee contract. Second, I consider the effect of removing quantity restrictions from the current revenue-sharing contracts. Finally, I consider the effect of switching completely to revenue-sharing contracts within the industry.

The first four columns of Table 8 give predicted average levels of inventories, prices, revenue-sharing take-up rates, and retailer and distributor profits based on the estimated parameters of the demand system. The last column of Table 8 lists the actual values constructed from the data for each of these variables. Comparing the first column of Table 8 to the last column gives some indication of the goodness-of-fit of the estimated behavioral model. The portion of retailers accepting revenue-sharing terms is estimated reasonably well, as is inventory. Price tends to be overestimated, and computed profits for A, B, and C titles also appear to be over-estimated as a result. While these values give some indication of the goodness-of-fit of the estimated demand system, they cannot be used for calculations of consumer surplus, and they do not account for the adverse selection problem facing upstream firms as a result of retailers' ability to choose between contractual forms. Conclusions about the relative effects of different pricing policies are drawn by comparing

columns 1 - 4.

8.1 Introduction of Current Revenue-Sharing Contracts

The first experiment considers the effect of introducing revenue sharing in its current form, relative to the use of only fixed-fee contracts. This is essentially what happened in the industry in early 1998 when Blockbuster and other retailers began adopting revenue-sharing contracts widely. Comparing columns 1 and 2 of Table 8 shows the effect of this contractual change. For A titles, average inventory increases from 20.1 to 24.2 for the average store-title pair, reflecting the alleviation of the double-marginalization problem under fixed-fee contracting. I predict that approximately 40 percent of firms accept revenue-sharing terms, and average price drops from \$4.64 to \$4.08. Average retailer profits increase by eight percent, although distributor profits are one percent lower. Consumers benefit the most, as consumer surplus increases by 15 percent for A titles. Examining the B titles shows that inventory again increases from 9.7 to 11.7, as 40 percent of retailers accept revenue-sharing terms. The change is accompanied by a reduction in price from \$3.47 to \$3.01. Retailer profits increase by 5.4 percent, and distributor profits are unchanged. Consumer surplus increases by 13 percent. Similar results hold for C titles.

8.2 Elimination of Inventory Restrictions

Next, I consider the effect of inventory restrictions in the revenue-sharing contracts. Under these conditions, retailers face the same monetary revenue-sharing contract terms (i.e., the same upfront fee u and revenue split y), but are subject to inventory restrictions. The results of this exercise must be interpreted carefully: one does not necessarily expect that the distributor would optimally charge the same upfront fee and revenue-split in the absence of inventory restrictions as they charge with inventory restrictions. In other words, while I allow retailers to fully re-optimize in this scenario, I do not allow the same opportunity for distributors. In the last exercise, empirical evidence suggests that fixed-fee prices did not change upon the introduction of revenue-sharing contracts. Thus, one might view the absence of distributor re-optimization as a less serious concern than in the current exercise. Even so, the lack of such re-optimization places limitations on our interpretations of the

results.[36]

Under the assumption that distributors do not change the contract terms u and y, the effect of eliminating inventory restrictions is seen by comparing columns 1 and 3 in Table 8. In the absence of inventory restrictions, more retailers accept revenue-sharing terms: 59 percent, 53 percent, and 51 percent for A, B and C titles respectively. With higher revenue-sharing take-up rates, average inventories increase, and price falls relative to the current environment. Retailer profit increases by one to three percent (across the three types of movies), and distributor profit falls by the same percentage. Consumers gain the most from the elimination of inventory restrictions and the associated higher rates of revenue-sharing: consumer surplus increases by four to ten percent relative to the current environment.

8.3 Revenue-Sharing Contracts Only

Recently, one major studio began distributing products directly to retailers, managing the distribution and retailer accounts internally. This has been viewed by some industry members as possibly laying the groundwork for adopting revenue-sharing terms more widely among retailers. Furthermore, Rentrak currently offers a few "output" programs in which a retailer agrees to accept revenue-sharing terms for a bundle of titles. In this third exercise, I consider the effect of moving to an environment in which only revenue-sharing terms are offered, but retailers are not bound by inventory restrictions. Again, I do not allow distributors to re-optimize, although it is unlikely that distributors would not change the observed contractual terms of the revenue-sharing contracts. Thus, one must be cautious when interpreting the results of this exercise.

If distributors do not change the terms of the revenue-sharing contracts, then the effect of implementing revenue-sharing for all retailers is given by comparing columns 1 and 4 in Table 8. In this exercise, retailers cannot choose fixed-fee terms. Inventories increase, and price falls for all three classes of titles. Retailer profit decreases by five to 15 percent, but distributor profits increase by three to nine percent. Consumer surplus also increases substantially, relative to the current environment.

[36] Simulations of the optimal wholesale terms (F, u, y) give estimates quite close to the actual terms, so the results do not change much if we allow for reoptimization at the upstream level.

8.4 Welfare Effects by Store Types

Tables 9 and 10 examine the incidence of the effects of the alternative contractual arrangements across retailers according to store size. Each of the ten panels corresponds to a unique size category.[37] Looking first at the actual average levels of price and revenue sharing "take-up" rates, one sees that price and total inventory levels increase with store size, while the incidence of revenue sharing declines monotonically at larger store sizes. The model predicts the same, although take-up rates of revenue-sharing contracts tend to be underpredicted and predicted inventory levels vary less across store size categories than actual inventories.

Comparing the first and second columns, one notices that small retailers benefit more from the introduction of the current contracts, with larger retailers benefitting to a lesser degree. Distributors are especially hurt by the ability of small downstream firms to choose revenue-sharing contracts for poorly performing titles: for stores with less than $14,000 of total monthly revenue, the upstream firm is actually worse off with the introduction of the current contracts. For larger stores, however, both distributors and retailers benefit from the current menu of contracts, compared to a menu that includes only fixed-fee contracts.

9 Robustness Tests

Tables 11 through 13 provide parameter values from estimating the model under various alternative modeling assumptions as a check on the robustness of the base results, essentially altering one assumption of the 'base model' at a time. The tables provide results for A, B, and C titles respectively; the first column in each table repeats the results from the appropriate column in Table 7 for comparison. Column 2 reports results using a weight matrix as in Hansen (1982); the results change very little, although the estimated demand elasticity for B titles increases from -0.48 to -0.63.

Column 3 reports results from estimating the model with two additional moment restrictions. The additional restrictions equate estimated accounting profits for retailers and distributors with actual accounting profits (according to the same assumptions on the costs of fixed-fee contracts as used in Tables 1 - 6 and 8). The reason for including these moment restrictions was to take advantage of additional information on firms' costs, especially the cost of production borne by the distributor. The disadvantage of this strategy is that I

[37] These are the same store size classifications used for setting quantity minimum and maximum requirements.

potentially introduce misspecification of the market structure of the upstream market if this market is not monopolistic. The results do not change much; in particular, the estimate of demand elasticity is close to that computed in the base model. Some coefficients do change; the effect of a local Blockbuster Video appears to be much stronger across all three movie categories. The additional moment restrictions are not rejected by the test of overidentifying restrictions proposed by Hansen (1982).[38]

The last three columns provide robustness tests of the specification of the τ variable, as discussed in section 5.2. First, column 4 provides results from estimating the model with different values of τ for each contract type. This is done in order to address concerns that revenue-sharing contracts are selected explicitly in order to increase inventory levels and satisfy demand more quickly, intentionally lowering the effective τ. In fact, we do see a stark difference in τ across the two contractual forms.[39] The effects of a local Blockbuster Video competitor and store size are now estimated to be much larger across all three title categories. However, estimates of price elasticities are quite similar to the base model.

Finally, I also allow for uncertainty in the τ parameter. In this case, we can interpret variation in the relationship between rentals and inventory directly as variation in the τ parameter, and thus I do not separately estimate measurement error in inventory.[40] Analytical results are not available in this case when quantity restrictions are seen to be binding; such observations comprise nearly half of the total sample. Thus, I estimate the model both for the subsample of observations for which the restrictions are not binding, and I also estimate the model for the whole dataset under the assumption that those binding observations reflect inventory decisions that were in fact optimally chosen. I present the results for the full dataset in column 5. Results that additionally allow for a distribution on the τ parameter under the assumption that inventory decisions were optimally chosen are presented in the last column. Under these assumptions, the effects of many of the demographic and store

[38]The base model interacts the inventory choice equation with the observed contract choice, and thus uses $2k + 4$ moment conditions to estimate $k + 4$ parameters where k is the dimension of X. The value of the test statistic for the base model, which is distributed according to a χ^2 distribution with $k = 13$ degrees of freedom is 0.25, 0.18, and 0.04 for A, B, and C title respectively. The value of the test statistic when the two additional moment restrictions based on accounting profits are also included is 0.38, 0.27, and 0.11 for the three classes of titles, and is distributed according to a χ^2 distribution with 15 degrees of freedom.

[39]The estimate of τ reported for all observations is the average of the two τ's, weighted by the number of observations for each contractual form.

[40]This variation is what identifies the variance of the measurement error in the base model, and I cannot point to variation in the data that might separately identify these two different sources of dispersion in the relationship between rentals and inventory.

characteristics on demand are quite close to the base results. The effect of a local competing Blockbuster Video, and the effect of store size is larger compared to the base results (much like the results using separate estimates of τ for the two contractual forms). The estimate of elasticity is now close to unity for all three categories of titles.

Finally, Tables 14 - 19 provide results of the same counter-factual exercises as Table 8 for the estimated parameter values under each alternative specification in Tables 11 - 13. Generally, the results are similar to the results of the counter-factual exercises using the results of the base model. The results using demand estimates from columns 5 and 6 in Tables 11 - 13 tend to estimate smaller effects of the current contracting environment relative to fixed linear pricing.[41] Nevertheless, the estimates are still within a reasonable range of the base estimates. Allowing for different τ's based on contract choice, or allowing for a distribution on τ increases the relative effect of eliminating the fixed-fee pricing contract for all title categories (i.e., see column 4 in tables 14 - 19). Overall, however the results seem robust to many different concerns one might raise about specific assumptions in the model.

10 Conclusion

This study considers the effect of a contractual change in the vertically-separated video rental industry. The contractual change involves the introduction of revenue-sharing contracts in addition to traditional fixed, linear pricing contracts. The nature of the contractual change itself is unique: not only do downstream retailers have a choice of contracts for each product, but they also face both minimum and maximum inventory restrictions under revenue-sharing terms. Casual evidence indicates that this contractual change had an important and substantial impact on firms' inventory decisions. However, to my knowledge, no theoretical study of revenue-sharing contracts considers a contracting environment of this type, and the existence of both minimum and maximum restrictions presents a puzzle for the standard analysis of revenue-sharing contracts.

The data in this study provide an unusually rich source of information on firms' decisions in such an environment. An important component to the study is the development of a model of firm behavior that rationalizes firms' contract choices and the existence of the

[41] Recall that these estimates reflect the assumption that inventory choices are optimal, even for observations where quantity restrictions are observed to be binding. These results thus reflect both the true estimates from the model incorporating variation in τ and misspecification of V^* in the contract choice equation.

inventory restrictions observed in revenue-sharing contracts. The model explains the use of inventory restrictions on the basis of an upstream firm's inability to discriminate among heterogeneous downstream markets when the upstream firm is constrained to offer the same upfront fees and revenue-splits to all retailers. The structural model is estimated empirically using a panel dataset of firms' decisions for a large set of products. Based on the estimated parameters of the structural model, I conduct several counter-factual experiments. First, I examine the effect of adopting revenue-sharing terms, and find that total upstream and downstream profits increase by as much as six percent relative to the use of fixed-fee pricing contracts. I also examine the potential effects of eliminating inventory restrictions and fixed-fee pricing contracts. I find that downstream firms benefit from the elimination of inventory restrictions, but upstream firm profits decrease. Eliminating both the inventory restrictions and the fixed-fee contracts leaves the upstream firm's profits virtually unchanged from the current environment and lowers downstream firms' profits.

The challenges of efficiently supplying firms in vertically-separated industries is a long-standing and important problem for both upstream and downstream firms, especially in many retail settings. Some industries have in fact found that vertical integration provides a better solution (for example, the automobile-rental industry). Many other industries use flexible buy-back policies or revenue-sharing contracts to transfer goods between manufacturers and retailers (such as the retail book industry and theatrical movie exhibition industry, respectively). By making use of sophisticated software and monitoring technology, the home video industry has created more flexible ways of transferring goods from upstream to downstream markets. By studying the contracts adopted in this industry, one hopes to better understand the empirical effects of such contractual innovations on firm and consumer welfare in these settings.

Appendix A: Quantity Requirements with Additional Sources of Heterogeneity

A.1 The Use of Quantity Requirements when V Varies

The revenue-sharing terms that induce the efficient level of inventory in each market are given by u^* in equation 10. With multiple downstream markets, the best the upstream firm can do is to set a single revenue-sharing contract, with terms given by equation 13. If $N = \overline{N}$ in all markets, then equation 13 reduces to

$$u^* = \frac{(\overline{N} - 1)\tau E(V)}{2\overline{N}\eta} + \frac{(\overline{N} + 1)l}{2\overline{N}} \tag{17}$$

When $\overline{N} = 1$, transferring inventory at marginal cost induces a downstream monopolist to charge the correct price and carry the efficient level of inventory in the average market. When $\overline{N} > 1$, however, competitive retailers would choose to overstock relative to the vertically-integrated firm's choice of inventory. Setting u^* as in equation 17 eliminates over- and under-stocking for the market with $V = E(V)$ and $N = \overline{N}$.[42]

If V varies across markets, equation 17 shows that one expects over- and under-stocking in all but the average market. In particular, for markets with high draws of V_m, u^* will be relatively too low, and firms in these high-value markets will overstock. For markets with low draws of V_m, u^* will be set relatively too high, and firms in these markets will understock. The under- and over-stocking problem under revenue-sharing terms is analogous to the under- and over-stocking problem laid out in the discussion of fixed-fee pricing in multiple, heterogeneous downstream markets. As shown in this example, revenue sharing requires a positive upfront fee in excess of marginal cost ($u^* > l > 0$) to avoid excessive price competition, unless $\overline{N} = 1$.

In order to reduce inefficiencies in inventory levels, the upstream firm can set quantity restrictions in the revenue-sharing contract. Consider the highest-value market, V_h. Each market has $N = \overline{N}$ firms, and u^* has been set to induce the correct inventory levels in the

[42] Over- and under-stocking refer to inventory choices relative to the vertically-integrated firm's choice of inventory, which maximizes industry profits.

average market. Thus, u^* is given by equation 17. This u^* induces firms in the average market to stock the efficient level of inventory, which is

$$C^*_{\overline{V}}(u^*) = \frac{\overline{V}}{2\tau} - \frac{l\eta}{2\tau^2}.$$

However, firms in the market with $V = V_h$ stock

$$C_{V_h}(u^*) = \frac{\overline{V}}{2\tau} - \frac{l\eta}{2\tau^2} + \frac{\overline{N}(V_h - \overline{V})}{(\overline{N}+1)\tau}$$

which is greater than the efficient level of inventory for the high-value market,

$$C^*_{V_h} = \frac{V_h}{2\tau} - \frac{l\eta}{2\tau^2}. \tag{18}$$

The difference between $C_{V_h}(u^*)$ and $C^*_{V_h}$, and the extent of overstocking in the high-value market, is given by

$$(C_{V_h}(u^*) - C^*_{V_h}) = \frac{(\overline{N}-1)(V_h - \overline{V})}{2(\overline{N}+1)\tau} \tag{19}$$

The number of firms is the same in all markets, so the upstream firm can mitigate this problem by setting a single maximum quantity for all retailers of $c_{max} = C^*_{V_h}/\overline{N}$ in order to prevent overstocking in the highest value market. In fact, depending on the distribution of V, the upstream firm may choose to set $c_{max} < C^*_{V_h}/\overline{N}$, creating understocking in the highest-value market, but reducing overstocking in other markets with $V_m \in [\overline{V}, V_h]$. Similarly, if the lowest value market has $V = V_l$, the upstream firm can set $c_{min} \geq C^*_{V_l}/\overline{N}$, which is the minimum amount of inventory the upstream firm wants retailers to hold in the lowest-value market. Recall that firms in the highest-value market pay too low an upfront fee, and keep too high a percentage of revenue. Similarly, firms in the lowest-value market pay too high an upfront fee, and keep too little of subsequent revenue. Thus, when setting c_{min} and c_{max}, the upstream firm must take into account the potential effects of the quantity requirements on firms' contract selections and possible exit from the industry. By now, the upstream firm is solving a more complicated problem than the problem in equation 9. The upstream firm's profit maximization problem, taking into account the ability to set a single pair of quantity requirements, (c_{min}, c_{max}), is:

$$\max_{\{u,y,c_{min},c_{max}\}} \rho(u,y)\pi^{RS}_s(u,y,c_{min},c_{max}) + (1-\rho(u,y))\pi^{FF}_s \mid F,\tau,\eta,\overline{N},f(V) \tag{20}$$

At this point, I have only addressed the use of a single pair of quantity requirements: a uniform minimum and maximum quantity for all retailers. Clearly, this increases the upstream firm's profits relative to revenue-sharing terms with no quantity requirements. Empirically, however, one observes quantity requirements that vary by store size. Consider defining store size in market m as $V_m/\overline{N}$. Retail firms are assumed to be symmetric, so all stores in market m are the same size. Recall that for all markets with $V_m < \overline{V}$, understocking occurs because u^* is set uniformly. All markets with $V_m > \overline{V}$ overstock inventory for the same reason. By conditioning quantity requirements on store size, the upstream firm can induce the vertically-integrated inventory levels in each market because store size is perfectly correlated with V_m. Only a minimum quantity requirement is necessary for small stores, and only a maximum quantity requirement is necessary for large stores. Essentially, conditioning quantity requirements on store size allows the upstream firm to perfectly set C_m^* in each market.

A.2 The Use of Quantity Requirements when N Varies

In this section, I examine the use of revenue sharing in downstream markets where $V = \overline{V}$ for all markets, but N_m varies across markets. Recall the optimal upfront fee for the upstream firm to charge per unit of inventory given by equation 17:

$$u^* = \frac{(\overline{N}-1)\tau E(V)}{2\overline{N}\eta} + \frac{(\overline{N}+1)l}{2\overline{N}}$$

when N varies, rather than V, the upstream firm sets u^* as:

$$u^* = \frac{(E(N)-1)\tau \overline{V}}{2E(N)\eta} + \frac{(E(N)+1)l}{2E(N)} \tag{21}$$

The upstream firm once again faces problems of under- and over-stocking because u^* depends on N. In particular, markets with many firms, $N_m > \overline{N}$, have "too much" competition, and inventory will be overstocked in these markets. On the other hand, markets with fewer than $\overline{N}$ firms have too little competition, which results in an under-supply of inventory. In this case, it is difficult to set a single pair of minimum and maximum quantity requirements for all firms. Setting a single quantity requirement can be difficult because store size will be small in markets with large N (and overstocking), while store size will be large in markets with small N (and understocking). Thus, it is possible that the maximum

quantity requirement for all firms may be less than the minimum quantity requirement. Allowing the upstream firm to condition quantity requirements on store size, however, solves the problem. Once again, the upstream firm can achieve the maximum attainable industry profits by setting quantity requirements by store size because store size is perfectly informative of N_m. Essentially, the upstream firm can perfectly discriminate across markets if allowed to condition quantity requirements on store size.

A.3 The Use of Quantity Requirements when Both V and N Vary

In this section, I consider the upstream firm's problem when both V and N vary across markets. Once again, setting a single u and y solves the inventory problem for the average market, but induces some markets to understock and some markets to overstock inventory. However, when both V and N vary across markets, it is less clear which markets will overstock and which will understock because both measures are varying. For example, consider a market with a low draw of V and large N. The low draw of V would induce retailers to understock, while large N would tend to lead to overstocking. The offsetting effects may induce retailers to stock the correct amount.

Now the use of store size for conditioning quantity requirements is very useful. Recall that store size was defined as V/N. Thus, when V does not vary, store size is perfectly informative of N, and when N does not vary, store size is perfectly informative of V. Conditional on store size, the upstream firm knows the optimal level of inventory exactly under these conditions. When both V and N vary, store size is no longer perfectly informative of the competitive conditions or size of a market. For example, two similarly-sized stores may exist in markets with a high draw of V and many firms, or with a low draw of V and few firms, respectively. The first store in the high-value market, will tend to overstock inventory. However, the second store will tend to understock inventory. Thus, it is no longer possible to stipulate an exact level of inventory, conditional on store size. However, the upstream firm can set bounds on inventory choices by setting minimum and maximum quantity requirements according to store size. The use of both minimum and maximum requirements arise because both V and N vary. Although it is not possible to perfectly discriminate across markets when both V and N vary, the firm achieves the highest attainable level of profits by setting minimum and maximum requirements in this way.

Appendix B: Construction of Weight Matrix, Standard Errors, and Truncation Adjustments for GMM Estimates

In this appendix, I describe the construction of the weight matrix, A, the calculation of the standard errors for the parameters θ, and the truncation adjustments used in the GMM estimates.

B.1 Construction of the Weight Matrix

The parameters θ are estimated using GMM to solve

$$\theta = \text{argmin} \left(\sum_i \psi(\theta, Z_i) \right)' \quad A \quad \left(\sum_i \psi(\theta, Z_i) \right)$$

where $\psi(\theta, Z_i)$ is the set of moment conditions discussed in the estimation section, equation 16. In practice, the first two moments, $E(q - \tau c) = 0$ and $E(\eta p - g_0(X, \theta) + Nq) = 0$ are estimated separately, essentially giving more weight to the calculation of the parameters τ and η, and requiring the parameters to fit these equations exactly. This can be incorporated in the GMM strategy by setting the weights corresponding to these moments arbitrarily high. For each of the remaining moments, the weight matrix A is constructed optimally using the two-step procedure outlined in Hansen (1982).

B.2 Calculation of Covariance Matrix

For a given weight matrix, Hansen (1982) shows that $\hat{\theta}$ converges in distribution to

$$\sqrt{I}(\hat{\theta} - \theta_0) \xrightarrow{d} N(0, (\Gamma' A \Gamma)^{-1} (\Gamma' A \Delta A \Gamma)(\Gamma' A \Gamma)^{-1})$$

where θ_0 is the vector of true parameter values, and Γ and Δ are defined as

$$\Gamma = E\left[\frac{\partial \psi}{\partial \theta'}(Z, \theta_0) \right], \quad \text{and} \quad \Delta = E\left[\psi(Z, \theta_0) \cdot \psi(Z, \theta_0)' \right].$$

I denote the number of observations as I to avoid confusion with the data on a retailer's number of competitors, N. The matrix Γ is estimated empirically as

$$\hat{\Gamma} = \frac{1}{I}\sum_{i} \frac{\partial \psi}{\partial \theta'}(Z, \hat{\theta})$$

In the absence of store- and title- correlations, Δ would be estimated empirically as

$$\hat{\Delta} = \frac{1}{I}\sum_{i} \psi_i(Z, \hat{\theta}) \cdot \psi_i(Z, \hat{\theta})'.$$

However, this estimate must be adjusted for both within-store and within-title correlation. I assume there are no correlations across moment conditions. Thus, allowing for store and title random effects requires that one estimates $\hat{\Delta}$ as

$$\hat{\Delta} = \frac{1}{I}\sum_{i} \psi_i(Z, \hat{\theta}) \cdot \psi_{-i}(Z, \hat{\theta})'$$

I assume observations drawn for different titles at different stores are not correlated. Thus, using slightly different notation, $\hat{\Delta}$ is given by

$$\hat{\Delta} = \frac{1}{I} \cdot [\sum_{i} \psi_{s,t}(Z, \hat{\theta}) \cdot \psi_{s,t}(Z, \hat{\theta})' + \sum_{s} \psi_{s,t}(Z, \hat{\theta}) \cdot \psi_{s,-t}(Z, \hat{\theta})' + \sum_{t} \psi_{s,t}(Z, \hat{\theta}) \cdot \psi_{-s,t}(Z, \hat{\theta})']$$

where (s,t) denotes title t at store s, $(s,-t)$ denotes all other titles taken by store s, and $(-s,t)$ denotes all other stores that took title t.

The standard errors account for the separate estimation of the first two moments by specifying A as

$$A \equiv \begin{bmatrix} 100a_{11} & 0 & 0 \cdots 0 \\ 0 & 100a_{22} & 0 \cdots 0 \\ 0 & 0 & a_{33} \cdots a_{36} \\ \vdots & \vdots & \vdots \\ 0 & 0 & a_{63} \cdots a_{66} \end{bmatrix}$$

where a_{ij} is the ij^{th} element of $\hat{\Delta}^{-1}$. The practice of estimating the first two moments separately corresponds to a GMM strategy in which the weight associated with these moments is arbitrarily high. Specifying A as above reflects this practice in the estimation of the standard errors. The covariance matrix for $\hat{\theta}$ is then estimated as $(\hat{\Gamma}' A \hat{\Gamma})^{-1}(\hat{\Gamma}' A \hat{\Delta} A \hat{\Gamma})(\hat{\Gamma}' A \hat{\Gamma})^{-1}$.

B.3 Truncation Adjustments

Conditional on retailers having a choice of contracts, the distribution of V is truncated from below for titles taken on fixed-fee terms, and truncated from above for titles taken on revenue-sharing terms, as indicated in the retailer's profit function in the behavioral model. The truncation point is equal to $V^*(\tau, \eta, F, u, y)$, which is given in equation 8 and also shown here as

$$V^*(\tau, \eta, F, u, y) = \frac{\eta(F - yu + \sqrt{y}(F - u))}{(1 - y)\tau}.$$

This gives the conditional expectation of V in the fourth and fifth moment conditions respectively as

$$\begin{aligned} g_1(X, \theta) &= E(V \mid RS = 1, X) = E(V \mid V < V^*, X) \\ &= \exp(X'\beta + \sigma_v^2/2)\frac{\Phi((\ln V^* - X'\beta)/\sigma_v) - \sigma_v)}{\Phi((\ln V^* - X'\beta)/\sigma_v)} \\ g_2(X, \theta) &= E(V \mid RS = 0, X) = E(V \mid V > V^*, X) \\ &= \exp(X'\beta + \sigma_v^2/2)\frac{1 - \Phi((\ln V^* - X'\beta)/\sigma_v) - \sigma_v)}{1 - \Phi((\ln V^* - X'\beta)/\sigma_v)} \end{aligned} \tag{22}$$

where Φ denotes the standard normal cumulative density function.

The truncation point given by $V^*(\tau, \eta, F, u, y)$ applies when inventory is chosen optimally, and is derived by equating retailer profits (evaluated at the optimal inventory levels) under each contractual form. When a retailer is constrained by inventory minimums or maximums for a particular title, the implied truncation point changes. For store-title pairs for which minimum or maximum inventory restrictions are observed to be binding, I denote the truncation point as $V_m^*(\tau, \eta, F, u, y, N)$, which is given by:

$$\begin{aligned} V_m^*(\tau, \eta, F, u, y, N) &= \tfrac{1}{2\tau}\left(y c_m \tau^2 (N+1)^2 + 2\eta F + \sqrt{c_m \tau^2 (y(N+1)^2 - 4N) + 4(F - u)\eta}\right) \\ \text{where } c_m &= \begin{cases} c_{min} \text{ if the minimum inventory restriction is binding} \\ c_{max} \text{ if the maximum inventory restriction is binding} \end{cases} \end{aligned} \tag{23}$$

Just as in the calculation of V^*, the truncation point V_m^* is derived by equating retailer profits under both contractual forms, except that retailer profit under revenue-sharing terms is now computed at c_m rather than at the optimal inventory choice, c^*. Adjusting $E(V)$ to

account for the implied truncation of the distribution of V when quantity restrictions apply occurs as above in equation 22, but evaluated at V_m^* rather than at V^*. Similar adjustments are made to account for truncation when calculating $E(V^2)$.

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Table 1: Revenue-Sharing vs. Fixed-fee Contracts: A Titles, Differences Between Stores for the Same Title*

	Stores accepting Revenue-Sharing	(S.D.)	Stores accepting Fixed-Fee	(S.D.)	T-stat of Diff.
No. People ('000s)	23.32	(0.79)	23.83	(1.18)	[0.8]
% Suburban	21.73	(1.28)	21.49	(2.02)	[-0.2]
% Married with Kids	28.14	(0.21)	27.81	(0.23)	[-2.3]
Median Income ('000s)	31.28	(0.57)	31.83	(0.88)	[1.2]
No. Competitors	2.63	(0.08)	2.59	(0.08)	[-0.8]
No. Blockbusters	1.06	(0.01)	1.06	(0.01)	[0.9]
Store Size[1]	3.87	(0.48)	4.81	(0.27)	[3.7]
Variety of Titles	659.73	(31.84)	590.28	(69.15)	[-2.0]
% with Sales > 5 %	35.68	(7.22)	32.92	(11.78)	[-0.4]
% with Adult > 5 %	32.96	(2.84)	31.55	(2.80)	[-0.8]
% with Games > 5 %	42.15	(7.55)	48.50	(11.09)	[1.0]
Copies	30.04	(9.91)	15.87	(7.18)	[-2.5]
Rentals (Q)	471.71	(172.70)	485.50	(159.83)	[0.1]
Price (P)	2.72	(0.07)	2.74	(0.07)	[0.6]
Retailer Profit	370.36	(202.18)	380.21	(261.56)	[0.1]
Distributor Profit	871.32	(312.26)	937.81	(453.87)	[0.3]
Observations	23		23		

*An observation in this table is a title. For each title, mean store characteristics are computed for the set of stores accepting each type of contract. The source of demographic data is 1990 U.S. Census data. Data on competing retailers is gathered from 1998 and 1999 phone book listings.
1) Stores are categorized into 10 separate groups by monthly revenue size. Larger group numbers correspond to larger store revenues.

Table 2: Revenue-Sharing vs. Fixed-fee Contracts: B Titles, Differences Between Stores for the Same Title*

	Stores accepting Revenue-Sharing	(S.D.)	Stores accepting Fixed-Fee	(S.D.)	T-stat of Diff.
No. People ('000s)	22.94	(0.55)	23.69	(0.73)	[2.0]
% Suburban	21.10	(1.38)	22.46	(1.27)	[1.8]
% Married with Kids	28.21	(0.20)	27.86	(0.12)	[-3.8]
Median Income ('000s)	31.34	(0.77)	31.58	(0.53)	[0.6]
No. Competitors	2.66	(0.07)	2.56	(0.05)	[-3.0]
No. Blockbusters	1.06	(0.01)	1.06	(0.01)	[-1.0]
Store Size[1]	3.48	(0.38)	4.95	(0.38)	[6.7]
Variety of Titles	698.81	(27.25)	608.88	(49.00)	[-3.9]
% with Sales > 5 %	31.83	(5.76)	38.32	(8.70)	[1.5]
% with Adult > 5 %	35.70	(3.50)	31.01	(2.53)	[-2.6]
% with Games > 5 %	43.34	(5.92)	43.25	(7.80)	[0.0]
Copies	12.98	(4.04)	7.29	(2.45)	[-2.9]
Rentals (Q)	235.66	(106.84)	291.65	(124.32)	[0.8]
Price (P)	2.68	(0.08)	2.74	(0.05)	[1.6]
Retailer Profit	188.45	(117.36)	349.60	(292.61)	[1.2]
Distributor Profit	424.91	(173.13)	437.47	(173.27)	[0.1]
Observations	35		35		

*An observation in this table is a title. For each title, mean store characteristics are computed for the set of stores accepting each type of contract. The source of demographic data is 1990 U.S. Census data. Data on competing retailers is gathered from 1998 and 1999 phone book listings.
1) Stores are categorized into 10 separate groups by monthly revenue size. Larger group numbers correspond to larger store revenues.

Table 3: Revenue-Sharing vs. Fixed-fee Contracts: C Titles, Differences Between Stores for the Same Title*

	Stores accepting Revenue-Sharing	(S.D.)	Stores accepting Fixed-Fee	(S.D.)	T-stat of Diff.
No. People ('000s)	25.89	(7.08)	27.03	(7.33)	[0.6]
% Suburban	20.12	(6.92)	20.01	(11.65)	[0.0]
% Married with Kids	27.59	(2.12)	27.28	(3.64)	[-0.4]
Median Income ('000s)	30.67	(3.02)	30.83	(4.71)	[0.2]
No. Competitors	2.58	(0.42)	2.74	(0.92)	[0.9]
No. Blockbusters	1.06	(0.05)	1.08	(0.12)	[0.9]
Store Size[1]	3.76	(0.52)	5.16	(1.27)	[5.7]
Variety of Titles	962.19	(156.20)	762.73	(189.94)	[-4.6]
% with Sales > 5 %	31.69	(10.78)	33.78	(21.25)	[0.5]
% with Adult > 5 %	46.90	(13.40)	42.61	(22.52)	[-0.9]
% with Games > 5 %	43.10	(12.43)	50.59	(25.15)	[1.5]
Copies	2.25	(1.43)	1.75	(1.23)	[-1.5]
Rentals (Q)	24.97	(28.69)	33.71	(39.58)	[1.0]
Price (P)	2.52	(0.20)	2.41	(0.48)	[-1.1]
Retailer Profit	19.98	(28.15)	-2.70	(79.71)	[-1.5]
Distributor Profit	39.39	(50.38)	84.48	(79.65)	[2.7]
Observations	1,055		991		

*An observation in this table is a title. For each title, mean store characteristics are computed for the set of stores accepting each type of contract. The source of demographic data is 1990 U.S. Census data. Data on competing retailers is gathered from 1998 and 1999 phone book listings.
1) Stores are categorized into 10 separate groups by monthly revenue size. Larger group numbers correspond to larger store revenues.

Table 4: Revenue-Sharing vs. Fixed-fee Contracts: A Titles, Differences Between Titles Within a Store*

	Titles taken on Revenue-Sharing	(S.D.)	Titles taken on Fixed-Fee	(S.D.)	T-stat of Diff.
Upfront Fee[1]	7.87	(0.86)	8.32	(0.89)	[3.1]
Revenue Kept by Retailer[1]	0.45	(0.01)	0.45	(0.01)	[0.5]
Minimum Inventory[1]	25.04	(16.14)	25.30	(14.49)	[0.1]
Maximum Inventory[1]	56.54	(31.29)	50.91	(25.64)	[-1.2]
% At Minimum	0.34	(0.34)	–	–	–
% At Maximum	0.13	(0.20)	–	–	–
No. A Titles Released	4.28	(0.50)	4.40	(0.70)	[1.2]
No. A Titles, Rev-Share	1.67	(0.31)	1.86	(0.37)	[3.4]
No. A Titles, Sell-thru	1.57	(0.27)	1.43	(0.32)	[-2.7]
Copies	35.37	(27.54)	13.42	(12.29)	[-6.2]
Rentals (Q)	585.67	(520.22)	398.53	(353.90)	[-2.5]
Price (P)	2.73	(0.40)	2.74	(0.44)	[0.1]
Price per day	1.84	(0.58)	1.88	(0.54)	[0.4]
Retailer Profit	486.48	(555.44)	294.99	(455.14)	[-2.3]
Distributor Profit	1,071.25	(959.18)	784.67	(728.00)	[-2.0]
Observations	5,439		4,961		

*An observation in this table is a store. For each store, mean title characteristics are computed for the set of titles taken under each type of contract. If a store chose revenue-sharing (fixed-fee) terms every time an A title was purchased, the store is not included as an observation in the column containing information on fixed-fee (revenue-sharing) terms. 1) For titles accepted on revenue-sharing terms, the averages of the upfront fee, revenue-split, and the minimum and maximum inventory restrictions represent the actual fees paid by the retailer (or adhered to, in the case of inventory restrictions). For titles accepted on fixed-fee terms, the averages of the upfront fee, revenue-split, and the minimum and maximum inventory restrictions represent the revenue-sharing terms available to the retailer when choosing between pricing contracts, but not actually paid. Under fixed-fee terms, retailers pay $70 per tape and face no revenue-split or inventory restrictions. A few titles are priced for "sell-through," with the fixed price per tape around $35.

Table 5: Revenue-Sharing vs. Fixed-fee Contracts: B Titles, Differences Between Titles Within a Store*

	Titles taken on Revenue-Sharing	(S.D.)	Titles taken on Fixed-Fee	(S.D.)	T-stat of Diff.
Upfront Fee[1]	8.43	(0.62)	8.66	(0.48)	[2.5]
Revenue Kept by Retailer[1]	0.45	(0.01)	0.45	(0.01)	[-1.2]
Minimum Inventory[1]	12.92	(8.21)	13.03	(7.47)	[0.1]
Maximum Inventory[1]	31.54	(17.07)	30.91	(15.91)	[-0.2]
% At Minimum	0.43	(0.38)	–	–	–
% At Maximum	0.09	(0.21)	–	–	–
No. B Titles Released	5.02	(1.15)	5.17	(0.73)	[1.0]
No. B Titles, Rev-Share	3.14	(1.12)	3.34	(1.03)	[1.1]
No. B Titles, Sell-thru	1.86	(0.49)	2.03	(0.46)	[2.1]
Copies	18.09	(15.24)	6.04	(5.61)	[-6.3]
Rentals (Q)	386.99	(423.43)	228.43	(211.45)	[-2.8]
Price (P)	2.73	(0.42)	2.72	(0.44)	[-0.1]
Price per day	1.77	(0.62)	1.85	(0.57)	[0.9]
Retailer Profit	351.32	(490.14)	256.32	(328.73)	[-1.4]
Distributor Profit	690.95	(745.25)	361.80	(339.56)	[-3.4]
Observations	5,194		5,243		

*An observation in this table is a store. For each store, mean title characteristics are computed for the set of titles taken under each type of contract. If a store chose revenue-sharing (fixed-fee) terms every time a B title was purchased, the store is not included as an observation in the column containing information on fixed-fee (revenue-sharing) terms.
1) For titles accepted on revenue-sharing terms, the averages of the upfront fee, revenue-split, and the minimum and maximum inventory restrictions represent the actual fees paid by the retailer (or adhered to, in the case of inventory restrictions). For titles accepted on fixed-fee terms, the averages of the upfront fee, revenue-split, and the minimum and maximum inventory restrictions represent the revenue-sharing terms available to the retailer when choosing between pricing contracts, but not actually paid. Under fixed-fee terms, retailers pay $70 per tape and face no revenue-split or inventory restrictions. A few titles are priced for "sell-through," with the fixed price per tape around $35.

Table 6: Revenue-Sharing vs. Fixed-fee Contracts: C Titles, Differences Between Titles Within a Store*

	Titles taken on Revenue-Sharing	(S.D.)	Titles taken on Fixed-Fee	(S.D.)	T-stat of Diff.
Upfront Fee[1]	7.83	(1.10)	7.72	(0.90)	[-0.7]
Revenue Kept by Retailer[1]	0.49	(0.04)	0.51	(0.03)	[3.6]
Minimum Inventory[1]	3.73	(3.58)	3.14	(1.66)	[-1.3]
Maximum Inventory[1]	12.36	(8.04)	12.13	(5.11)	[-0.2]
% At Minimum	0.41	(0.33)	–	–	–
% At Maximum	0.07	(0.17)	–	–	–
No. C Titles Released	70.50	(6.59)	73.78	(3.65)	[3.7]
No. C Titles, Rev-Share	57.22	(4.62)	59.25	(3.30)	[3.1]
No. C Titles, Sell-thru	36.30	(5.05)	37.92	(3.87)	[2.2]
Copies	5.94	(6.97)	2.07	(1.04)	[-4.7]
Rentals (Q)	125.09	(181.27)	54.01	(38.01)	[-3.3]
Price (P)	2.65	(0.42)	2.56	(0.45)	[-1.2]
Price per day	1.68	(0.64)	1.66	(0.61)	[-0.2]
Retailer Profit	111.59	(196.34)	34.19	(80.66)	[-3.1]
Distributor Profit	216.20	(347.56)	103.63	(55.03)	[-2.7]
Observations	5,247		5,483		

*An observation in this table is a store. For each store, mean title characteristics are computed for the set of titles taken under each type of contract. If a store chose revenue-sharing (fixed-fee) terms every time a C title was purchased, the store is not included as an observation in the column containing information on fixed-fee (revenue-sharing) terms.
1) For titles accepted on revenue-sharing terms, the averages of the upfront fee, revenue-split, and the minimum and maximum inventory restrictions represent the actual fees paid by the retailer (or adhered to, in the case of inventory restrictions). For titles accepted on fixed-fee terms, the averages of the upfront fee, revenue-split, and the minimum and maximum inventory restrictions represent the revenue-sharing terms available to the retailer when choosing between pricing contracts, but not actually paid. Under fixed-fee terms, retailers pay $70 per tape and face no revenue-split or inventory restrictions. A few titles are priced for "sell-through," with the fixed price per tape around $35.

Table 7: Estimated Parameter Values from GMM Estimation

$\partial \ln V / \partial X (*1000)$	A Titles	B Titles	C Titles
People	0.5	0.1	0.4
	(0.5)	(0.3)	(0.3)
% Suburban	38.9	2.1	-1.0
	(37.0)	(12.3)	(10.3)
% Married w/ Kids	20.8	-8.6	-3.0
	(129.9)	(45.7)	(148.9)
Median Income	-0.0	-0.3	-0.9
	(0.6)	(0.4)	(1.1)
No. Blockbusters	15.5	128.1	51.4
	(17.5)	(5.3)	(42.0)
Store Size	2.8	110.2	16.8
	(3.0)	(1.7)	(4.7)
No. All Releases	-1.0	8.6	-0.1
	(4.5)	(3.2)	(3.8)
No. Rev-Share Releases	-315.9	-31.3	0.7
	(8.9)	(1.8)	(3.4)
No. Sell-thru Releases	-22.4	4.1	1.6
	(8.8)	(3.5)	(2.9)
Sales > 5 %	-3.3	-8.3	4.1
	(17.2)	(18.3)	(27.4)
Adult > 5 %	5.0	-94.7	-2.4
	(13.6)	(12.8)	(37.4)
Game Rental > 5 %	-75.6	1.3	30.8
	(17.8)	(13.1)	(9.1)
$\hat{\tau}$	20.38	28.96	21.21
	(0.07)	(0.10)	(0.12)
$\hat{\eta}$	255.56	212.97	46.56
	(0.27)	(1.37)	(0.42)
$\hat{\sigma}_{\ln v}$	0.08	0.04	0.05
	(0.00)	(0.00)	(0.00)
$\hat{\sigma}_{\epsilon}$	0.30	0.44	0.04
	(0.26)	(1.38)	(0.16)
Price Elasticity at Observed Q, P	-0.70	-0.48	-0.52
	(0.001)	(0.003)	(0.005)
Observations	99,794	146,459	647,535

Standard errors in parentheses.

Table 8: Counter-factual Experiments

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 1: A titles					
Inventory	24.24	20.08	26.94	31.19	24.00
Price	4.08	4.64	3.55	2.88	2.73
% Revenue-Sharing	39.91	0.00	58.55	100.00	53.04
Retailer Profit	901.58	828.85	927.87	859.74	393.30
Dist. Profit	1187.27	1203.72	1174.40	1228.81	911.55
% Change Ret. Profit		-8.07	2.92	-4.64	
% Change Dist. Profit		1.39	-1.08	3.50	
% Change CS		-14.74	9.62	30.31	
Panel 2: B titles					
Inventory	11.71	9.72	12.32	14.27	9.50
Price	3.01	3.47	2.79	2.24	2.72
% Revenue-Sharing	40.41	0.00	53.08	100.00	37.78
Retailer Profit	529.52	500.73	533.57	448.91	296.85
Dist. Profit	583.52	582.20	576.14	637.26	437.69
% Change Ret. Profit		-5.44	0.77	-15.22	
% Change Dist. Profit		-0.23	-1.26	9.21	
% Change CS		-13.02	4.07	23.58	
Panel 3: C titles					
Inventory	3.62	2.84	3.85	4.23	2.94
Price	2.94	3.54	2.63	2.29	2.57
% Revenue-Sharing	35.29	0.00	51.10	100.00	47.14
Retailer Profit	111.33	93.31	115.09	101.67	55.25
Dist. Profit	113.20	118.75	110.53	120.27	102.45
% Change Ret. Profit		-16.19	3.37	-8.68	
% Change Dist. Profit		4.90	-2.36	6.25	
% Change CS		-21.46	6.58	17.21	

Table 9: Welfare Effects by Store Size (A Titles)

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Size 1: Monthly Rev < $4,000					
Inventory	20.84	19.45	26.37	30.35	11.30
Price	4.18	4.58	3.47	2.81	2.59
% Revenue-Sharing	57.75	0.00	59.80	100.00	71.12
% Change Ret. Profit		-8.60	2.85	-4.73	
% Change Dist. Profit		9.64	6.68	10.18	
Size 2: Monthly Rev > $4,000 and < $7,000					
Inventory	23.73	19.96	26.84	31.07	11.97
Price	3.92	4.62	3.54	2.88	2.64
% Revenue-Sharing	5684	0.00	58.56	100.00	62.02
% Change Ret. Profit		-9.26	2.26	-5.50	
% Change Dist. Profit		6.28	3.24	8.25	
Size 3: Monthly Rev > $7,000 and < $10,000					
Inventory	25.18	20.34	27.29	31.68	14.79
Price	3.92	4.66	3.60	2.93	2.69
% Revenue-Sharing	50.94	0.00	57.81	100.00	57.87
% Change Ret. Profit		-9.76	1.76	-5.77	
% Change Dist. Profit		2.88	0.96	6.56	
Size 4: Monthly Rev > $10,000 and < $14,000					
Inventory	26.00	20.39	27.20	31.60	18.40
Price	3.92	4.67	3.60	2.93	2.73
% Revenue-Sharing	43.99	0.00	58.01	100.00	52.20
% Change Ret. Profit		-8.94	1.51	-6.02	
% Change Dist. Profit		0.52	-1.55	3.63	
Size 5: Monthly Rev > $14,000 and < $18,000					
Inventory	25.87	20.58	27.50	31.88	23.74
Price	4.05	4.68	3.60	2.94	2.76
% Revenue-Sharing	36.68	0.00	58.38	100.00	48.88
% Change Ret. Profit		-8.21	2.37	-5.18	
% Change Dist. Profit		-0.73	-2.86	2.39	

Table 10: Welfare Effects by Store Size (A Titles, cont.)

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Size 6: Monthly Rev > $18,000 and < $25,000					
Inventory	24.63	20.19	27.00	31.26	30.18
Price	4.18	4.65	3.56	2.88	2.80
% Revenue-Sharing	27.55	0.00	58.34	100.00	46.22
% Change Ret. Profit		-7.20	3.23	-4.46	
% Change Dist. Profit		-2.41	-4.67	-0.30	
Size 7: Monthly Rev > $25,000 and < $33,000					
Inventory	23.11	19.61	26.35	30.44	38.55
Price	4.27	4.60	3.49	2.81	2.86
% Revenue-Sharing	19.54	0.00	59.15	100.00	43.83
% Change Ret. Profit		-6.27	4.99	-2.47	
% Change Dist. Profit		-2.06	-5.59	-2.20	
Size 8: Monthly Rev > $33,000 and < $40,000					
Inventory	23.39	19.87	26.59	30.77	46.31
Price	4.32	4.63	3.54	2.85	2.86
% Revenue-Sharing	16.11	0.00	58.25	100.00	40.98
% Change Ret. Profit		-4.66	6.13	-1.25	
% Change Dist. Profit		-2.07	-4.93	-2.36	
Size 9: Monthly Rev > $40,000 and < $50,000					
Inventory	23.32	20.13	27.08	31.32	56.20
Price	4.40	4.66	3.57	2.90	2.86
% Revenue-Sharing	13.00	0.00	59.06	100.00	38.04
% Change Ret. Profit		-3.41	7.54	0.45	
% Change Dist. Profit		-2.47	-4.00	0.20	
Size 10: Monthly Rev > $50,000					
Inventory	20.80	18.79	25.54	29.35	77.71
Price	4.39	4.55	3.39	2.73	2.83
% Revenue-Sharing	8.18	0.00	60.57	100.00	32.31
% Change Ret. Profit		-2.70	8.78	1.83	
% Change Dist. Profit		-1.85	-4.87	-2.37	

Table 11: Estimated Parameter Values from GMM Estimation, A Titles

$\partial \ln V / \partial X (*1000)$	Base	Hansen	Profits	Different τ's	Not Binding	Uncertain τ
People	0.5	1.0	3.5	6.9	0.5	1.7
	(0.5)	(0.5)	(0.7)	(0.3)	(0.4)	(0.4)
% Suburban	38.9	72.2	31.7	40.2	28.3	-43.6
	(37.0)	(15.9)	(25.5)	(15.4)	(19.3)	(18.0)
% Married w/ Kids	20.8	27.6	-43.5	4.2	11.4	498.6
	(129.9)	(55.3)	(97.6)	(57.4)	(75.9)	(78.7)
Median Income	-0.0	-0.1	0.6	0.1	-0.0	1.0
	(0.6)	(0.5)	(0.8)	(0.6)	(0.5)	(0.5)
No. Blockbusters	15.5	16.4	143.4	159.4	12.1	165.9
	(17.5)	(12.4)	(16.9)	(10.1)	(11.3)	(10.9)
Store Size	2.8	3.7	29.0	186.1	1.3	191.9
	(3.0)	(3.9)	(2.1)	(2.7)	(2.7)	(2.4)
No. All Releases	-1.0	-0.5	-18.7	13.7	34.9	-25.8
	(4.5)	(4.3)	(4.0)	(4.0)	(4.5)	(4.6)
No. Rev-Share Releases	-315.9	-328.3	-80.5	-164.9	-133.6	-67.5
	(8.9)	(10.9)	(8.1)	(7.8)	(8.2)	(8.0)
No. Sell-thru Releases	-22.4	-15.9	-36.0	-29.8	-104.8	-52.7
	(8.8)	(8.8)	(8.2)	(9.5)	(8.3)	(8.5)
Sales > 5 %	-3.3	-3.3	19.7	-69.2	-2.4	9.0
	(17.2)	(11.9)	(14.9)	(9.8)	(11.3)	(10.2)
Adult > 5 %	5.0	5.0	-51.6	1.8	2.7	1.4
	(13.6)	(16.5)	(18.2)	(12.5)	(10.2)	(10.2)
Game Rental > 5 %	-75.6	-25.5	79.8	-83.3	-69.3	-38.6
	(17.8)	(13.1)	(14.9)	(10.8)	(10.7)	(10.0)
$\hat{\tau}$	20.38	21.51	20.38	22.88	20.38	20.70
	(0.07)	(0.07)	(0.09)	(0.09)	(0.08)	(0.00)
$\hat{\tau}, RS$	–	–	–	15.88	–	–
$\hat{\tau}, FF$	–	–	–	30.80	–	–
$\hat{\eta}$	255.56	258.43	228.54	234.77	215.89	180.57
	(0.27)	(0.10)	(2.75)	(3.18)	(1.83)	(3.06)
$\hat{\sigma}_{\ln v}$	0.08	0.08	0.08	0.07	0.08	0.44
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)
$\hat{\sigma}_\epsilon$ (or) $\hat{\sigma}_\tau$	0.30	0.14	0.26	0.19	0.33	0.004
	(0.26)	(0.09)	(2.78)	(3.17)	(1.79)	(0.39)
Price Elasticity	-0.70	-0.69	-0.78	-0.76	-0.83	-0.99
at Observed Q, P	(0.001)	(0.000)	(0.009)	(0.010)	(0.007)	(0.017)
Observations	99,794	99,794	99,794	99,794	99,794	99,794

Table 12: Estimated Parameter Values from GMM Estimation, B Titles

$\partial \ln V/\partial X(*1000)$	Base	Hansen	Profits	Different τ's	Not Binding	Uncertain τ
People	0.1	1.9	1.2	0.1	0.6	2.0
	(0.3)	(0.3)	(0.3)	(0.2)	(0.6)	(0.4)
% Suburban	2.1	-18.9	-0.6	2.1	6.4	12.0
	(12.3)	(16.5)	(13.1)	(10.0)	(49.0)	(18.9)
% Married w/ Kids	-8.6	9.6	-229.0	-5.2	-5.6	-15.8
	(45.7)	(58.7)	(50.7)	(87.1)	(132.9)	(84.2)
Median Income	-0.3	-0.0	-1.5	-0.6	-0.4	-2.7
	(0.4)	(0.4)	(0.3)	(0.4)	(0.2)	(0.5)
No. Blockbusters	128.1	132.5	220.4	256.5	43.1	220.0
	(5.3)	(9.1)	(7.0)	(11.4)	(6.3)	(10.8)
Store Size	110.2	10.4	68.7	149.9	32.4	178.2
	(1.7)	(2.3)	(1.3)	(2.0)	(2.2)	(2.5)
No. All Releases	8.6	-0.4	8.8	4.8	-5.7	23.0
	(3.2)	(3.7)	(3.1)	(2.7)	(2.9)	(3.6)
No. Rev-Share Releases	-31.3	-30.5	13.6	4.9	2.6	-5.7
	(1.8)	(3.4)	(2.5)	(3.9)	(1.6)	(2.9)
No. Sell-thru Releases	4.1	-55.0	-38.5	-2.1	12.1	-38.0
	(3.5)	(5.2)	(4.1)	(3.4)	(1.7)	(5.0)
Sales > 5 %	-8.3	31.1	-1.0	-1.8	0.2	-32.0
	(18.3)	(8.8)	(7.0)	(11.6)	(13.6)	(9.7)
Adult > 5 %	-94.7	11.4	48.5	-44.9	-15.1	-13.6
	(12.8)	(8.2)	(7.3)	(7.5)	(23.0)	(9.7)
Game Rental > 5 %	1.3	159.2	9.9	1.9	1.1	3.6
	(13.1)	(8.8)	(6.9)	(9.0)	(5.7)	(9.1)
$\hat{\tau}$	28.96	30.52	28.96	32.28	28.96	29.15
	(0.10)	(0.15)	(0.11)	(0.11)	(0.07)	(0.00)
$\hat{\tau}, RS$	–	–	–	18.86	–	–
$\hat{\tau}, FF$	–	–	–	40.43	–	–
$\hat{\eta}$	212.97	159.68	169.25	186.43	197.64	101.76
	(1.37)	(1.33)	(1.62)	(0.09)	(0.30)	(1.97)
$\hat{\sigma}_{\ln v}$	0.04	0.09	0.08	0.01	0.01	0.53
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
$\hat{\sigma}_\epsilon$ (or) $\hat{\sigma}_\tau$	0.44	0.29	0.00	0.59	0.66	0.07
	(1.38)	(1.40)	(1.59)	(0.17)	(0.35)	(0.06)
Price Elasticity	-0.48	-0.63	-0.60	-0.54	-0.51	-1.00
at Observed Q, P	(0.003)	(0.005)	(0.006)	(0.000)	(0.001)	(0.019)
Observations	146,459	146,459	146,459	146,459	146,459	146,459

Table 13: Estimated Parameter Values from GMM Estimation, C Titles

$\partial \ln V/\partial X(*1000)$	Base	Hansen	Profits	Different τ's	Not Binding	Uncertain τ
People	0.4	2.3	0.5	7.3	3.7	4.9
	(0.3)	(0.8)	(0.9)	(0.5)	(0.9)	(0.7)
% Suburban	-1.0	2.8	-0.9	-3.6	0.0	-0.6
	(10.3)	(27.6)	(15.6)	(35.7)	(66.3)	(22.2)
% Married w/ Kids	-3.0	-4.5	-3.1	-36.3	-0.4	-52.0
	(148.9)	(36.5)	(68.9)	(96.3)	(292.2)	(115.6)
Median Income	-0.9	-1.5	-0.9	-2.8	-0.5	-0.4
	(1.1)	(0.7)	(0.4)	(0.7)	(0.5)	(0.7)
No. Blockbusters	51.4	77.4	59.8	261.7	95.1	98.4
	(42.0)	(11.6)	(16.8)	(12.0)	(35.0)	(17.4)
Store Size	16.8	26.0	20.0	164.0	59.1	86.4
	(4.7)	(3.0)	(2.8)	(2.5)	(9.4)	(3.4)
No. All Releases	-0.1	-0.1	-0.1	0.0	0.5	2.4
	(3.8)	(1.5)	(1.1)	(1.4)	(1.6)	(1.9)
No. Rev-Share Releases	0.7	2.8	0.6	-1.9	-0.0	-2.5
	(3.4)	(1.9)	(0.8)	(1.7)	(2.9)	(2.2)
No. Sell-thru Releases	1.6	4.2	1.5	1.8	4.6	6.7
	(2.9)	(1.3)	(1.7)	(1.0)	(3.6)	(1.3)
Sales > 5 %	4.1	23.7	4.3	2.6	-4.8	-44.8
	(27.4)	(12.6)	(13.8)	(17.4)	(24.4)	(14.3)
Adult > 5 %	-2.4	-2.1	-2.3	-3.9	-0.4	15.1
	(37.4)	(21.6)	(11.9)	(14.6)	(40.3)	(15.8)
Game Rental > 5 %	30.8	66.6	32.0	122.3	88.0	81.0
	(9.1)	(24.4)	(12.3)	(12.6)	(21.2)	(13.9)
$\hat{\tau}$	21.21	21.33	21.21	22.94	21.21	20.29
	(0.12)	(0.08)	(0.05)	(0.14)	(0.08)	(0.01)
$\hat{\tau}, RS$	–	–	–	14.84	–	–
$\hat{\tau}, FF$	–	–	–	30.16	–	–
$\hat{\eta}$	46.56	43.04	51.69	31.76	39.68	21.40
	(0.42)	(0.17)	(0.16)	(0.42)	(0.38)	(1.01)
$\hat{\sigma}_{\ln v}$	0.05	0.06	0.06	0.10	0.06	0.66
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.05)
$\hat{\sigma}_\epsilon$ (or) $\hat{\sigma}_\tau$	0.04	0.03	0.03	0.01	0.60	0.20
	(0.16)	(0.24)	(0.16)	(0.29)	(0.17)	(0.06)
Price Elasticity	-0.52	-0.56	-0.47	-0.76	-0.61	-1.13
at Observed Q, P	(0.005)	(0.002)	(0.001)	(0.010)	(0.006)	(0.053)
Observations	647,535	647,535	647,535	647,535	647,535	647,535

Table 14: Counter-factual Experiments, A Titles

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 1: Base					
Inventory	24.24	20.08	26.94	31.19	24.00
Price	4.08	4.64	3.55	2.88	2.73
% Revenue-Sharing	39.91	0.00	58.55	100.00	53.04
Retailer Profit	901.58	828.85	927.87	859.74	393.30
Dist. Profit	1187.27	1203.72	1174.40	1228.81	911.55
% Change Ret. Profit		-8.07	2.92	-4.64	
% Change Dist. Profit		1.39	-1.08	3.50	
% Change CS		-14.74	9.62	30.31	
Panel 2: Hansen					
Inventory	21.24	17.14	23.52	27.23	24.00
Price	3.75	4.31	3.25	2.64	2.73
% Revenue-Sharing	39.21	0.00	59.67	100.00	53.04
Retailer Profit	741.09	670.57	767.56	722.90	393.30
Dist. Profit	1018.18	1027.75	1001.95	1039.18	911.55
% Change Ret. Profit		-9.52	3.57	-2.45	
% Change Dist. Profit		0.94	-1.59	2.06	
% Change CS		-16.68	9.28	29.97	
Panel 3: Profits Included					
Inventory	24.06	19.77	26.52	29.70	24.00
Price	4.15	4.80	3.69	3.05	2.73
% Revenue-Sharing	44.72	0.00	61.25	100.00	53.04
Retailer Profit	907.44	849.24	922.11	842.97	393.30
Dist. Profit	1167.03	1172.68	1159.41	1199.37	911.55
% Change Ret. Profit		-6.41	1.62	-7.10	
% Change Dist. Profit		0.48	-0.65	2.77	
% Change CS		-16.16	9.30	24.59	

Table 15: Counter-factual Experiments, A Titles cont.

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 4: Different τ's					
Inventory	24.12	17.53	25.72	28.59	24.00
Price	3.87	4.71	3.57	2.97	2.73
% Revenue-Sharing	43.45	0.00	55.06	100.00	53.04
Retailer Profit	1432.37	1336.67	1445.25	1032.16	393.30
Dist. Profit	1089.81	1042.42	1087.56	1420.83	911.55
% Change Ret. Profit		-6.68	0.90	-27.94	
% Change Dist. Profit		-4.35	-0.21	30.37	
% Change CS		-12.50	3.54	18.41	
Panel 5: Restrictions Not Binding					
Inventory	23.41	20.26	26.04	29.64	24.00
Price	4.46	4.95	3.88	3.19	2.73
% Revenue-Sharing	34.37	0.00	57.50	100.00	53.04
Retailer Profit	958.23	929.71	969.60	889.17	393.30
Dist. Profit	1209.50	1207.09	1191.45	1254.82	911.55
% Change Ret. Profit		-2.98	1.19	-7.21	
% Change Dist. Profit		-0.20	-1.49	3.75	
% Change CS		-12.69	10.57	27.43	
Panel 6: Uncertain τ					
Inventory	22.60	19.43	23.36	27.07	24.00
Price	4.64	5.22	4.36	3.49	2.73
% Revenue-Sharing	35.04	0.00	47.74	100.00	53.04
Retailer Profit	1590.40	1541.08	1597.67	1127.01	393.30
Dist. Profit	1166.43	1155.43	1152.47	1530.12	911.55
% Change Ret. Profit		-3.10	0.46	-29.14	
% Change Dist. Profit		-0.94	-1.20	31.18	
% Change CS		-7.12	1.87	19.67	

Table 16: Counter-factual Experiments, B Titles

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 1: Base					
Inventory	11.71	9.72	12.32	14.27	9.50
Price	3.01	3.47	2.79	2.24	2.72
% Revenue-Sharing	40.41	0.00	53.08	100.00	37.78
Retailer Profit	529.52	500.73	533.57	448.91	296.85
Dist. Profit	583.52	582.20	576.14	637.26	437.69
% Change Ret. Profit		-5.44	0.77	-15.22	
% Change Dist. Profit		-0.23	-1.26	9.21	
% Change CS		-13.02	4.07	23.58	
Panel 2: Hansen					
Inventory	8.02	7.44	8.45	10.52	9.50
Price	3.30	3.46	3.11	2.29	2.72
% Revenue-Sharing	15.46	0.00	29.05	100.00	37.78
Retailer Profit	384.79	379.36	387.50	338.02	296.85
Dist. Profit	451.21	447.77	447.25	479.01	437.69
% Change Ret. Profit		-1.41	0.71	-12.15	
% Change Dist. Profit		-0.76	-0.88	6.16	
% Change CS		-6.06	4.61	32.06	
Panel 3: Profits Included					
Inventory	10.30	9.30	10.64	12.92	9.50
Price	3.46	3.74	3.33	2.51	2.72
% Revenue-Sharing	25.52	0.00	32.94	100.00	37.78
Retailer Profit	537.49	526.55	539.24	441.57	296.85
Dist. Profit	557.03	555.27	553.94	620.08	437.69
% Change Ret. Profit		-2.04	0.33	-17.85	
% Change Dist. Profit		-0.32	-0.55	11.32	
% Change CS		-7.45	2.56	26.28	

Table 17: Counter-factual Experiments, B Titles, cont.

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 4: Different τ's					
Inventory	10.98	8.16	11.62	12.99	9.50
Price	3.10	3.65	2.92	2.38	2.72
% Revenue-Sharing	33.88	0.00	41.05	100.00	37.78
Retailer Profit	683.85	639.38	687.96	482.71	296.85
Dist. Profit	502.61	485.92	501.68	669.42	437.69
% Change Ret. Profit		-6.50	0.60	-29.41	
% Change Dist. Profit		-3.32	-0.18	33.19	
% Change CS		-11.35	2.81	18.25	
Panel 5: Restrictions Not Binding					
Inventory	10.81	9.69	11.38	13.92	9.50
Price	3.26	3.57	3.10	2.34	2.72
% Revenue-Sharing	27.68	0.00	36.42	100.00	37.78
Retailer Profit	469.82	462.32	471.45	427.13	296.85
Dist. Profit	574.15	576.91	576.61	608.84	437.69
% Change Ret. Profit		-1.60	0.35	-9.09	
% Change Dist. Profit		0.48	0.43	6.04	
% Change CS		-9.71	4.87	29.42	
Panel 6: Uncertain τ					
Inventory	8.95	8.56	9.08	10.73	9.50
Price	4.43	4.59	4.31	3.36	2.72
% Revenue-Sharing	13.36	0.00	21.71	100.00	37.78
Retailer Profit	942.65	937.84	943.92	601.81	296.85
Dist. Profit	516.91	514.91	513.80	799.29	437.69
% Change Ret. Profit		-0.51	0.13	-36.16	
% Change Dist. Profit		-0.39	-0.60	54.63	
% Change CS		-1.85	0.68	17.45	

Table 18: Counter-factual Experiments, C Titles

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 1: Base					
Inventory	3.62	2.84	3.85	4.23	2.94
Price	2.94	3.54	2.63	2.29	2.57
% Revenue-Sharing	35.29	0.00	51.10	100.00	47.14
Retailer Profit	111.33	93.31	115.09	101.67	55.25
Dist. Profit	113.20	118.75	110.53	120.27	102.45
% Change Ret. Profit		-16.19	3.37	-8.68	
% Change Dist. Profit		4.90	-2.36	6.25	
% Change CS		-21.46	6.58	17.21	
Panel 2: Hansen					
Inventory	3.30	2.59	3.52	3.86	2.94
Price	2.92	3.51	2.61	2.27	2.57
% Revenue-Sharing	35.03	0.00	52.07	100.00	47.14
Retailer Profit	102.54	86.54	106.16	93.35	55.25
Dist. Profit	103.43	108.08	100.79	110.10	102.45
% Change Ret. Profit		-15.60	3.53	-8.97	
% Change Dist. Profit		4.49	-2.56	6.45	
% Change CS		-21.07	6.79	17.21	
Panel 3: Profits Included					
Inventory	3.76	2.86	4.00	4.40	2.94
Price	2.79	3.42	2.50	2.17	2.57
% Revenue-Sharing	38.05	0.00	53.27	100.00	47.14
Retailer Profit	106.71	86.37	110.78	99.43	55.25
Dist. Profit	113.42	118.61	110.99	119.11	102.45
% Change Ret. Profit		-19.07	3.81	-6.82	
% Change Dist. Profit		4.57	-2.14	5.01	
% Change CS		-23.77	6.65	17.44	

Table 19: Counter-factual Experiments, C Titles, cont.

Variable	Current	Fixed-fee Only	No Inven. Restrict.	Rev-Share Only	Actual
Panel 4: Different τ's					
Inventory	3.07	2.39	3.20	3.52	2.94
Price	3.48	4.06	3.27	2.78	2.57
% Revenue-Sharing	34.01	0.00	45.71	100.00	47.14
Retailer Profit	188.85	179.19	190.39	135.11	55.25
Dist. Profit	101.84	99.18	102.20	148.74	102.45
% Change Ret. Profit		-5.11	0.82	-28.45	
% Change Dist. Profit		-2.61	0.36	46.05	
% Change CS		-9.30	2.08	13.60	
Panel 5: Restrictions Not Binding					
Inventory	3.40	2.76	3.58	3.95	2.94
Price	3.15	3.72	2.87	2.47	2.57
% Revenue-Sharing	33.55	0.00	48.71	100.00	47.14
Retailer Profit	122.76	108.79	125.34	106.69	55.25
Dist. Profit	112.12	116.65	109.63	123.52	102.45
% Change Ret. Profit		-11.39	2.10	-13.10	
% Change Dist. Profit		4.05	-2.22	10.17	
% Change CS		-17.40	5.31	16.52	
Panel 6: Uncertain τ					
Inventory	2.74	2.50	2.81	3.19	2.94
Price	4.34	4.71	4.15	3.41	2.57
% Revenue-Sharing	20.55	0.00	30.24	100.00	47.14
Retailer Profit	158.34	152.95	159.18	121.91	55.25
Dist. Profit	105.28	108.20	104.11	133.89	102.45
% Change Ret. Profit		-3.40	0.53	-23.01	
% Change Dist. Profit		2.78	-1.11	27.18	
% Change CS		-7.33	2.16	16.94	