Vertical Contracts in the Video Rental Industry

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Abstract

A large body of theoretical work has explored the channels through which vertical contracts can induce efficiency improvements. However, it is also important to study vertical contracts empirically in order to gain insight into the relative size of different types of efficiency gains. In this paper, I empirically analyze a contractual innovation in the vertically-separated video rental industry. Prior to 1998, video stores obtained inventory from movie distributors using simple linear pricing contracts. In 1998, revenue-sharing contracts were widely adopted. I investigate the effect of the introduction of revenue-sharing contracts on firms' profits and consumer welfare. I analyze a new panel dataset of home video retailers that includes information on individual retailers' contract and inventory choices, as well as rentals and contract terms for 246 movie titles and 6,137 retailers in the U.S during each week of 1998 and 1999 and the first half of 2000. A structural econometric model of firms' behavior is developed that describes the nature of firms' contract choices. Estimates from this model indicate that both upstream and downstream profits increase by 10 percent under the revenue-sharing contract for popular titles. For less popular titles, the effects can be even larger. I also estimate that consumers benefit when revenue-sharing contracts are adopted.

1 Introduction

Coordinating supply decisions between manufacturers and retailers is challenging in industries where both firms separately maximize profits. In many settings, the use of simple, linear pricing rules between manufacturers and retailers leads to unaligned incentives, and may harm consumers through a suboptimal supply of a good in a market. One such outcome results from the presence of two mark-ups (both a manufacturer mark-up, and a retailer mark-up); additional incentive problems arise from the need to compensate downstream retailers for promotional effort or service provision. Virtually all products are disseminated to markets through a vertical chain, and understanding the benefits of more flexible contractual arrangements has important implications for industry generally. Thus, these issues have spawned a wealth of theoretical literature on vertical restraints, vertical contracts, and boundaries of the firm, which develops arrangements that lead to optimal supply. For example, vertical contracts between an upstream manufacturer and a downstream retailer can offer more flexibility for coordinating supply decisions than simple linear pricing.

In contrast, empirical work on these issues has lagged behind, due in large part to the difficulty in obtaining data on proprietary supply arrangements. In this study, I use a new and extensive dataset of vertical contracts in the home video industry to identify empirically the extent to which such contracts can align manufacturer and retailer supply incentives, and the impact this has on social welfare. The form of the contracts is a revenue-sharing arrangement, which was widely adopted by firms beginning in 1998. The contracts specify an upfront fee per unit of inventory (between \$3 and \$8) and a revenue split paid on the basis of rental revenue (between 40 and 60 percent to the retailer). Prior to the availability of revenue-sharing contracts, video stores obtained inventory from movie distributors using linear-pricing contracts, consisting of a single wholesale price per unit of inventory (typically around \$65 per tape). These linear-pricing contracts remain available to retailers after the introduction of revenue-sharing contracts, and retailers choose their preferred contract each time a new title is released.

The dataset includes information on the contract and inventory choices, total rentals and sales, and contract terms, for 246 movie titles at 6,137 retailers in the U.S. over a 130-week period. The included firms represent approximately 30 percent of all U.S. video rental retailers. Due to the extremely detailed nature and the extensive coverage of the data, this is one of the most complete sources of information on a retail industry that has

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been collected in the empirical IO literature.

In reduced-form analyses of the data, I find a strong selection effect of retailer-title pairs across the two types of contracts. Correcting for some of these selection effects, I find a small positive effect of the revenue-sharing contracts on retailer profits for popular titles, but a small negative effect of the contracts for less-popular titles. Decomposing the differences across retailers who choose different contracts indicates that unobservable characteristics of retailer-title pairs account for the selection effect. Following the reduced-form analyses, I estimate a structural model of the industry using the first-order conditions derived from a theoretical model of optimal firm behavior.

The use of structural modeling in vertical markets is relatively uncommon compared to its use in horizontal market structures. This is due in part to the extensive data requirements necessary to make structural modeling believable in vertical settings. An important advantage of structurally modeling such markets is the ability to analyze the welfare effects of various vertical contractual relationships, which cannot be done on the basis of reduced-form work alone. On the basis of the estimated parameters of my structural model, I conduct several counter-factual experiments in order to quantify the welfare effects of the vertical contracts in this industry. The results indicate that both upstream and downstream profits increase by approximately 10 to 20 percent and consumers benefit when revenue-sharing contracts are used. Empirically, small retailers adopt these contracts more extensively than large retailers, and I estimate that the benefits to small retailers are more substantial than the gains to large retailers. For example, I predict that profits of the smallest retailers increase by approximately 30 percent, while those of the largest retailers increase by eight percent for one class of movie titles.

The findings speak to a broad theoretical literature examining the social implications of different vertical relationships. The core of this literature focuses on the mechanisms through which vertical contracts align firms' incentives to induce more efficient behavior.[1] These mechanisms include revenue sharing or two-part tariffs, licensing, franchise arrangements and various forms of vertical integration. Indeed, the ability to align firms' incentives through integration has spawned a related literature on firm boundaries and contractual incompleteness that also focuses on the question of how contracts can induce optimal ef-

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[1]See for example Bernheim and Whinston (1998), Besanko and Perry (1993), Katz and Shapiro (1984), Rey and Tirole (1986a, 1986b), O'Brien and Shaffer (1992), Segal and Whinston (2000), and Spengler (1950).

fort provision.[2] The theoretical literature also examines the potential for vertical arrangements to induce anti-competitive behavior (e.g., by excluding competing suppliers from a downstream market).[3] These concerns are especially prevalent if the vertical arrangement includes restraints such as resale price maintenance, exclusive territories, exclusive dealing, or quantity forcing arrangements.[4]

Despite the vast theoretical literature on vertical arrangements and contracts, empirical evidence on the effects of such contracts for social welfare is scarce. In this study, I empirically examine the social effects of one type of vertical arrangement: revenue-sharing contracts. The form of these contracts is quite general, and similar contracts are used in many other settings (e.g., two-part tariffs, licensing, and franchise arrangements). Furthermore, revenue-sharing contracts may substitute for other coordinating mechanisms, such as vertical integration. It is important to understand the relative size of the welfare effects of vertical contracts empirically, because we cannot speculate on this from the perspective of theory alone. Previous empirical work has documented the reasons for the use of different contracting arrangements in different settings, and has tested theoretical models of optimal contracts (i.e., asking whether firms adopt the contractual form predicted by theory).[5] In contrast, this paper exploits detailed data on retail transactions to understand the welfare implications of vertical contracts, taking into account the fact that firms endogenously choose their contractual form. Also in this vein, Asker (2004a and 2004b) empirically measures the welfare effect of exclusive dealing contracts and assesses whether foreclosure occurs in the market for beer, Brenkers and Verboven (2006) examine the effects of liberalizing the distribution system in the European car market, Chipty (2001) examines the effects of vertical integration in the market for cable television, and Villas-Boas (2005) develops a method for ascertaining the nature of a vertical relationship from price and cost data at the retail level. Other empirical work on contracting arrangements examines the adoption of monitoring technology and its effect on vertical integration (Baker and Hubbard, 2003 and 2004).

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[2]Coase (1937), Grossman and Hart (1986), Williamson (1979), and Klein, Crawford and Alchian (1978) are seminal contributions. Hart (1988) and Joskow (1985) provide good summaries of this literature.

[3]See for example Comanor and Frech (1985), Mathewson and Winter (1984, 1986, 1987), and Salop and Scheffman (1983). Tirole (1988) also provides a review of many of the theoretical contributions.

[4]Indeed, the legal treatment of vertical contracts has been influenced by predictions in the theoretical literature about the trade-off between the contracts' efficiency-inducing and anti-competitive effects.

[5]See for example Ackerberg and Botticini (2002), Allen and Leuck (1992, 1993, 1999), Bhattacharyya and Lafontaine (1995), Bresnahan and Reiss (1985), Corts (1999), Hanssen (2000), Lafontaine (1992, 1995), Lafontaine and Slade (1997), Shepard (1993), and Slade (1993).

Finally, this paper also 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. 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. In another paper, Cachon and Lariviere (2004) compare revenue sharing to other methods of coordinating inventory in vertically-separated industries, using the example of the video-rental industry.

The rest of the paper proceeds as follows. First, I discuss some of the institutional details of the video rental industry. A theoretical model of firm behavior is presented in section 3. Section 4 describes and summarizes the data used in the analysis, and provides reduced-form estimates of the effects of the contractual form on retailer profits. The estimation methodology is described in section 5. Section 6 provides results from the estimation procedures, and section 7 presents the results of counter-factual experiments. The final section concludes.

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.[6] 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.[7] In 2001, there were over 20,000 home video retailer outlets, split evenly between independently-owned small chains and large chains such as Blockbuster, Hollywood Video, and others.[8]

Retailers

Traditionally, video retailers acquired rental inventory from the distribution arm of a movie studio via a fixed, linear price.[9] between \$65 and \$70 per tape.[10] In addition to linear pricing, revenue sharing became a widely-used contractual arrangement in 1998. Under the

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

[7]VSDA 2000 annual report.

[8]VSDA 2002 annual report.

[9]For the remainder of the paper, I refer to the upstream firm as the distributor.

[10]Exceptions to the linear pricing policy are titles priced to encourage direct sales to consumers. Volume discounts or price breaks through "copy-depth" programs may apply to the wholesale price.

typical revenue-sharing arrangement, the retailer pays an upfront fee of $3 to $8 per tape and shares rental receipts with the distributor, retaining about 45 percent of rental revenue.[11]

Retailers must choose between linear pricing 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 subject to quantity discounts under linear-pricing terms, or constrained under revenue-sharing terms. I discuss the nature of these restrictions in greater detail below.

Distributors

Anti-trust laws prevent distributors from offering different prices to different buyers for exactly the same product (i.e., third-degree price discrimination). Section 2 of the Clayton Act, as amended by the 1936 Robinson-Patman Act, makes price discrimination of this type illegal, and I assume that the upstream firm must offer the same contractual prices (wholesale prices, upfront fees, and revenue-splits) to all downstream retailers.[12]

The Robinson-Patman Act does not, however, speak to quantity restrictions or quantity discounts.[13] Under linear pricing, retailers freely choose how much inventory to purchase taking into account any quantity discounts offered by the distributor. However, under revenue-sharing terms, distributors require retailers to adhere to minimum and maximum quantity requirements that vary across ten categories of firm size.[14] The quantity requirements vary much more across titles than price does.[15]

Quantity restrictions can always be set in such a way as to not be binding on retailers. Thus, their use should be at least weakly preferred by the upstream firm. The benefit

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[11]She also 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 rarely vary by title.

[12]This assumption is borne out empirically.

[13]Quantity discounts would be equivalent to second-degree price discrimination. The critical distinction from the point of view of the anti-trust law is that all firms face the same menu of prices under second-degree price discrimination, whereas under third-degree price discrimination, some firms simply receive a more favorable price than others for the same bundle of goods (here, it would be for the same number of tapes).

[14]The use of quantity discounts under linear pricing contracts–which is second-degree price discrimination– differs from the use of minimum and maximum quantity restrictions, which is similar to third-degree price discrimination conducted on the basis of store size.

[15]For example, minimum requirements for one title across the 10 store-size categories are: (8,11,14,18,23,28,34,40,47,54). Maximum inventories allowed for the same title across store-size categories are: (15,26,30,40,48,60,70,80,90). Thus, a "Size One" store (one with less than $4000 of monthly revenue) must take between 8 and 15 copies of this title if electing a revenue-sharing contract.

of quantity restrictions to the upstream firm can be achieved through at least two mechanisms. First, quantity restrictions can fine-tune inventory choices across heterogeneous retail markets when price does not vary. For example, quantity restrictions can soften price competition in very competitive markets (through a binding maximum restriction), and strengthen it in less-competitive markets (through a binding minimum restriction). Second, quantity restrictions can affect retailers' choices of contracts.

The Introduction of New Contractual Forms

Much of the theoretical literature on contracts focusses on the issue of the optimal contractual form. Thus, it is natural to ask (1) why revenue-sharing contracts were not adopted sooner in this industry, and (2) why distributors continue to offer linear-pricing contracts after revenue-sharing contracts are available.

The adoption of revenue-sharing contracts requires two things in order to assure both parties that revenues are accurately reported: extensive computer monitoring of millions of transactions, and external verification of the results. Monitoring costs clearly fell during the late 1990's with the availability of low-cost computer networks. Previously, large chains could set up specialized computers and software for monitoring transactions internally, but small retailers could not afford to do so. Also in the late 1990's, several software packages became available for tracking and downloading data in a standardized format. These smart cash registers made monitoring revenue much easier and cheaper than it used to be.[16] Furthermore, low-cost high-speed Internet access enabled external verification of the transaction data. The largest retail chain in the industry, Blockbuster Video, adopted revenue-sharing terms with several studios in early 1998, and other retailers followed quickly.[17]

As technological advances made revenue-sharing a feasible contractual option, both upstream and downstream firms adopted these contracts and approximately 10,000 firms had access to revenue-sharing contracts in 2000. 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 the wholesaler administering the revenue-sharing contracts. Thus, if linear pricing contracts are withdrawn, distributors lose access to half of all retail outlets, and may also face potential foreclosure charges for excluding retailers from

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[16]For more on this, see Varian (2001).

[17]The adoption of revenue-sharing contracts by Blockbuster also seems to have had a catalyzing effect on the adoption rates of other retailers.

acquiring inventory.[18] One might expect that the upstream firm would therefore restrict linear-pricing contracts to downstream firms that do not have the ability to participate in revenue-sharing contracts. This is not possible because U.S. copyright law allows the owner of a lawful copy to rent, lease, lend or resell copyrighted work. Thus, retailers with the ability to participate in revenue-sharing agreements cannot be excluded from choosing linear-pricing terms unless all retailers are excluded.[19]

3 A Theoretical Model of Firm Behavior

In this section, I develop a simple theoretical model of firm behavior that incorporates the major features of the contractual environment facing video retailers. The model makes several simplifying assumptions. First, I assume there is no coordination across retail stores that belong to the same chain. My interviews of industry participants strongly support this assumption, especially for inventory and pricing decisions. Second, I do not explicitly model competition across films and film distributors. Each distributor is modeled as a monopolistic supplier of an individual title, which is assumed to not compete with other titles. Although this is a stronger assumption, studio executives cite release dates as an important mechanism for strategically avoiding competition with other titles.

3.1 A Single Downstream Market

I first consider a monopolistic upstream firm producing one product that is sold in a single downstream market. Each unit of inventory of a particular product (or 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.

Let the marginal cost of producing a unit of inventory be denoted as l and let one unit of inventory produce τ rentals. Assuming that the firm does not purchase extra inventory,

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[18]Both of these explanations have been offered in my interviews with industry executives.

[19]Empirically, linear-pricing terms continue to be offered to all firms at prices that do not change after the introduction of revenue sharing.

the maximum industry profit in the absence of price discrimination (and the profit achieved by a vertically-integrated firm) is

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

where the market-clearing price, p, is given by the inverse demand function, Q is the market supply of rentals, and C is inventory.

Thus, one can re-write industry profits in equation 2 as a function of C, and first-order conditions give the inventory level, C^*_{VI}, that maximizes industry profits:

$$C^*_{VI} = \frac{1}{2} \left(\frac{V}{\tau} - \frac{l\eta}{\tau^2} \right). \qquad (3)$$

In a vertically-separated industry 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 linear-pricing 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.

3.1.1   Retailers' Profit Maximization

In a vertically-separated industry, downstream firms observe the contracts and 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.[20]

Assuming that the same relationship holds between inventory and the quantity of rentals for all retailers, total revenues for retailer i are given by:

$$q_i p = (\tau c_i)p = \frac{c_i}{\eta} \left(V\tau - \tau^2 \sum_{k=1}^{N} c_k \right).$$

Retailer i maximizes expected profits by first choosing a contractual form and then an inventory level, c_i. I introduce the indicator variable R, which takes the value one if a

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[20]Note that the number of retailers in a vertically-*integrated* industry is irrelevant, because only a single industry-level profit function is maximized. Thus, there is no need to introduce multiple retailers in the market until we consider a vertically-separated industry. The assumption of Cournot competition between independent retailers is consistent with the explanations I have heard from retailers about the nature of their business decisions. While average price does vary across titles for a retailer, the primary strategic action the retailers describe is the decision of how many copies of a title to provide to the market.

revenue-sharing contract is chosen, and zero if a linear-pricing contract is chosen. Thus, for a given title, retailer i first chooses R_i, and then chooses c_i to solve the problem

$$\max_{\{R_i\}} R_i(\max_{\{c_i\}} \pi_i^{RS}(c_i)) + (1 - R_i)(\max_{\{c_i\}} \pi_i^{LP}(c_i)). \tag{4}$$

Solving the second stage gives retailer i's profits under linear pricing and revenue sharing:

$$\pi_i(c_i|R_i = 0) = \frac{V\tau}{\eta}c_i - \frac{\tau^2}{\eta}c_i \sum_{k=1}^{N} c_k - Fc_i$$

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

I assume the downstream firm incurs no additional cost to produce τ rentals from each unit of inventory.[21]

Solving for the equilibrium choice of c_i yields

$$c_i^* = \frac{1}{(N+1)}\left(\frac{V}{\tau} + N_{RS}\frac{u\eta}{\tau^2} + N_{LP}\frac{F\eta}{\tau^2} - N\frac{a_i\eta}{\tau^2}\right) \tag{5}$$

where N_{RS} denotes the number of competing firms choosing a revenue-sharing contract and N_{LP} denotes the number of competing firms choosing a linear-pricing contract.[22] The cost per tape for firm i is given by a_i which equals F when a linear-pricing 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 5, 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.

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[21]Retailers are allowed to cover costs by selling inventory at the end of the pre-determined rental period, or by keeping rental revenues after the rental period. To account for this, I model the revenue-sharing payments as being applied to revenues after costs have been covered. This introduces a discrepency between the model and the contracts, because the model assumes profit sharing. However, the only difference is that the optimal upfront fee would be scaled up by a factor of y. Modeling the contracts in this way allows me to capture the transfer made by the upstream firm at the end of the rental period in a sensible way.

[22]Note that $N = N_{RS} + N_{LP} + 1$.

In the case in which firms play either a symmetric pure-strategy revenue-sharing contract equilibrium or a symmetric pure-strategy linear-pricing contract equilibrium, equation 5 reduces to $c^*_{i,LP}$ or $c^*_{i,RS}$ respectively, with total inventory in the market given by

$$C^*_{LP} \equiv Nc^*_{i,LP} = \frac{N}{(N+1)}\left(\frac{V}{\tau} - \frac{F\eta}{\tau^2}\right) \qquad C^*_{RS} \equiv Nc^*_{i,RS} = \frac{N}{(N+1)}\left(\frac{V}{\tau} - \frac{u\eta}{\tau^2}\right). \quad (6)$$

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

$$V^* \equiv \frac{\eta(F - yu + \sqrt{y}(F - u))}{\tau(1 - y)}. \quad (7)$$

The retailer's contractual choice depends on the relative contract terms, (F, u, and y), the rental technology τ, and the slope of demand, η. For a given set of contractual terms, a high V or τ induces a retailer to accept linear-pricing terms, while a low V or τ induces a retailer to accept revenue sharing. A higher wholesale price, F, increases V^*. On the other hand, a higher upfront fee or a lower percentage of revenues left with the retailer reduces V^*.

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 6 equals the vertically-integrated firm's choice of inventory, C^*_{VI} from equation 3. The upfront fee that achieves this result is given by:

$$u_{VI} = \frac{(N-1)\tau V}{2N\eta} + \frac{(N+1)l}{2N} \quad (8)$$

The ability of the upstream firm to tax profits through y implies that the optimal $u^* = u_{VI}$ for any value of y. Setting y equal to zero satisfies a zero-profit condition for the downstream firms. However, it also induces retailers to reject revenue sharing in favor of linear pricing if the linear-pricing contract allows retailers to make positive profit. Thus, one expects the upstream firm to set $y > 0$ (as long as N is finite), such that the downstream retailers are at least as well off as they would have been under linear-pricing terms.[23] Both the upstream

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[23]Note that the optimal price under linear pricing is $F^* = \frac{\tau V}{2\eta} + \frac{l}{2}$ (with $y = 0$ by definition), so that as long as the intercept of demand exceeds marginal cost (i.e., as long as $V > \frac{l}{\tau}$), the linear price per tape will exceed the upfront fee per tape under revenue sharing, and fewer inventories will be held by retailers under the linear pricing contract. Finally, as $N \to \infty$, u_{VI} approaches F^*.

and downstream firms benefit from revenue sharing because revenue sharing allows the firms to attain the maximum level of industry profits.

3.2 Many Downstream Markets

We have seen that revenue sharing aligns upstream and downstream firms' incentives by transferring inventory at $u^* = u_{VI}$ and taxing subsequent revenues when a single downstream market exists. In fact, efficient inventory levels can also be achieved by linear pricing as the downstream market becomes more competitive, because as $N \to \infty$, u_{VI} approaches F^*. However, when multiple, heterogeneous downstream markets exist and the upstream firm is unable to charge different wholesale prices across markets, neither linear pricing nor revenue sharing necessarily induce efficient inventory holdings. Consider the upstream firm's profit-maximization problem in the absence of revenue sharing when M different downstream markets exist. The profit function is:

$$(F - l) \sum_{m=1}^{M} \frac{N_m}{(N_m + 1)\tau} \left(V_m - \frac{F\eta}{\tau} \right) \tag{9}$$

and the optimal wholesale price is:

$$F^* = \frac{\tau \sum_{m=1}^{M} \frac{N_m V_m}{(N_m+1)}}{2\eta \sum_{m=1}^{M} \frac{N_m}{(N_m+1)}} + \frac{l}{2}. \tag{10}$$

The studio would like to charge a different F_m^* for each of the M markets, but retailers' ability to resell tapes prevents this. The optimal F^* is thus a weighted average of the set of F_m^*'s that would be charged in each market if perfect price discrimination were possible. Similarly, the optimal upfront fee under revenue sharing is:

$$u^* = \frac{\tau \sum_{m=1}^{M} \frac{N_m(N_m-1)V_m}{(N_m+1)^2}}{2\eta \sum_{m=1}^{M} \frac{N_m^2}{(N_m+1)^2}} + \frac{l \sum_{m=1}^{M} \frac{N_m}{(N_m+1)}}{2 \sum_{m=1}^{M} \frac{N_m^2}{(N_m+1)^2}} \tag{11}$$

Thus, the existence of multiple, heterogeneous markets introduces the possibility that downstream firms may still make inefficient inventory decisions under revenue sharing terms because the upfront fee is calibrated to some average market, not to any individual one.

3.3 Upstream Firm Profit and the Role of Quantity Restrictions

Section 2 described inventory restrictions under revenue-sharing terms, which can have two effects. First, they can induce retailers to holdmore or less inventory, addressing the problem of inefficient inventory holdings due to the existence of multiple, heterogeneous downstream markets. Second, they can affect a retailer's choice of contract. When inventory restrictions are binding, equation 7 changes because the inventory under revenue-sharing terms is no longer equal to the best-response quantity from the Cournot model of competition. Instead, it is equal to the binding quantity requirement (either the minimum or the maximum). Allowing for this, one can recalculate $V^{*r}(\cdot)$ (where I use the superscript r to indicate that this is calculated under a binding minimum or maximum restriction):

$$V^{*r}(\tau, \eta, F, u, y, N, c^r) = \frac{1}{2\tau}\left(yc^r\tau^2(N+1)^2 + 2\eta F + \sqrt{c^r\tau^2(y(N+1)^2 - 4N) + 4(F-u)\eta}\right)$$

$$\text{where } c^r = \begin{cases} c^{min} \text{ if the minimum inventory restriction is binding} \\ c^{max} \text{ if the maximum inventory restriction is binding} \end{cases}$$

(12)

Thus, quantity restrictions can induce higher or lower take-up rates of revenue-sharing contracts for any given vector of prices (F, u, y), in addition to affecting inventory holdings.

I have not attempted to show how, exactly, upstream firms set quantity restrictions as a function of title characteristics. The results that follow, and the underlying sources of identification, all rely on retailer-level decisions, which is the true strength of the data source.[24] However, the restrictions are a factor in retailers' choices of contracts, even if the process of setting them is outside of the model.

4 Data Summary and Regression Analysis

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

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[24]Quantity restrictions and other upstream pricing decisions are only observed at the level of a title, and the data are weaker on this dimension, since the number of titles is much smaller than the number of retailer-title pairs. This fact, along with the fact that unobservable characteristics of titles are likely to be important determinants for setting these restrictions, is the reason that I do not fully derive the upstream firm's choice of these restrictions.

forms. Finally, I provide a regression analysis of the effect of revenue-sharing on retailer profits.

4.1 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 retailers' 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.[25] I observe 6,322 retailers, ranging in size from single-store locations to a chain with 1,652 locations. Of these 6,322 retail locations, I am able to match 6,137 stores with local demographic and phone book data.

For these 6,137 stores, I observe transaction data for 130 weeks between January, 1998 and June, 2000. These stores represent about 30 percent of all stores in the industry. I discard observations for titles released after December 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.[26] 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.

For each title, I observe the month of release, 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

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[25]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.

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

of more than \$40 million, and titles in the B and C categories have theatrical box-office revenues of \$15 - \$40 million and \$0.25 - \$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 37 A titles, 46 B titles, and 163 C titles for which both revenue-sharing and linear-pricing contracts are offered. These titles represent roughly half of all titles released during this period; the other half were offered exclusively on linear-pricing terms, and I exclude these titles from the analysis. I also observe title characteristics, including genre, MPAA rating, and in the case of A and B titles, actual box-office receipts.

In addition to title characteristics, I observe the terms of the revenue-sharing contract offered to retailers for each title, and I observe retail prices under linear-pricing terms.[27] Rentrak does not provide the actual wholesale prices paid by retailers under linear-pricing terms, which could reflect additional volume discounts or bonus inventory from "copy-depth" programs. I adjust the retail price to reflect the true wholesale price in the following ways. First, according to industry executives, the wholesale price paid by retailers before any additional discounts reflects a 35 percent discount off of the published retail price. I apply this discount. Second, I use trade journals to create a matrix of published discounts available under linear-pricing terms. These discounts most often apply to A and B titles. The published records describe exactly how the discounts are applied. Some are simple volume discounts; others are complicated discounts that depend on a store's purchases of other, past titles. I apply each of these discounts to each store-title pair, assuming that if a published discount was available, the retailer took advantage of it. On average, I estimate that these discounts reduce the wholesale price paid by retailers by approximately 12 percent. The average wholesale price under linear-pricing terms after making these adjustments is \$66. Finally, the marginal cost (to the distributor) of producing, packaging and shipping a pre-recorded videocassette tape is around two dollars according to industry sources.

At the store-title level, I observe the type of contract chosen by the retailer and the number of tapes purchased.[28] Transactions are recorded weekly for each store-title com-

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[27]Retail price is usually over \$100 per tape for the first six months of release, when the retail price drops considerably and the title is sold directly to consumers. However, a few consumers (mostly collectors) do pay the initial high retail price. For more details on pricing in the sales market, see Mortimer (2005).

[28]Linear-pricing contracts are offered on all titles, although some distributors do not offer revenue-sharing

bination. 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. In the analyses that follow, I summarize over weekly detail for each store-title pair and use the total performance of a store-title pair as the variable of interest. For each store-title pair, I use the average price over the life of the movie at that store, which is calculated using total revenues and total transactions. The weekly detail are used to construct a measure of the incidence of "stock-out" events, but I do not use weekly price detail directly in any part of the analysis. A stock-out event is estimated to occur if the number of rentals exceeds inventory by a factor of three in any given week. One can think of this as an assumption that on average, stores use a two-day rental period, with each tape coming back one day late once each week. I stop tracking titles after 20 weeks for computational reasons; nearly 98 percent of all rentals have occured by this time. Thus, the stock-out variable can range from zero to 20.[29]

In order to observe (or at least proxy for) local competitive conditions, I supplement the Rentrak data with Yellow Pages listings for all video retail stores in the United States for 1998 through 2000. 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 from 2000 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.

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 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

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terms until after 1999. Titles for which only linear-pricing terms are offered are not currently used in the analysis.

[29]The stock-out variable is clearly a rough estimate of the true stock-out events experienced for any given store-title pair. To address concerns about measurement of this variable, I have tried several alternative definitions and I have checked the average stock-out probabilities with industry sources. Based on these checks, I believe the current measure is a good approximation to the number of true stock-out events.

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.

4.2 Summary Statistics

Tables 1 - 3 and 4 - 6 examine differences between titles taken by stores on revenue-sharing versus linear-pricing contracts for A, B, and C titles. Tables 1 - 3 examine differences between stores that choose different pricing contracts for the same title. Tables 4 - 6 examine differences between titles on linear-pricing 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 linear-pricing contracts and stores accepting revenue-sharing contracts for the same title. Table 1 provides information for the 37 A titles released during 1998 and 1999 for which stores had a choice of contract. Tables 2 - 3 provide information for the 46 B titles and 163 C titles respectively. Two of the A titles, and one B title were not taken under linear-pricing terms by any store. Stores accepting linear-pricing contracts tend to be correlated with demographic variables associated with higher levels of rental demand. For example, stores on linear-pricing 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.

Stores choosing linear-pricing tend to have slightly fewer competitors, except in the case of C titles, where stores accepting linear-pricing contracts tend to face competition from more Blockbuster Video outlets. Store size differs significantly between the two groups: stores choosing revenue sharing are significantly smaller than those choosing linear pricing.

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 counterparts choosing linear pricing for the same title. However, rental

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activity is significantly lower despite the larger inventory levels. Prices are lower at the stores choosing revenue sharing, and profits of both the retailers and studios are also lower at these stores.

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 types of titles taken under linear-pricing versus revenue-sharing terms within each store. The variation that exists in contract prices is primarily due to low take-up rates of revenue-sharing terms for titles produced by one studio that charged $10.30 per tape instead of $8.30 per tape as an upfront fee. For A titles, stores are more likely to choose revenue-sharing for action/adventure movies and less likely to choose revenue-sharing for dramas or suspense pictures. 'R' rated movies are also more likely to be chosen on revenue-sharing terms, as are titles with higher theatrical box-office receipts. For B titles, retailers are more likely to choose revenue-sharing for action/adventure movies and dramas, and less likely to choose revenue-sharing for comedies or suspense movies.

The second panel of tables 4 - 6 shows differences in outcomes on the two contracts. Inventory is 2.5 to three times higher under revenue-sharing terms. Rentals are also larger, but only by about one-third. I report the average price of renting each title, which is measured without regard to the length of the rental period. Prices do not vary significantly across the two contractual forms within a store. According to industry executives, rental stores often charge the same amount for a rental under the two contractual arrangements, but allow for a longer rental period for titles under revenue-sharing contracts. However, this effect is not captured well by the data.[30] Both retailer and distributor profits are higher for titles under revenue-sharing terms than titles under linear-pricing contracts.[31] Finally, the incidence of stock-out events is lower under the revenue-sharing contracts.

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[30]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. Comparing the measure of price per day for the two groups of titles taken by each store shows mixed results. Stores set lower per-day prices for B titles on revenue-sharing contracts than for titles on linear-pricing contracts. However, the difference is not statistically significant.

[31]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 linear-pricing terms, relative to titles taken on revenue-sharing terms within a store. This is present in the data; I allow for retailer uncertainty in the estimation. 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.

Stylized Facts about Price Variation

In the theoretical model, price is assumed to vary both across stores in different markets and across titles, but not within a market for the same title. I use the average price of a store-title pair in estimation. Figures 1 and 2 show the distribution of these prices across stores in different markets and across titles. In figure 1, I calculate the average price across all titles in a given store and show the distribution of those prices. In figure 2, I show the distribution of the average price of each title across all stores. Both distributions are shown to the same scale. Cross-store variation is more extensive than cross-title variation, but price variation in both dimensions is consistent with the assumptions of the theoretical model.

The theoretical model also assumes that price variation for a given title does not exist within a market. Figure 3 show the difference between the maximum and minimum prices within a market, calculated for each title. Although not all observations are zero, deviations are not common. Contrast this to the distribution shown in figure 4, which documents variation in price across stores in different markets, again calculating the difference between the maximum price of all stores and the minimum price of all stores for a given title. Similarly, figure 5 shows price variation across titles within a store, defined as the difference between the maximum price and the minimum price across all titles in the store. Both figures 4 and 5 show much more extensive variation than figure 3. All three figures are shown to the same scale for comparison.[32]

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 linear-pricing terms and average firm profits under revenue-sharing terms. Of course, contractual form is not randomly assigned; retailers optimally choose contracts on the

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[32]These results may seem counterintuitive based on the experience of observing prices at any given time in a video store. They are driven by two features of the analysis. First, I use the average price of a title over its lifetime at a retail location. Thus, price variation across titles within a store comes from different prices for different titles at any point in time, as well as from variation in how quickly a title is moved from a high-price "New Release" section to a low-price "Catalog" section. Second, this variation is driven by the fact that when I do observe stores in the same market renting the same title, they tend to not display large differences in this average "lifetime" price. Unfortunately, I don't observe all retailers in the market, and the assumption probably fails in some settings in which I cannot see competitors' prices; especially perhaps if the competition is a Blockbuster Video outlet. I condition on the presence of a Blockbuster Video outlet when estimating demand, but must otherwise maintain the assumption, due to lack of data.

basis of some unobserved heterogeneity. Thus, a simple difference between the average accounting profits for firms that chose linear pricing 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.

To address the concerns of endogenous contract choice, I provide two types of analyses. In the first, I control for additional characteristics, so that conditional on these characteristics, contract choice can be taken as randomly assigned. I provide results from these regression analyses in the next section. In the second type of analysis, I rely more heavily on the theoretical model presented in section 3 in order to estimate a structural model of this market. I use the first-order conditions of the retailers (such as the optimal choices of inventories and contracts) to generate moment conditions. From these moment conditions, I estimate the parameters of the model. The benefit of this approach is that it gives an alternative estimate of the effects of revenue-sharing contracts on firms' profits, and in addition, it provides welfare effects for consumers.[33]

4.3 Regression Analysis

Table 7 presents regression-adjusted effects of revenue-sharing contracts on retailers' profits for A, B, and C titles. The dependent variable is the natural log of retailer profits. The first column provides the unadjusted estimate of the effect of revenue-sharing on profits. Recall that the model predicts a negative bias in this estimate because small firms, or firms that expect to have poor performance on a title, should be more willing to share revenue. The first panel of Table 7 estimates this effect to be around negative 37 percent for A titles. B and C titles fare just as poorly in the unadjusted figures: they have a negative 60 and negative 78 percent effect of revenue-sharing respectively.

Column two adjusts for store and title characteristics (including store size), as well as the log of inventory.[34] One could conceive of several different ways of adjusting for cost: one way would be to use profit per tape as the dependent variable. Due to the different cost structures under the two contracts, however, one expects very different profits measured at

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[33]A number of the restrictions in section 3 are lifted in the construction of the moment conditions. These are noted in the estimation section.

[34]I get similar results using title fixed-effects rather than title characteristics.

the per-tape level. Putting the log of inventory on the right-hand side adjusts for inventory in a more flexible way, since the coefficient is not constrained to be one. I also interact the inventory variable with contract choice to allow for the fact that the contracts have different cost structures on a per-tape basis.[35] We still see a negative effect of revenue sharing in this specification, but it is only around 23 to 34 percent for A and B titles respectively.

One source of bias in this specification might be due to competition with other titles in the store, or to anticipated stock-out events resulting from local impatience for a movie, studio advertising at the video release date, local competition, or a combination of such factors. In column three, I include the total inventory at the store of other A, B, or C titles that were released in the same month as the title being analyzed in order to control for competition across titles. (I use inventory of other A titles if the title is an A title, and so on.) If stock-out events affect the profitability of revenue-sharing contracts, one should also adjust for these factors. Column four includes the estimated number of weeks (up to 20) in which stock-outs occurred for the store-title pair, and an interaction of this with a dummy for whether or not the movie was an action/adventure title. This is motivated by industry sources, and by the summary statistics, in which action/adventure titles are more likely to be taken on revenue-sharing terms. Conditional on having the same number of stock-out events and the same level of inventory of other titles, I then assume that contract choice is randomly assigned. These results indicate a 4 percent increase in retailer profit due to revenue sharing for A titles, although I still estimate a small negative effect for B and C titles.

Given that retailers always have the choice to do linear-pricing instead of revenue-sharing, it seems apparent that the ability to condition on observables is not sufficient to remove the bias due to the endogeneity of contract choice. If one were directly interested in the effect of contract form on the log of profits, one could alternatively attempt to correct for contract selection by instrumenting for the choice of contract. Unfortunately, I have been unable to find convincing instruments for the choice of contract in this setting.[36] Even in the presence of a good instrumental variable for contract choice, one is unlikely to recover

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[35]One might still worry in this case about the endogeneity of retailer inventory and the consistency of the estimated coefficient. Unfortunately, without convincing instruments, I must rely on the assumption that contract choice is randomly assigned after we have conditioned on these variables.

[36]One hope was to use quantity restrictions as an instrument for contract choice. Indeed, the theoretical model implies that quantity restrictions do affect retailers' choices of contracts. However, the quantity restrictions only affect contract choice for those retailers at the margin, and turns out to be a weak instrument for predicting contract choice in the whole sample.

the true effect of interest from the IV strategy if the effect of the contract differs for different store-title pairs. In this case, the correct specification would include a random coefficient on contract choice, which will not be recovered from a single instrumental variable.

Another method of isolating the effect of the contract on profits is to decompose the difference in profits as in Oaxaca (1973). In order to do this, I estimate separate equations for each type of contract, regressing the log of profits on all the X's in the full regression specification for each of the two sub-populations. Table 8 decomposes this difference. Both the values of the observed characteristics and their effect on profits are lower for the stores that chose revenue-sharing contracts. The positive effect of revenue-sharing contracts for stores that choose them is due to unexplained factors, such as unobserved demand shocks for a store-title pair.

5   Estimation

This section describes the estimation of the structural model and relates it to the theoretical model in section 3. The theoretical model gives specific predictions linking firms' contract and inventory choices to the competitive conditions and demand conditions in their markets. I use the predictions from the model to generate a set of moment conditions. Several relationships in the theoretical model must be generalized to accomodate variation in the data that is not considered in the model. These generalizations are introduced as I describe the moment conditions. Estimation then proceeds via Generalized Method of Moments (GMM).

Data include the quantity and price of rentals (q and p), contract choice (R), inventory (c), cost per unit of inventory (equal to the upfront fee under revenue-sharing terms, u, or the wholesale price under linear-pricing terms, F), revenue splits (y), quantity minimums and maximums for each store-title pair under the revenue-sharing contract form (c^{min} and c^{max}), the number of retailers in each market (N), and a set of demographic, title, and store characteristics (X).[37] I denote the full set of data as $Z = (q, p, R, c, u, F, y, N, X, c^{min}, c^{max})$,

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[37]When constructing market-level demand, 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. 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 is the characteristics and decisions of the observed firm. Finally, my sample occasionally includes more than one store in the same zipcode area. In

where an observation is a store-title pair.[38] Price is calculated as the average price over all weeks and quantity is given by the total number of rentals over all weeks.

I construct moment conditions from the retailer inventory equation, the demand equation, retailer profits, and the relationship between rentals and inventory. The parameter τ relates rentals to inventory. I assume that the retailer does not observe τ ex-ante, but that she does know the distribution of τ, and thus, can form an expectation of τ. This allows for uncertainty in retailer demand for rentals. For a given $E(\tau)$, the retailer's inventory decision determines the maximum number of rentals produced. In order to minimize ex-ante cost, the firm will choose inventory (c) to satisfy $c = q/E(\tau)$. Ex-post, q will be determined by the actual draw of τ, multiplied by c.

Equation 5 gives inventory as a function of (expected) τ and the realization of V for that store-title pair. I assume that V is known to the retailer when she makes her purchasing decision (so that all the uncertainty about future rentals enters through τ from the retailer's point of view). From the researcher's point of view, V has observed and unobserved components, which I model as:

$$ln(V_i) = X_i\beta + \xi_i.$$

The i subscripts index store-title pairs. The vector of observable characteristics X_i contains population, monthly store revenue, the theatrical box-office revenues of a title (for A and B titles only), the size of a retail location's chain, whether or not the store competes with a Blockbuster Video outlet, the total number of tapes of other similar titles held by that store (where similar titles are defined to be the same class (A, B, or C) and the same month of release), and the total number of weeks in which the store-title pair was estimated to have stocked-out.[39] I assume that ξ is normally distributed with mean zero and variance σ_V^2.

Inverting equation 5 gives $\ln(V_i)$ as a function of observed inventory c_i:

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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, the inventory of other titles, and stock-out events.

[38]Thus, I consider the total performance of a title over its lifetime in a video store. By tracking the total lifetime performance of a title, I allow consumers to substitute across time.

[39]The inventory of similar titles and the stock-out incidence are also meant to soften the impact of the assumption that there are no cross-title effects. Including this information gives the residual demand for the title of interest, so that if cross-title effects are strong enough, I capture them through the inclusion of these variables.

$$\ln(V_i) = \ln[(N_i + 1)E(\tau)c_i + a_i\eta/E(\tau)] \tag{13}$$

where a denotes the price per tape under the retailer's chosen contract (ie., a takes value F under linear-pricing, and value u under revenue-sharing.) Assuming that the unobserved demand shifters are orthogonal to the observed demand shifters suggests the moment condition:

$$E(\xi X) = E((\ln(V_i) - E(\ln(V_i)|Z_i, \sigma_V^2))X) = 0 \tag{14}$$

The moment condition is complicated by the theoretical implication that contract types are selected endogenously on the basis of ξ. Thus, the expectation of $\ln(V_i)$ (which would otherwise just be equal to $X_i\beta$) should be adjusted to account for the fact that the distribution of $\ln(V_i)$ is truncated from above in the case of revenue sharing, or from below in the case of linear pricing. This is essentially analogous to using an Inverse Mills Ratio to adjust for selection bias. The point of truncation is informed by the theoretical model; specifically, by equation 7 which derives the cut-off value of V^* at which a store will choose to do revenue sharing.[40] The adjustment is seen here for firms on linear-pricing contracts, and for firms on revenue-sharing contracts in which a quantity restriction is not binding.

$$E(\ln(V) \mid R = 0, X) = E(\ln(V) \mid V > V^*, X) = X'\beta + \sigma_V \frac{\phi(\ln(V^*))}{1 - \Phi(\ln(V^*))}$$
$$E(\ln(V) \mid R = 1, X) = E(\ln(V) \mid V < V^*, X) = X'\beta + \sigma_V \frac{-\phi(\ln(V^*))}{\Phi(\ln(V^*))} \tag{15}$$

where Φ denotes the standard normal cumulative density function. When quantity restrictions are binding, these adjustments use V_m^* from equation 12 instead of V^*. Finally, as I discuss next, I allow for additional flexibility in the τ parameter, which complicates the calculation of V^* and V_m^*. Appendix A provides more details.

Consistent estimation of β requires that ξ is orthogonal to X. This is a traditional assumption in the literature on demand analysis.[41] Recall that X does not include price,

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[40]Note that V^* depends on the terms of the contracts (F, u, y) and τ, which are assumed to be exogenous to the contract decision. I don't instrument for the contract terms because there is virtually no variation across titles within a studio and "class" of movies (i.e., A, B or C movies). Thus, variation across titles and retailers within a studio and class is primarily driven by differences in τ, and I instrument for τ (details provided later in this section).

[41]For many of the included $X's$, such as title characteristics (box office) or local demographics (population), the assumption seems reasonable. With respect to the tapes of other similar titles, or stock-out events, the assumption is somewhat stronger, but not unlike the assumptions made in most demand analyses.

which is one variable one might think was correlated with ξ. I discuss identification of the price coefficient later in this section.

I also make use of the inventory equation to estimate the variance of ξ. The moment condition is given by:

$$\ln(V_i)^2 - E(\ln V_i | Z_i, \sigma_V^2)^2 - \sigma_V^2 = 0 \tag{16}$$

Again, this moment condition is adjusted for truncation, as Z_i includes R_i and $E[\ln(V)]^2$ is no longer equal to $(X_i\beta)^2$ when $\ln(V)$ is truncated.

The information structure relating rentals to inventory is as follows. Retailers know the distribution of τ, but not what their realization of τ will be ex-ante. Thus, I allow for retailer uncertainty about demand through τ. Retailer decisions are made on the basis of $E(\tau|\text{data})$ After rentals have occurred, we observe the actual draw of τ, which I model as:

$$ln(\tau_i) = ln(q_i/c_i) = \lambda D + \epsilon_i$$

I assume that ϵ is normally distributed with mean zero and variance σ_τ^2. The vector D contains variables that shift τ. Importantly, D consists of two indicators for the different contractual forms (ie., R_i and $(1 - R_i)$). The reason for including R_i in D is to allow for the fact that the retailer cost structures under the two contracts lead to different intensities of inventory use. This is an important generalization of the empirical model compared to the theoretical model presented earlier, which ignored differences in τ across the two contract types.

The inclusion of R_i leads to several complications. First, the retailer knows that the expectation of τ takes a different value based on her choice of contract. This complicates the retailer's subsequent choice of contract, and thus, it affects the truncation of the distribution of ξ. Adjusting for this is conceptually straightforward; one just re-solves equation 7 with a different τ in the retailer's profit functions for each contract. I provide the adjustment in Appendix A. The second complication is that ϵ is correlated with R_i by assumption (because c_i depends on ξ, and R_i is a function of ξ), so there is a simultaneity bias for estimating λ. I instrument for contract choice with genre.[42] Genre does not have an independent effect

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[42] I omit the comedy dummy for C titles. One could also include interactions of genre with local demographic characteristics.

on τ, but is strongly correlated with contract choice, as seen in tables 4 through 6. Denote the set of genre indicators as W. Thus, I construct a moment condition:

$$E(\epsilon W) = E((\ln(\tau_i) - \lambda D)W) = 0. \tag{17}$$

There is no truncation problem for estimating the parameters of the distribution of τ, thus the moment condition above provides a consistent estimate of λ. I also make use of the technology equation to estimate the variance of ϵ. I use the second moment of the ratio of rentals to inventory to generate the moment condition:

$$E(\ln(\tau_i)^2 - (\lambda D)^2 - \sigma_\tau^2) = 0. \tag{18}$$

I think of these four types of moment conditions as identifying the parameters $(\beta, \lambda, \sigma_V,$ and $\sigma_\tau)$. This leaves the parameter η to be estimated. Consider the demand function given by equation 1, which relates market-level quantity to price through a linear demand function $(Q = V - \eta p)$.

The intercept of demand, V, varies across markets and across titles within a market according to the observed and unobserved demand shifters $X\beta$ and ξ. I have already specified the distribution, and thus the expectation function, of V. Ignoring for now the truncation issues, consider the following specification of market demand:

$$Q_i = E(V|X_i, \beta) + \xi_i - \eta p_i.$$

Suppose that market level quantity (Q) was calculated empirically as the number of firms (N) multiplied by the observed quantity of the representative store in the dataset (q). In this case, incorporating the demand equation above would overspecify the model because one could observe two stores with identical X's, inventories, and numbers of competitors, but which charge different prices in their respective markets. As a result, I introduce a third error term on market-level quantity. Thus, I assume that market-level quantity, Q, is given by:

$$Q_i = N_i q_i + \zeta_i$$

The error term ζ_i could contain several things: ζ could be measurement error. It could also contain unobserved differences in marginal costs across retailers in different markets,

other retailer asymmetries across markets, or unobserved differences in the cost curves of the local (but unobserved) competitors. All of these effects would lead to differences in market-level quantities (and thus in market price) across different markets. I assume that ζ is uncorrelated with N_i and q_i. I then use the demand equation to form the following moment condition:

$$E(\xi - \zeta) = E(N_i q_i - E(V_i | Z_i, \sigma_V^2) + \eta p_i) = 0. \tag{19}$$

Once again, the conditional expectation of V must be adjusted to account for truncation, as before. The truncation is adjusted for the fact that we now use V instead of $\ln(V)$, but the intuition is exactly the same as before. The details are provided in Appendix A. In addition to adjusting the expected value of V for truncation, I make one other change to this moment condition when estimating the model. I re-scale the moment condition by the total quantity in the market (ie., I divide the whole moment condition by $N_i q_i$). I rescaled the moment condition because convergence to a global minimum worked poorly without re-scaling this condition.[43] The consistency of the estimate of η only depends on the assumption that $E(\xi - \zeta) = 0$. Unlike many other estimators in the literature on demand systems, I do not use the conditional moments of the demand curve as moment conditions. Instead, I use conditional moments of the supply curve, plus one unconditional moment for the market-level demand to identify the parameters β and η. Often, researchers use only one of these two types of moment conditions, and introduce an instrument for price in order to estimate the coefficient on price consistently. Here, I make use of the fact that I observe firms' costs, so these may be utilized directly for estimation. This is fortunate, as the potential instruments for price in the absence of cost data are less palatable here than in other settings.

In addition to the five sets of moment conditions just discussed, I also incorporate retailers' profit functions as a sixth condition. This moment condition is derived from equation 4 in the theoretical model of section 3. Simply put, I assume that in expectation, actual retailer profit equals the profit predicted for a retailer as a function of the parameters $(\beta, \tau, \eta, \sigma_V^2, \sigma_\tau^2)$. I do not incorporate another error term, because the profit function does not overspecify the model. By construction, two firms with the same values of $X, c, N, p, R, q, a,$

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[43]I have also checked that the results hold for an arbitrary scaling constant that is constant across all markets. They do, but the process of finding a global minimum is more difficult in this case.

and y will have the same actual profit. I estimated the model both with and without this additional restriction. The additional restriction improves the fit of the estimates, and is not rejected by a test of over-identification. I denote the parameter vector by $\theta = (\lambda, \eta, \beta, \sigma_V, \sigma_\tau)$, and the set of moment conditions as $\psi(\theta, Z)$, defined as:

$$
\psi(\theta, Z) \equiv
\begin{pmatrix}
\xi X \\
ln(V)^2 - (X\beta)^2 - \sigma_V^2 \\
\epsilon W \\
ln(\tau)^2 - (\lambda D)^2 - \sigma_\tau^2 \\
(\xi - \zeta) \\
\pi - E(\pi | \theta, Z)
\end{pmatrix}
\tag{20}
$$

Generalized Method of Moments solves:

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

where $\psi(\theta, Z_i)$ is the set of moment conditions and A is a weight matrix. The weight matrix A is chosen efficiently according to Hansen (1982). Previous results examined the sensitivity of a similar estimator to alternative choices of A. See Mortimer (2002) for details. All standard errors adjust for correlations within stores and titles, essentially allowing for store and title random effects. The calculation of standard errors for the estimated parameter values is discussed in Appendix A.

A final comment on the estimation concerns the assumption of Cournot competition between downstream 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 through a Blockbuster dummy in the X's. Based on the facts of this industry, I believe this captures the most important effects of competition across markets, while limiting the computational burden.[44]

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[44]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, despite observing the number of firms in a market, unobservable heterogeneity in the strength of competition across markets may be important. Introducing unobservable heterogeneity into the model is accomplished in a limited way through the error term ζ, which allows for an error in market-level quantity. However, I maintain the assumption that this error is uncorrelated with price. Alternatively, one could model this effect by introducing an error term on N

6   Results

The GMM estimation is conducted separately for A, B, and C titles. Table 9 gives the estimated parameters of the model. Column 1 gives results from estimating the model for A titles. Store characteristics include the number of people in the market, store size (measured by monthly revenue in thousands of dollars), the size of a store's chain, and the number of Blockbuster Video outlets competing with the store. More people in a market increase demand at a store, and larger stores have larger demand. The effect of store size is larger for A and B titles than for C titles. Theatrical box-office has a positive effect on demand, as do the number of Blockbuster Video outlets in the zipcode. Industry sources often identify the positive effect of a Blockbuster outlet 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. Video stores in larger chains face stronger demand for A titles than for B and C titles. Once again, this could reflect endogenous entry of larger chains into areas with these sorts of preferences across titles.

The inventory of other "close" A titles held by the store does not have any effect on demand for A titles. This result seems to indicate that for very popular, large box-office movies, other titles are not close substitutes. In contrast, the effect of inventory of other B and C titles on the demand for B and C titles is positive and significant. This may reflect seasonality or other effects which make these similar titles appear to be complementary in demand. The number of weeks in which a title is seen to stock-out is estimated to have a large, negative effect on demand. The effect is strongest for A and B titles, and seems to indicate that for some customers, the unavailability of a title in a particular week causes them to not rent that movie at any future date. All effects are statistically significant, with the exception of the effect of additional inventory of other titles for demand of A titles.

There is a large difference between the expected number of rentals per tape under the two contractual forms. The expectation of τ, which is lognormally distributed, is equal to 43.88 for A titles on linear-pricing contracts, and equal to 15.71 for A titles on revenue-sharing contracts. The difference in τ across the two contracts is significant both statistically and economically. The price coefficient η from Table 9 indicates that a \$1.00 increase in the price of a rental would result in roughly 509 fewer rentals over the life of a movie for A

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directly. This would complicate the model computationally, but would be slightly less restrictive.

titles, 214 fewer rentals for B titles, and 79 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 -1.1 for A titles, -0.8 for B titles, and -0.6 for 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 firms are pricing in a part of the market demand curve where elasticities are low is an indication that video retailing is a relatively competitive industry, especially for the less-popular B and C titles.

7   Counterfactual Experiments and Welfare Analysis

As noted in the introduction, a sizeable theoretical literature investigates the potential welfare implications of different vertical contracts, but empirical work has not addressed the importance of these theoretical findings. I conduct several counterfactual experiments in order to investigate empirically whether alternative vertical contracts have meaningful effects on social welfare. Table 10 presents results for A, B, and C titles from three such exercises based on the parameter values in Table 9. First, I consider the effect of eliminating revenue-sharing in its current form, which simulates the situation in which firms only use a linear-pricing 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 column of Table 10 lists the actual values of average levels of inventories, prices, revenue-sharing take-up rates, and retailer and distributor profits. Average price is around $2.80, and average inventory ranges from 4.5 tapes for C titles to 23 tapes for A titles. Revenue-sharing take-up rates vary between 40 percent for B titles and 54 percent for A titles. Total retailer profit in the sample ranges from $31 million for C titles to $61 million for A titles; total distributor profit ranges from $38 million to $93 million for C and A titles respectively.

The next column of Table 10 gives predicted values for each variable based on the estimated parameters in Table 9. Comparing these first two columns of Table 10 gives some indication of the goodness-of-fit of the estimated theoretical model. The portion of retailers accepting revenue-sharing terms is estimated reasonably well, as is inventory and price. The

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percent of retailers accepting revenue-sharing terms is somewhat over-predicted for B titles. Total retailer profits are predicted very well for all three title types. Distributor profits are generally a bit underestimated. 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 2 - 5.

7.1 Introduction of Current Revenue-Sharing Contracts

The first experiment considers the effect of eliminating revenue sharing in its current form, resulting in the use of only linear-pricing contracts. Comparing columns 2 and 3 of Table 10 shows the effect of this contractual change. For A titles, average inventory in the absence of revenue-sharing decreases from 23 tapes to 17 tapes for the average store-title pair, reflecting the double-marginalization problem under linear pricing. I predict that average price increases from $2.36 to $2.75. Total retailer profits decrease by 11 percent, and distributor profits are 10 percent lower. Consumer surplus also decreases, by two percent for A titles. Examining the B titles shows that inventory again decreases from 12.3 tapes to 10.5. Unlike the predicted effects for A titles, the elimination of revenue-sharing does not result in a price increase for B titles. Presumably, the maximum quantity restrictions work to limit quantities in some markets under revenue-sharing terms. Price is almost unchanged: it is predicted to be $3.41 under linear-pricing, compared to $3.46 under revenue-sharing. Retailer profits decrease by 23 percent with the elimination of revenue-sharing contracts, and distributor profits decrease by 21 percent. Consumer surplus also decreases, by about 22 percent. Similar negative effects hold for C titles under the elimination of revenue-sharing contracts: quantity falls, price rises modestly, and both firms and consumers are worse off without the revenue-sharing contracts.

On the basis of these results, I conclude that the average effect of the more flexible revenue-sharing contracts on retailer profits is positive, and larger than the effect predicted by a simple linear regression model. The results here are much more in line with the effects noted by industry executives. Given that firms always have the option of choosing linear-pricing contracts instead of revenue-sharing contracts, the results are also more intuitive than the negative effects predicted in the regression analysis for B and C titles.

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7.2 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 not 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. Empirical evidence suggests that wholesale 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 in the current exercise.

Under the assumption that distributors do not change the contract terms F, u and y, the effect of eliminating inventory restrictions is seen by comparing columns 2 and 4 in Table 10. In the absence of inventory restrictions, more retailers accept revenue-sharing terms for A and C titles: 67 percent, and 46 percent respectively. Acceptance of revenue-sharing terms is virtually unchanged for B titles. Average inventories do not change much. In the case of A and C titles, this is a result of more low-value stores choosing to be active in the market on more titles. For all three types of titles, price falls significantly, relative to the current environment. Total retailer profit decreases by six to 20 percent (across the three types of movies), compared to the current environment. This is somewhat surprising, since we are eliminating restrictions from the point of view of the retailer. The effect is driven by the fact that price falls significantly when maximum quantity restrictions are eliminated. Distributor profit also falls by about 8 to 34 percent. On the other hand, consumer surplus increases by four to eight percent for C and A titles from the elimination of inventory restrictions. The loss of the maximum quantity restrictions causes some retailers to withdraw from the market for B titles, leaving consumers modestly worse off in that case. As expected, the availability of this contract leads to average retailer profit that is higher than the profit predicted under no revenue-sharing in column 3.

The results here support the discussion in section 3.3, which identified two mechanisms through which inventory restrictions might affect firm profits. The first mechanism was the ability of quantity restrictions to soften price competition in very competitive markets (through a binding maximum restriction), and strengthen it in less-competitive markets

(through a binding minimum restriction). The second mechanism was the fact that quantity restrictions can affect retailers' choices of contracts. We see both effects in the results of the counterfactual exercise in this section: retailers are more likely to choose revenue-sharing contracts in the absence of quantity restrictions. Consistent with the fact that retailers are pricing in a relatively inelastic part of the demand curve, the maximum quantity restrictions seem to play a role for softening price competition in many of these markets.

7.3   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 all of a studio's 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 seems 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 2 and 5 in Table 10. In this exercise, retailers cannot choose linear-pricing terms. Average inventories increase, and price falls for all three classes of titles. Retailer profit decreases significantly: on the order of 40 - 50 percent, but distributor profits increase by nine to 15 percent for A and C titles. Consumer surplus also increases substantially for A and C titles: consumers are roughly 11-15 percent better off relative to the current environment.

The results from this exercise ignore the fact that many retailers may not have access to the necessary technology for implementing revenue-sharing contracts. The improvement in distributors' bottom lines for the stores that do have access to revenue-sharing (roughly half of all stores) is relatively modest: 8 percent for the most popular titles. Thus, it seems likely that eliminating linear-pricing contracts may not make sense when the other half of the market is taken into consideration, unless the technological ability to use these contracts is adopted more widely.

7.4 Effects by Store Types

Table 11 examines the incidence of the effects of the alternative contractual arrangements across retailers according to store size. Each of the five panels corresponds to a unique size category.[45] 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 overpredicted for all but the largest size category, and predicted inventory levels vary less across store size categories than actual inventories. Predicted price tends to vary more than the actual price across the store size categories.

Comparing the second and third columns, one notices that small retailers benefit more from the introduction of the current contracts then large retailers. Distributors are hurt by the ability of some downstream firms to choose revenue-sharing contracts for poorly performing titles: for stores with less than $7,000 to $14,000 of total monthly revenue, the upstream firm is actually worse off with the introduction of the current contracts. For the largest retail stores, however, both distributors and retailers benefit from the current menu of contracts, compared to a menu that includes only linear-pricing contracts.

8 Conclusion

This study examines the welfare effects of revenue-sharing contracts in the video rental industry. The estimates indicate that revenue-sharing contracts had an important and substantial impact on social welfare, increasing profits for both upstream and downstream firms and consumer surplus. I also examine the potential effects of eliminating inventory restrictions under revenue-sharing terms, and eliminating linear-pricing contracts from the market. I find that firm profits decrease with the elimination of inventory restrictions and consumers are generally better off. Eliminating both the inventory restrictions and the linear-pricing contracts generally improves consumer surplus and increases the upstream firm's profits for this set of retailers; however, it lowers downstream firms' profits.

The challenge of efficiently supplying firms in vertically-separated industries is a long-standing and important problem, especially in retail settings. The potential for vertical

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[45]These use a slightly aggregated version of the store size classifications used for setting minimum and maximum quantity restrictions.

contracts to improve efficiency on one hand, or reduce competition on the other, makes empirical work crucial to understanding the degree and direction of the contracts' effects. In the case of the video rental industry, the use of revenue-sharing contracts was primarily efficiency-inducing, and lead to substantial improvements in social welfare.

Appendix A: 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.

A.1 Construction of the Weight Matrix

The parameters θ are estimated using GMM to solve

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

where $\psi(\theta, Z_i)$ is the set of moment conditions discussed in the estimation section, equation 20. The weight matrix A is constructed optimally using the two-step procedure outlined in Hansen (1982), and correcting for correlations between titles within the same store, and between stores for the same title. I outline this correction here.

A.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

$$\hat{\Delta} = \frac{1}{I} \cdot \left[\sum_i \psi_{s,t}(Z, \hat{\theta}) \cdot \psi_{s,t}(Z, \hat{\theta})' + \sum_s \psi_{s,t}(Z, \hat{\theta}) \cdot \psi_{s,-t}(Z, \hat{\theta})' + \sum_t \psi_{s,t}(Z, \hat{\theta}) \cdot \psi_{-s,t}(Z, \hat{\theta})' \right]$$

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. I choose the weight matrix $A = \hat{\Delta}^{-1}$, as in Hansen (1982). The covariance matrix for $\hat{\theta}$ is then estimated as $(\hat{\Gamma}'\hat{\Delta}^{-1}\hat{\Gamma})^{-1}$.

A.3   Truncation Adjustments When τ Does Not Vary by Contract

Conditional on retailers having a choice of contracts, the distribution of V is truncated from below for titles taken on linear-pricing terms, and truncated from above for titles taken on revenue-sharing terms, as indicated in the retailer's profit function in the theoretical model. The truncation point is equal to $V^*(\tau, \eta, F, u, y)$, which is given in equation 7 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 (conditional on contract choice) as:

$$E(V \mid RS = 1, X) = E(V \mid V < V^*, X)$$
$$= \exp(X'\beta + \sigma_v^2/2) \frac{\Phi((\ln V^* - X'\beta)/\sigma_v) - \sigma_v)}{\Phi((\ln V^* - X'\beta)/\sigma_v)}$$

$$\text{(21)}$$

$$E(V \mid RS = 0, X) = E(V \mid V > V^*, X)$$
$$= \exp(X'\beta + \sigma_v^2/2) \frac{1 - \Phi((\ln V^* - X'\beta)/\sigma_v) - \sigma_v)}{1 - \Phi((\ln V^* - X'\beta)/\sigma_v)}$$

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 equation 12 and reproduced here:

$$V_m^*(\tau, \eta, F, u, y, N) = \tfrac{1}{2\tau}\left(yc_m\tau^2(N+1)^2 + 2\eta F + \sqrt{c_m\tau^2(y(N+1)^2 - 4N) + 4(F-u)\eta}\right)$$

$$\text{where } c_m = \begin{cases} c_{min} & \text{if the minimum inventory restriction is binding} \\ c_{max} & \text{if the maximum inventory restriction is binding} \end{cases}$$

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 21, but evaluated at V_m^* rather than at V^*.

A.4 Truncation Adjustments When τ Does Vary by Contract

When τ differs by contract, V^* is no longer given by the expression in equation 7. Denote the expected value of τ under revenue-sharing terms as τ_r, and under linear-pricing terms as τ_l. Then, $V^*(\tau_r, \tau_l, F, u, y, N)$ is given by the following expression:

$$V^*(\cdot) = \frac{(\tau_r NF + y\tau_l u - \sqrt{\tau_r^2 N^2 F^2 + 2\tau_r NFy\tau_l u + 2\tau_r^2 NF^2 + y\tau_l^2 u^2 + F^2\tau_r^2 - 2y\tau_r^2 NF^2 - yF^2\tau_r^2})\eta}{(y-1)\tau_l\tau_r}$$

Similarly, the truncation point when inventory restrictions are binding is $V_m^*(\tau_r, \tau_l, F, u, y, N, c_m)$, which is given by:

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$$V_m^*(\cdot) = \tfrac{1}{2\tau_l}\left(2c_m y\tau_l\tau_r N + c_m y\tau_l\tau_r + c_m y\tau_l\tau_r N^2 + F\eta - \sqrt{(\cdot)}\right)$$

(22)

$$\text{where } c_m = \begin{cases} c_{min} & \text{if the minimum inventory restriction is binding} \\ c_{max} & \text{if the maximum inventory restriction is binding} \end{cases}$$

and where

$$(\cdot) \equiv 6c_m^2 y^2\tau_l^2\tau_r^2 N^2 + 4c_m^2 y^2\tau_l^2\tau_r^2 N + 4c_m^2 y^2\tau_l^2\tau_r^2 N^3 + 8c_m y\tau_l\tau_r NF\eta$$
$$+ c_m^2 y^2\tau_l^2\tau_r^2 + 4c_m y\tau_l\tau_r F\eta + c_m^2 y^2\tau_l^2\tau_r^2 N^4 + 4c_m y\tau_l\tau_r N^2 F\eta - 8c_m^2 y\tau_l^2 N^2\tau_r^2 \qquad (23)$$
$$- 4c_m^2 y\tau_l^2 N\tau_r^2 - 4c_m y\tau_l^2 u\eta N^2 - 4c_m^2 y\tau_l^2 N^3\tau_r^2 - 4c_m y\tau_l^2 u\eta - 8c_m y\tau_l^2 u\eta N.$$

Once the new values of V^* and V_m^* are computed, the conditional expectation is calculated in the same way as when τ does not vary by contract (see equation 21 above).

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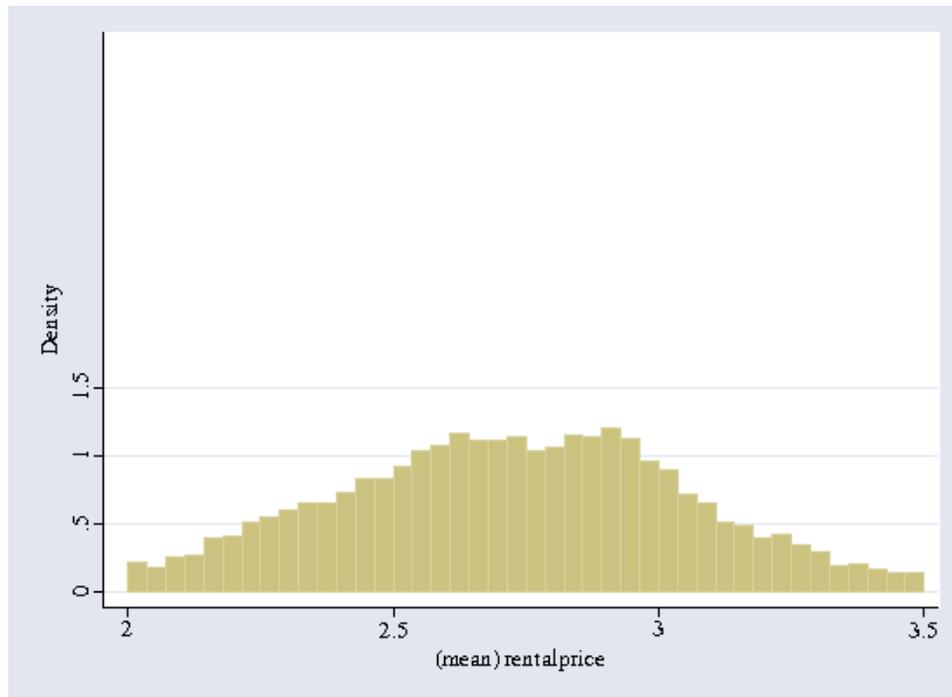
Figure 1: Price Variation Across Stores (Obs is Store's Avg. P)
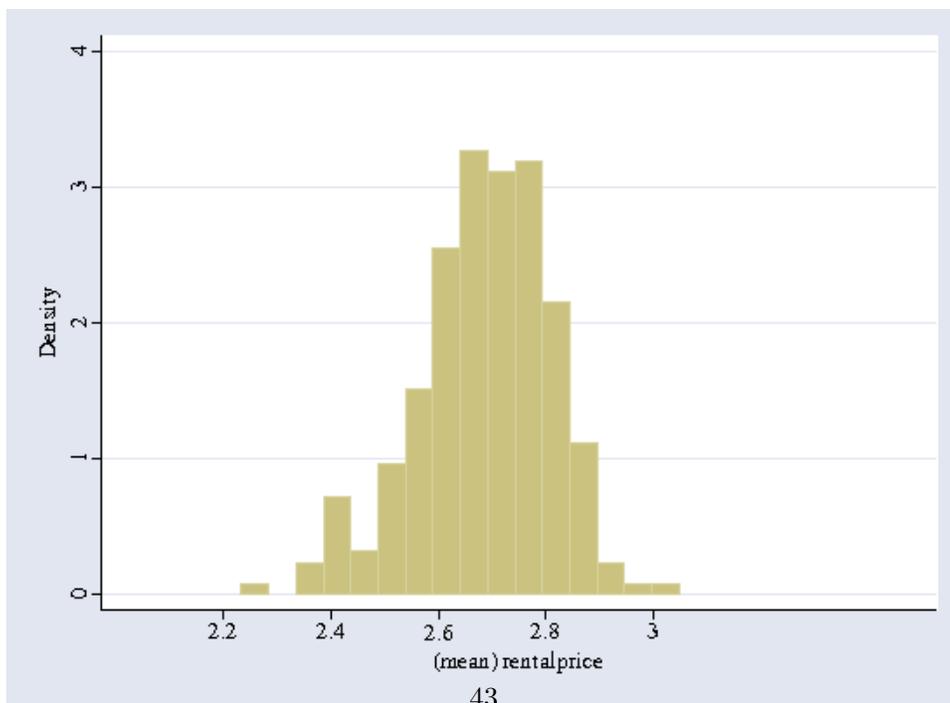
Figure 2: Price Variation Across Titles (Obs is Avg. P of Title)
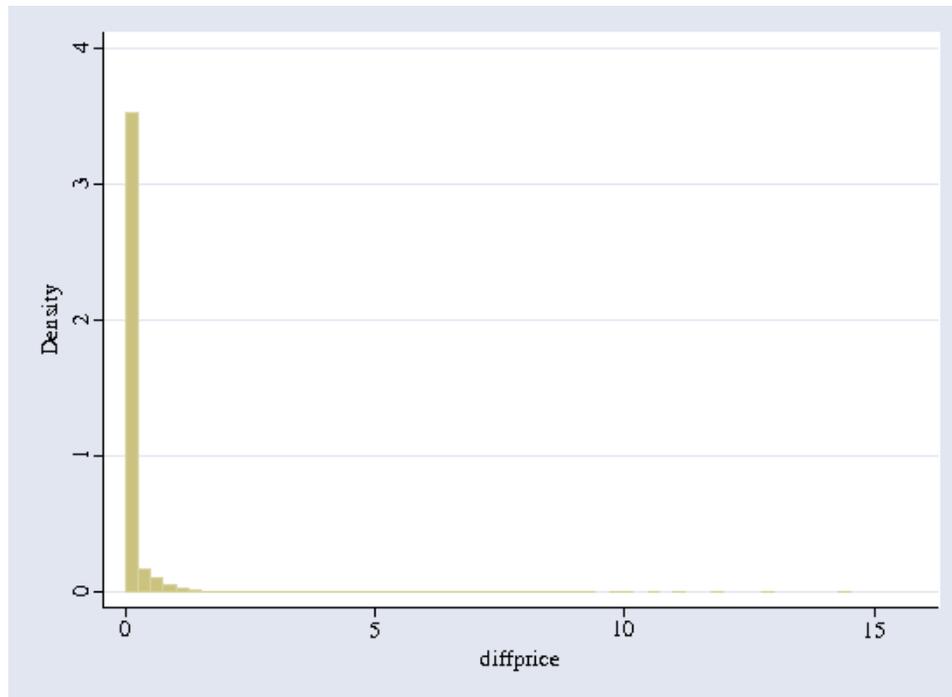
Figure 3: Price Variation Within Markets (Obs is max p - min p for a Title in a Market)
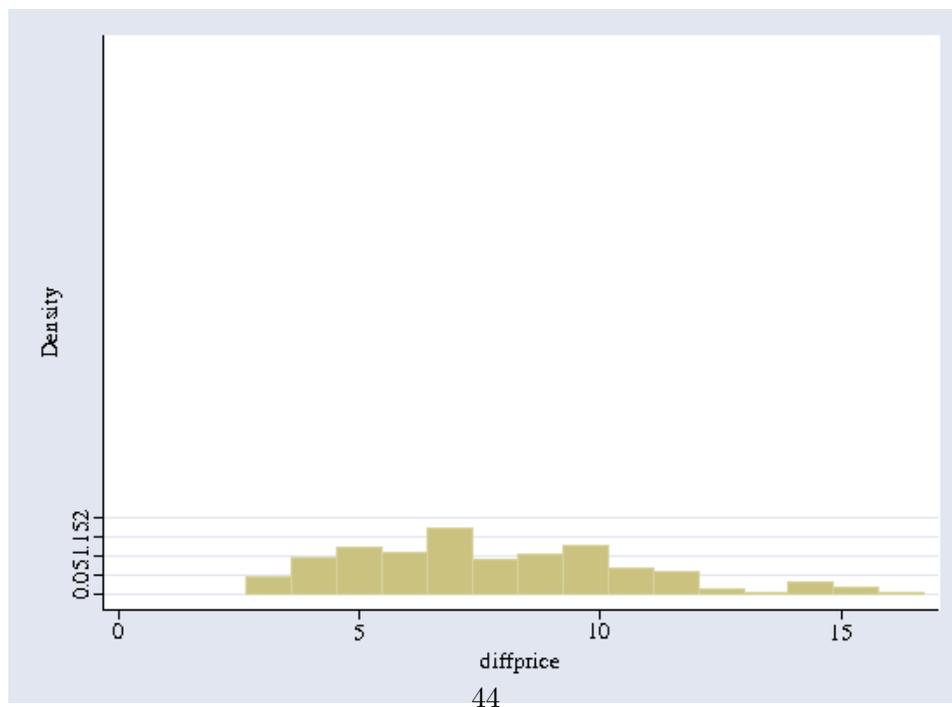
Figure 4: Price Variation Across Stores in Different Markets (Obs is max p of all stores - min p of all stores for each Title)
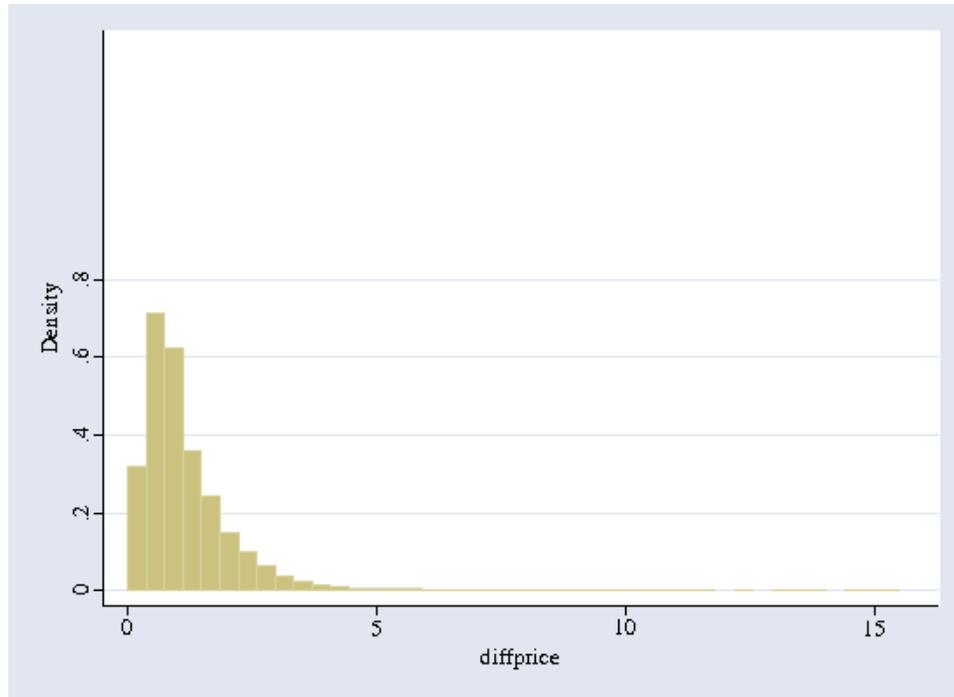
Figure 5: Price Variation Across Titles Within a Store (Obs is max p of all Titles - min p of all Titles in a Store)

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

	Stores accepting Revenue-Sharing	(S.E.)	Stores accepting Linear-Pricing	(S.E.)	T-stat of Diff.
No. People	24.28	(0.21)	23.81	(0.21)	[1.53]
% Suburban	10.14	(0.21)	10.96	(0.21)	[−2.87]
% Married with Kids	24.19	(0.07)	23.54	(0.04)	[9.38]
Median Income	43.32	(0.41)	42.57	(0.26)	[2.14]
No. Blockbusters	0.32	(0.01)	0.30	(0.01)	[2.32]
No. Competitors	2.72	(0.02)	2.63	(0.02)	[4.40]
Monthly Revenue	127.99	(3.76)	192.12	(2.95)	[−14.56]
Copies	26.56	(1.48)	13.63	(0.97)	[8.17]
Rentals (Q)	429.75	(24.95)	499.35	(28.22)	[−3.65]
Price (P)	2.81	(0.02)	2.87	(0.01)	[−3.85]
Retailer Profit	363.93	(31.02)	559.56	(38.60)	[−6.82]
Distributor Profit	806.11	(46.41)	859.89	(58.09)	[−1.32]
Observations	37		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 2000 U.S. Census data. Data on competing retailers is gathered from 1998,1999,2000, and 2001 phone book listings.

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

	Stores accepting Revenue-Sharing	(S.E.)	Stores accepting Linear-Pricing	(S.E.)	T-stat of Diff.
No. People	23.83	(0.17)	23.95	(0.18)	[−0.48]
% Suburban	10.34	(0.15)	11.06	(0.15)	[−3.68]
% Married with Kids	24.25	(0.04)	23.45	(0.04)	[16.58]
Median Income	43.07	(0.33)	42.49	(0.23)	[2.07]
No. Blockbusters	0.31	(0.01)	0.30	(0.00)	[1.58]
No. Competitors	2.70	(0.01)	2.64	(0.02)	[3.40]
Monthly Revenue	113.74	(2.78)	196.52	(3.59)	[−22.35]
Copies	12.37	(0.57)	6.93	(0.41)	[10.26]
Rentals (Q)	222.56	(12.05)	281.19	(15.46)	[−6.78]
Price (P)	2.72	(0.01)	2.84	(0.01)	[−8.65]
Retailer Profit	188.35	(13.24)	339.67	(24.99)	[−8.46]
Distributor Profit	398.05	(20.64)	443.98	(27.12)	[−1.85]
Observations	46		45		

*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 2000 U.S. Census data. Data on competing retailers is gathered from 1998,1999,2000, and 2001 phone book listings.

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

	Stores accepting Revenue-Sharing	(S.E.)	Stores accepting Linear-Pricing	(S.E.)	T-stat of Diff.
No. People	24.66	(0.21)	27.1	(0.31)	[−8.24]
% Suburban	9.76	(0.18)	7.87	(0.34)	[6.45]
% Married with Kids	23.02	(0.16)	21.58	(0.18)	[10.13]
Median Income	45.25	(0.36)	45.88	(0.48)	[−1.45]
No. Blockbusters	0.31	(0.01)	0.37	(0.01)	[−4.91]
No. Competitors	2.73	(0.02)	2.72	(0.03)	[0.22]
Monthly Revenue	145.32	(2.65)	300.12	(7.00)	[−25.35]
Copies	4.22	(0.20)	2.22	(0.10)	[14.13]
Rentals (Q)	68.98	(4.16)	92.17	(4.76)	[−9.23]
Price (P)	2.70	(0.01)	2.79	(0.02)	[−4.67]
Retailer Profit	58.81	(4.06)	109.47	(7.45)	[−9.96]
Distributor Profit	119.14	(7.29)	138.51	(7.01)	[−4.03]
Observations	163		163		

*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 2000 U.S. Census data. Data on competing retailers is gathered from 1998,1999,2000, and 2001 phone book listings.

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

	Titles taken on Revenue-Sharing	(S.E.)	Titles taken on Linear-Pricing	(S.E.)	T-stat of Diff.
Upfront Fee	7.63	(0.02)	8.29	(0.01)	[−30.68]
Revenue Kept by Retailer	0.46	(0.00)	0.45	(0.00)	[18.21]
Minimum Inventory	21.55	(0.18)	22.05	(0.16)	[−1.91]
Maximum Inventory	49.36	(0.36)	46.19	(0.31)	[6.19]
% At Minimum	29.31	(0.45)	–		N/A
% At Maximum	17.88	(0.32)	–		N/A
% Action-Adventure	39.26	(0.26)	27.19	(0.27)	[31.74]
% Comedy	28.14	(0.25)	27.91	(0.32)	[0.55]
% Drama	14.96	(0.19)	25.00	(0.31)	[-27.75]
% Suspense-Horror	12.05	(0.17)	14.92	(0.23)	[-9.90]
% Romance	1.21	(0.05)	1.74	(0.10)	[-5.10]
% Sci-Fi	4.40	(0.09)	3.23	(0.12)	[7.59]
Box Office Rev (100,000's)	81.91	(0.26)	72.59	(0.23)	[25.12]
% Rated PG-13	27.53	(0.26)	43.68	(0.35)	[−34.29]
% Rated R	71.41	(0.27)	56.32	(0.35)	[31.68]
Inventory	32.5	(0.31)	11.3	(0.15)	[57.86]
Rentals	567.22	(6.13)	409.15	(4.67)	[19.24]
τ (Rentals/Inventory)	17.88	(0.08)	44.87	(0.36)	[−66.21]
Price	2.88	(0.05)	2.84	(0.01)	[0.88]
Retailer Profit	539.33	(7.39)	440.28	(5.41)	[10.16]
Distributor Profit	1021.28	(11.73)	714.91	(9.54)	[18.96]
Stockout Total	0.78	(0.01)	3.55	(0.03)	[−89.64]
Observations	5635		4915		

*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. Linear-Pricing Contracts: B Titles, Differences Between Titles Within a Store*

	Titles taken on Revenue-Sharing	(S.E.)	Titles taken on Linear-Pricing	(S.E.)	T-stat of Diff.
Upfront Fee	8.10	(0.01)	8.41	(0.01)	[−17.10]
Revenue Kept by Retailer	0.46	(0.00)	0.45	(0.00)	[15.31]
Minimum Inventory	11.33	(0.10)	12.44	(0.09)	[−7.79]
Maximum Inventory	27.68	(0.20)	29.62	(0.20)	[−6.38]
% At Minimum	37.09	(0.52)	–		N/A
% At Maximum	13.89	(0.33)	–		N/A
% Action-Adventure	17.80	(0.33)	12.51	(0.18)	[13.83]
% Comedy	25.51	(0.32)	35.14	(0.28)	[-22.82]
% Drama	35.17	(0.45)	24.14	(0.27)	[20.95]
% Suspense-Horror	10.89	(0.21)	15.62	(0.24)	[-14.88]
% Romance	7.19	(0.17)	8.57	(0.21)	[-5.14]
% Sci-Fi	3.43	(0.11)	4.02	(0.11)	[-3.81]
Box Office Rev (100,000's)	27.83	(0.06)	27.14	(0.04)	[9.25]
% Rated PG	22.88	(0.44)	15.60	(0.20)	[14.04]
% Rated PG-13	21.31	(0.26)	23.99	(0.24)	[−7.02]
% Rated R	55.81	(0.39)	60.42	(0.27)	[−8.97]
Inventory	16.78	(0.17)	5.98	(0.07)	[53.80]
Rentals	347.48	(4.17)	240.58	(2.67)	[20.20]
τ (Rentals/Inventory)	20.53	(0.10)	45.92	(0.26)	[−82.51]
Price	2.79	(0.01)	2.80	(0.01)	[−1.63]
Retailer Profit	339.22	(5.25)	280.34	(3.46)	[8.76]
Distributor Profit	618.37	(7.77)	383.91	(4.65)	[24.25]
Stockout Total	0.90	(0.01)	3.26	(0.02)	[−80.21]
Observations	5261		5028		

*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. Linear-Pricing Contracts: C Titles, Differences Between Titles Within a Store*

	Titles taken on Revenue-Sharing	(S.E.)	Titles taken on Linear-Pricing	(S.E.)	T-stat of Diff.
Upfront Fee	7.86	(0.02)	8.63	(0.01)	[−32.17]
Revenue Kept by Retailer	0.48	(0.00)	0.46	(0.00)	[30.37]
Minimum Inventory	4.49	(0.04)	5.89	(0.03)	[−23.54]
Maximum Inventory	12.88	(0.10)	16.61	(0.10)	[−23.44]
% At Minimum	40.65	(0.43)	–		N/A
% At Maximum	12.73	(0.30)	–		N/A
% Action-Adventure	29.47	(0.30)	28.13	(0.28)	[3.26]
% Comedy	0.02	(0.00)	0.02	(0.00)	[-0.77]
% Drama	36.12	(0.31)	37.20	(0.29)	[-2.54]
% Suspense-Horror	29.26	(0.38)	27.90	(0.28)	[2.90]
% Romance	2.19	(0.08)	2.17	(0.08)	[0.22]
% Sci-Fi	2.93	(0.08)	4.57	(0.14)	[-10.01]
% Rated PG	1.38	(0.05)	1.36	(0.06)	[0.24]
% Rated PG-13	8.28	(0.19)	7.29	(0.15)	[3.59]
% Rated R	17.24	(0.24)	21.21	(0.23)	[−10.57]
Inventory	7.12	(0.09)	2.63	(0.02)	[43.81]
Rentals	138.14	(2.12)	111.08	(0.92)	[10.21]
τ (Rentals/Inventory)	18.21	(0.10)	44.75	(0.16)	[−124.15]
Price	2.73	(0.01)	2.73	(0.01)	[−0.87]
Retailer Profit	131.04	(2.34)	125.40	(1.23)	[1.87]
Distributor Profit	239.38	(4.13)	170.16	(1.45)	[13.76]
Stockout Total	0.50	(0.01)	2.42	(0.02)	[−85.18]
Observations	4376		4803		

*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: Regression Analysis, Dependent Variable is ln (Retailer Profit)*

Independent Variable	1	2	3	4
A Titles				
Revenue-sharing chosen	-0.367	-1.007	-0.971	-0.203
	(0.091)	(0.159)	(0.155)	(0.144)
RS*ln(inventory)	–	0.255	0.238	0.078
		(0.058)	(0.056)	(0.049)
$\partial\pi/dRS$	-0.367	-0.228	-0.243	0.037
R^2	0.020	0.415	0.418	0.534
B Titles				
Revenue-sharing chosen	-0.605	-0.762	-0.777	-0.431
	(0.053)	(0.132)	(0.142)	(0.112)
RS*ln(inventory)	–	0.181	0.186	0.164
		(0.052)	(0.056)	(0.044)
$\partial\pi/dRS$	-0.605	-0.343	-0.347	-0.051
R^2	0.053	0.414	0.547	0.553
C Titles				
Revenue-sharing chosen	-0.779	-1.308	-1.257	-0.717
	(0.048)	(0.105)	(0.108)	(0.090)
RS*ln(inventory)	–	0.214	0.217	0.227
		(0.046)	(0.046)	(0.038)
$\partial\pi/dRS$	-0.779	-0.997	-0.942	-0.388
R^2	0.069	0.370	0.496	0.506

* Standard errors in parentheses. Right-hand side variables in each specification are:
1) None.
2) ln(med. income), ln(pop.), % suburban, % married with kids, no. of Blockbuster, Hollywood Videos, and 'other' video stores, ln(monthly rev.), 4 chain-size dummies; MPAA rating, genre, box-office revenues, 'R' rating*(% married with kids), ln(inventory).
3) Same as 2), plus, total inventory at the store of other 'A', 'B', or 'C' movies released in the same month.
4) Same as 3), plus, the number of weeks in which the title was 'stocked-out', and an interaction of the stock-out variable and the Action/Adventure genre dummy.

Table 8: Oaxaca-style Decomposition, Dependent Variable is ln (Retailer Profit)*

	Total Difference	Difference in X's	Difference in β's	Unexplained Difference
A Titles	-0.362	-0.759	-0.021	0.418
	(0.122)	(0.176)	(0.110)	(0.159)
B Titles	-0.602	-0.811	-0.109	0.318
	(0.102)	(0.167)	(0.101)	(0.152)
C Titles	-0.779	-0.849	-0.521	0.591
	(0.095)	(0.137)	(0.074)	(0.105)

* Standard errors in parentheses. Right-hand side variables are as in specification (4) from table 7.

Table 9: Estimated Parameter Values from GMM Estimation

$\partial \ln V/\partial X(*100)$	A Titles	B Titles	C Titles
People	0.439	0.471	0.315
	(0.033)	(0.020)	(0.040)
Store Size (Monthly Rev.)	2.444	2.269	0.374
	(0.051)	(0.031)	(0.067)
Theatrical Box Office	0.207	1.450	–
	(0.062)	(0.033)	
Chain Size	0.005	-0.014	-0.018
	(0.001)	(0.000)	(0.001)
Inventory, Other Titles	0.003	0.162	0.458
	(0.046)	(0.011)	(0.061)
No. Blockbusters	13.804	12.772	9.238
	(0.870)	(0.573)	(1.226)
No. Weeks Stocked-out	-10.314	-10.042	-4.525
	(0.447)	(0.138)	(0.240)
$\ln(\hat{\tau})$, Linear Pricing	3.764	3.720	3.835
	(0.027)	(0.007)	(0.012)
$\ln(\hat{\tau})$, Revenue-Sharing	2.737	2.955	3.679
	(0.023)	(0.011)	(0.014)
$\hat{\eta}$, Slope of Demand	509.722	213.522	79.387
	(49.743)	(3.641)	(5.031)
$\hat{\sigma}_V$	0.187	0.210	0.253
	(0.003)	(0.001)	(0.004)
$\hat{\sigma}_\tau$	0.414	0.529	0.453
	(0.031)	(0.006)	(0.018)
Price Elasticity	-1.085	-0.797	-0.623
at Mean Q, P	(0.107)	(0.013)	(0.037)
Observations	110,687	141,673	203,291

Standard errors in parentheses.

Table 10: Counter-factual Experiments

Variable	Actual	Current	Linear-Price Only	No Inven. Restrict.	Rev-Share Only
Panel 1: A titles					
Avg. Inventory	21.36	22.91	17.10	21.95	38.20
Avg. Price	2.83	2.36	2.75	1.81	1.66
% Revenue-Sharing	53.60	64.52	0.00	67.02	100.00
Total Retailer Profit (Mil.)	61.00	62.77	55.82	57.49	35.51
Total Distributor Profit (Mil.)	93.44	57.43	51.98	50.86	62.43
% Change Retailer Profit			-11.07	-8.41	-43.43
% Change Distributor Profit			-9.50	-11.45	8.70
% Change Consumer Surplus			-2.10	8.02	15.45
Panel 2: B titles					
Avg. Inventory	9.26	12.33	10.58	12.31	19.27
Avg. Price	2.78	3.46	3.41	2.43	2.28
% Revenue-Sharing	40.03	64.28	0.00	63.39	100.00
Total Retailer Profit (Mil.)	46.04	50.90	39.30	40.36	25.06
Total Distributor Profit (Mil.)	61.48	46.25	31.84	30.17	39.25
% Change Retailer Profit			-22.79	-20.71	-50.77
% Change Distributor Profit			-31.16	-34.77	-15.14
% Change Consumer Surplus			-22.22	-7.08	-2.03
Panel 3: C titles					
Avg. Inventory	4.31	4.56	3.70	4.17	9.62
Avg. Price	2.72	3.34	3.44	2.59	2.38
% Revenue-Sharing	46.73	40.90	0.00	46.43	100.00
Total Retailer Profit (Mil.)	30.61	30.96	28.80	29.06	17.34
Total Distributor Profit (Mil.)	38.47	25.43	22.65	23.43	29.40
% Change Retailer Profit			-6.99	-6.17	-44.01
% Change Distributor Profit			-10.94	-7.89	15.60
% Change Consumer Surplus			-8.47	4.02	11.10

Table 11: Welfare Effects by Store Size (A Titles)

Variable	Actual	Current	Linear-Price Only	No Inven. Restrict.	Rev-Share Only
Size 1: Monthly Rev < $4,000 (N = 16,341)					
Avg. Inventory	10.53	12.52	11.54	15.48	20.01
Avg. Price	2.80	1.53	2.25	1.11	1.06
% Revenue-Sharing	73.15	88.95	0.00	87.88	100.00
% Change Retailer Profit			-29.82	-16.52	-30.49
% Change Distributor Profit			-16.48	-3.66	-3.98
Size 2: Monthly Rev > $4,000 and < $7,000 (N = 20,435)					
Avg. Inventory	13.24	17.66	11.46	17.49	23.26
Avg. Price	2.77	1.67	2.24	1.24	1.17
% Revenue-Sharing	65.48	87.13	0.00	84.61	100.00
% Change Retailer Profit			-28.46	-16.17	-31.37
% Change Distributor Profit			-8.43	-3.09	-3.24
Size 3: Monthly Rev > $7,000 and < $10,000 (N = 17,064)					
Avg. Inventory	16.02	22.36	12.33	19.07	27.51
Avg. Price	2.79	1.90	2.31	1.41	1.31
% Revenue-Sharing	58.14	79.25	0.00	78.01	100.00
% Change Retailer Profit			-19.71	-10.48	-29.22
% Change Distributor Profit			0.09	-0.14	0.75
Size 4: Monthly Rev > $10,000 and < $18,000 (N = 30,449)					
Avg. Inventory	21.71	24.61	14.51	22.33	37.75
Avg. Price	2.82	2.30	2.51	1.81	1.65
% Revenue-Sharing	46.22	57.56	0.00	63.45	100.00
% Change Retailer Profit			-11.50	-6.87	-32.92
% Change Distributor Profit			1.34	-4.22	-0.25
Size 5: Monthly Rev > $18,000 (N = 26,398)					
Avg. Inventory	37.37	31.95	24.57	30.80	68.60
Avg. Price	2.92	3.73	3.44	2.97	2.67
% Revenue-Sharing	37.87	31.06	0.00	37.54	100.00
% Change Retailer Profit			-8.42	-7.80	-48.38
% Change Distributor Profit			-15.58	-18.73	17.26