The Effects of Full-Line Forcing Contracts:

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October 8, 2007

1 Introduction

We consider the effects of full-line forcing or bundling contracts in the video rental industry. Studios offer their titles to video rental stores under four different contract types: linear pricing (LP), revenue sharing (RS), full-line forcing (FLF) and sell-through pricing (STP). Under linear pricing contracts the store pays a fixed price per tape, usually between $65 and $70. Under revenue sharing the upfront fee is much lower (around $8-$10 per tape) but the store also pays a fraction (in the region of 55%) of the rental revenues to the studio. The full-line forcing contract involves profit sharing under slightly better terms than the RS contracts but the store is also required to buy all the titles produced by the studio in the time period of the contract (usually 12 months). Finally, studios sell some titles on sell-through price terms: all buyers, including video rental stores, can purchase them for around $20-$25 per tape. There is no contract choice for these titles.

We discuss the intuition that in the absence of full-line forcing contracts, stores have an incentive to choose LP contracts for the titles for which they expect to have high demand, and RS contracts for other titles. This generates an adverse selection effect: the revenue sharing contract mitigates the inefficiencies generated by double marginalization, but does so only for low-demand titles, for which these inefficiencies are relatively small. The introduction of full-line forcing contracts may have three effects on the industry. First, since the store is required to take all the studio's titles on the same profit-sharing contract, some titles will be pulled out of LP contracts. This increases efficiency by reducing the double marginalization problem and therefore increases the total profits to be divided between the studio and the store. We refer to this as the "efficiency effect" of the FLF contract. Second, if a store chooses a FLF contract when it would otherwise not have taken all of the studio's titles this will increase the number of the studio's titles which are available to the consumer in total. We call this the "market expansion effect". Finally, and conversely, the store may compensate for the requirement to take all of this studio's titles by dropping some titles produced by other studios, particularly if inventory holding costs are high. This is the "leverage effect" of bundling: the studio may offer a bundling contract for exactly this reason. The overall effect of bundling on efficiency and welfare depends on the relative importance of these three effects and is an empirical question.

We develop an empirical model of the industry and perform counterfactual analyses to investigate the three effects of bundling contracts. We ask how different the market would look in terms of the number of titles offered to consumers, the mix of studios producing those titles, prices and store and studio profits if full-line forcing contracts were not available. Our initial reduced form

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analyses show that the overall patterns in the data are consistent with the first two effects but that the leverage effect may be small. Selection issues - in particular those caused by stores choosing which contracts to accept - mean that a structural model is needed to analyze the market fully.

We model consumer demand for titles using a flexible nested logit framework which takes advantage of our large dataset by including both store and title fixed effects as well as decay rates, prices and numerous interaction terms. The demand system accounts for competition across titles, and allows the choice set for consumers to adjust in each month based on the set of new titles released by studios. The missing link is then the cost of holding inventory: this is critical to our understanding of the market expansion and leverage effects. It includes rent and restocking costs (which are likely to be small for each tape) and also the opportunity cost of holding multiple tapes of a particular title rather than waiting to see if better titles are released in the future. This cost may be large, particularly for FLF contracts where the retailer is required to commit to purchasing at least a minimum number of tapes of every title produced by the studio in the following year. We estimate this cost using a method of moments methodology with inequalities, following the approach developed in Pakes, Porter, Ho and Ishii (2006). [Not yet completed; we plan to estimate a reduced-form function for this cost including store, studio and market characteristics as independent variables.] Finally we [will] perform counterfactuals to investigate what the market would look like without full-line forcing contracts.

Our results suggest that...

This analysis does not focus on the question addressed in the theoretical literature on bundling: the reason why upstream firms might choose to offer bundling contracts. Our results are, however, informative on this question. There are three potential explanations in our context. The first is the efficiency issue discussed above: if titles are pulled from LP contracts into FLF contracts this increases efficiency by reducing the double marginalization problem, increasing the total profits to be divided between studio and store. The theoretical literature does not consider this possibility. The second is the leverage theory: bundling or tying may be used to "leverage" market power in one market to exclude competitors in another market. This theory has been discussed in numerous theoretical papers including, for example, Whinston (1990), Choi and Stefanadis (2001), Carlton and Waldman (2002) and Nalebuff (2004). The third explanation is price discrimination. If the preferences of the downstream firms (rental stores in our application) for each good are negatively correlated, then the upstream firm (studio) can profit by bundling goods together. Adams and Yellen (1976) provide the first formal model of price discrimination through tying, which was later generalized by McAfee, McMillian and Whinston (1989) and Salinger (1995) among others. Our demand model is sufficiently rich to accommodate this effect: a negative correlation in preferences across stores could be generated if the consumer population differs across markets and if preferences for particular titles vary across demographic groups. The demand model incorporates these effects. However, our data,which cover only 7 studios that offer FLF contracts, do not allow us to analyze the price discrimination story explicitly. We focus instead on the store's choice of whether to take the bundling contract. The demand model is also rich enough to consider this question, since it allows the store to predict which titles will be particularly popular with its population.

There are to our knowledge very few previous empirical bundling papers. The first is by Chu, Leslie and Sorensen (2007). It studies bundling of tickets sold to consumers by a theatre company that produces a season of 8 plays. The authors focus on examining the profitability of simple alternative pricing strategies to mixed bundling, and show that these alternatives can yield profits that are very close to those of mixed bundling. There is also a small literature which uses reduced form analyses to investigate the pro-competitive and anti-competitive effects of slotting allowances (which are paid by manufacturers to supermarkets in order to reserve shelf space for their products). See for example Marx and Shaffer (2004). No previous authors have estimated a structural model

of bundling in a supply chain setting.

This paper continues as follows. In Section 2 we outline the important institutional features of the industry and develop a simple theoretical model which illustrates the key effects. Section 3 describes the data; Section 4 sets out our reduced form analysis. In Section 5 we provide an overview of the model. Section 6 considers demand, Section 7 covers the inequalities methodology and Section 8 describes our counterfactual analyses. Finally, Section 9 concludes.

2 Full-Line Forcing in the Video Rental Market

This section considers the theoretical effects of tying in the video rental market. We begin by summarizing some important institutional features of the market. Then we discuss the theoretical implications of tying for efficiency in this industry.

2.1 The video rental market

The video rental industry has two primary tiers[1]. Studios make and distribute movies which are acquired by video rental stores who offer them for rental and sale to consumers. The studios use three different contractual forms for titles targeted to the rental market in their dealings with the rental stores. The first is linear pricing. Studios offer a title to a store for a fixed price per tape, usually between \$65 and \$70. They may also offer quantity discounts (introducing some second-degree price discrimination).

The second contractual form is revenue sharing. Studios enter into an agreement with the rental store to share the revenue generated by a title, in return for charging a reduced up-front fee. In the typical revenue sharing agreement the studio charges a upfront fee of \$3 to \$8 per tape and receives in the order of 55% of the rental revenue. The inventory decision of the rental store is often constrained by both minimum and maximum quantity restrictions. Revenue sharing and linear pricing contracts both operate on a per title basis. That is, for each individual title, the rental store is free to choose both whether to purchase the title and which form of contract to take.

In contrast, the third form of contract, the full-line forcing contract or output program, requires the rental store to purchase all titles released by the studio during the period of the agreement (typically 12 months) and to take them all under the same contract type[2]. In many other respects output programs resemble revenue sharing agreements. For each title, the studio receives an upfront fee per tape and a share of the revenues, both of which are usually lower than the revenue sharing terms. The quantity taken by the retailer is again restricted to be within a range.

Antitrust laws (Section 2 of the Clayton Act as amended by the 1936 Robinson-Patman Act) prevent distributors from offering different prices to different buyers for exactly the same product. This legislation does not, however, apply to quantity restrictions or quantity discounts. In our application the data are consistent with a model where the studio must offer the same contractual prices (wholesale prices, upfront fees and revenue division) to all rental stores. The maximum and minimum quantity requirements for revenue-sharing contracts can and do vary with the box office of the movie and the size of the store.

[1] Our analysis ignores Rentrak and wholesalers.

[2] Some exceptions apply: titles released by the studio on "sell-through pricing" terms are exempt, and several studios allow for limitations on the total number of titles that a retailer must accept within any given month. Usually, this limit is three titles per month: if the studio releases more than 3 titles in a month (a rare event), the retailer is only obligated to accept three of them. Finally, full-line forcing contracts also typically include opt-out clauses for movies with 'objectionable' content.

In addition to setting contractual terms the distributor can in theory choose which of the contractual forms to offer. In particular one might expect the studio to choose not to offer linear pricing contracts since these are the least flexible contractual arrangements. In reality, however, full-line forcing contracts were not introduced until the middle of our dataset, in February 1999. Both these and revenue-sharing agreements require extensive computer monitoring of millions of transactions; only about half of the stores in the industry had the technology to adopt these contracts by 1998[3]. Thus studios were unlikely to choose not to offer linear pricing contracts during the period of our data since by doing so they would substantially reduce their target market[4]. Thus rental stores can discipline the studios by opting to take linear-pricing terms when revenue-sharing splits are not satisfactory. The empirical evidence suggests that linear-pricing terms continue to be offered to all firms even when revenue-sharing terms are also available.

One further institutional detail concerns "sell-through priced" titles. These include, for example, children's movies and some very popular titles: the studio sells these movies to all buyers, including video rental stores, for quite low prices, often around $20-25 per tape[5]. This is much lower than the wholesale price under linear pricing contracts. There is no contract choice for sell-through priced titles: we condition on these titles' existence in the demand model and account for them in our calculation of the store's total returns in the inequalities framework but we do not model the contract choice.

Finally, note that the sales market is important for studios and should be included in any model of their choices of contract types. However, sales provide only a small proportion of the revenues of rental stores whose choices are the focus of this paper.

2.2 Empirical Implications of Theory on Tying

If demand is independent across titles, and if only revenue sharing and linear pricing contracts are available, then retailers will choose linear pricing terms when expected demand for the title is above a certain cutoff value and revenue sharing terms for lower-quality titles[6]. Thus the efficiency loss from double marginalization may not be mitigated for high-value titles, for which the loss is relatively large. This is the source of the "efficiency effect" of a full-line forcing contract: since the contract requires the store to take all of the relevant studio's titles on the same revenue-sharing terms, valuable titles are pulled out of linear pricing contracts, which may significantly reduce the double marginalization problem[7].

We expect to observe two other welfare effects of introducing full-line forcing contracts. First, if the store previously took only a subset of the studio's titles, the fact that it must now take all of them implies a market expansion effect. This is probably welfare-improving since it increases the size of consumers' choice sets. (It may also be consistent with the price discrimination motive for

[3] Our dataset includes only stores that have the technology to do revenue sharing contracts.

[4] They were prevented from offering these contracts only to stores without revenue-sharing capability by the Copyright Act of 1976. This states that the owner of a lawful copy can "sell or otherwise dispose of" the copy and implies that retailers with the ability to participate in revenue-sharing agreements cannot be excluded from choosing linear-pricing terms unless all retailers are excluded from these terms.

[5] Sell-through priced titles are exempt from the requirement that stores choosing a FLF contract take all of the studio's titles on FLF terms.

[6] Mortimer (2007) demonstrates this in a market that is consistent with the assumptions in our empirical model.

[7] The double marginalization problem would be negligible if retailers' marginal costs were very low. However, since each tape can be used only for a finite number of rentals before it breaks, and since inter-store competition implies a need to purchase multiple tapes in order to service demand quickly, each additional rental generates additional costs from purchasing new tapes. That is, we think of a tape as a "box containing τ_{jm} rentals", so stores' marginal costs include $\frac{1}{\tau}*$ the cost per tape, a non-negligible amount, in addition to the opportunity cost of holding inventory which we discuss below.

bundling by studios.) Conversely, this effect together with the non-zero cost of holding inventory may prompt the store to drop other studios' titles: this is the leverage effect and is likely welfare-reducing since it reduces inter-studio competition.

The relative magnitudes of these three effects will depend on the mean and variance of demand for the titles produced by different studios and the extent of complementarities between them and also on stores' inventory holding costs. The aggregate welfare effect of full-line forcing contracts is therefore an empirical question.

3 The Dataset

Our primary data source is Rentrak Corporation, an organization that distributes movies under revenue-sharing and full-line forcing contractual arrangements and monitors these contracts to facilitate payments between retailers and studios. The complete dataset combines information from a previous study (Mortimer 2007) with additional information from Rentrak on full-line forcing contracts. Over 11,000 retailers used Rentrak between 1998 and 2001, accounting for over half of all retailers in the industry. Approximately 4,000 of these are Blockbuster Video and Hollywood Video stores: we do not observe their transactions. We observe 7,525 retailers (over 30% of all stores in the industry), ranging in size from single-store locations to a chain with 1,652 locations. For each store we observe transaction data between January 1 1998 and June 30 2002 and follow 1025 titles released during these months.

For each store we observe the total monthly revenue of a store, its zip code, the size of its chain and considerable detail regarding product mix, such as the overall percentages of game, adult, rental, and sales revenues. We also observe the date the store joined the Rentrak database and the date the store left Rentrak if applicable. The vast majority of store exits (over 90 per cent) represent store closure[8]. The zip code information allows us to supplement the primary Rentrak data with several additional sources. Phonebook listings of competing video retail locations in each year, as well as separate indicators of competing Blockbuster and Hollywood Video locations are included. We also merge in data from the 2000 US Census on the local demographic characteristics of each store. We define a local market as a zip code area: the average zip code contains approximately 24,000 people and 2.6 video retail stores. Larger areas, such as 4-digit zip codes or Metropolitan Statistical Areas (MSA's) are also feasible ways of defining markets but are probably too large for most video store customers.

Every movie title is tracked individually, using a title identifier but not the actual title name. For each title we observe a studio identifier (but not the actual studio name), its month of release to video, genre (such as Comedy or Action/Adventure), and MPAA rating (such as R or PG). We also observe box-office categories, denoted A, B, C and D. Titles in the A category have theatrical box-office revenues of more than \$40 million; those in the B and C categories have revenues of \$15-40 million and \$0.25-15 million respectively. Titles in the D category do not have a theatrical release: these are "direct-to-video" titles such as instructional or exercise videos. Many of these titles are bought only by a single store; we exclude D titles from our analysis. The dataset includes 212 A titles, 195 B titles, and 618 C titles.

In addition to title characteristics, we observe the terms of the revenue-sharing and full-line forcing contracts offered to retailers for each title, and retail prices under linear-pricing contracts. Rentrak does not provide the actual wholesale prices paid by retailers under linear-pricing terms: we adjust the retail price to reflect the true wholesale price using guidance from Rentrak and industry

[8] For 1116 stores, data collection ended for titles released after December 1999. We include these stores in demand estimation up to that date. [Consider whether to include them in the supply side.]

sources (see Mortimer 2007 for details).

Finally, at the store-title level we observe the type of contract chosen by the retailer and the number of tapes purchased. Transaction data are recorded at the store-title-week level. They provide information on the number of rentals per tape, on total weekly revenues per tape and on inventory levels (which do not vary across weeks). We discard observations for titles released after January 1 2002 so that rental activity for each title is tracked for at least 6 months. We aggregate weekly rental data to the month level (both the number of rentals and average rental prices for the month) in order to smooth out any weekly demand fluctuations. We therefore have 54 months of transaction data for titles released over 48 months.

We take several steps to clean the dataset. First we exclude observations where average price per rental is less than \$0.50 or more than \$7 and those where store demographic data is missing. We drop five titles whose wholesale price is zero. Ten titles have two values for release month: for nine of them the majority of observations have the same (earlier) value so we assume that the later date refers to a special edition and switch to the earlier date for all observations. The tenth title has half the observations with one release date and half with another: we drop this title from the dataset. We are left with 7,189 stores, 963 titles (201 in the A box-office category, 188 B titles and 574 C titles) and 59 studios in the dataset.

Of the 7,189 retail stores in the clean dataset, 7,107 participated in at least one linear pricing contract during the period of the analysis, 6,687 participated in at least one revenue-sharing contract and 4,896 participated in at least one full-line forcing contract. Full-line forcing contracts were first introduced in February 1999 of the dataset. 7 out of 59 studios offer a full-line forcing contract at some point in our panel.

Summary statistics are provided in Tables 1 to 4. Table 1 sets out average contract terms, numbers of rentals, prices and inventories for each contract type. Averages are taken across store-title pairs. The average estimated wholesale price for linear pricing contracts is \$66.82, compared to an average upfront fee of \$8.48 for revenue sharing contracts, \$3.60 for full-line forcing contracts and a price of \$15.17 for sell-through price contracts. Retailers on average keep 46% of revenues under revenue sharing contracts and 59% of revenues under full-line forcing contracts. Average month 1 rentals are highest under revenue sharing contracts but the decay rate is also greatest for these titles; by month 3 linear priced titles have higher demand and this remains true in months 4 and 5. Average rental prices differ very little across contract types. Not surprisingly, retailers extract the largest number of rentals per tape for titles purchased under linear pricing contracts. Average inventory levels are highest for titles purchased under sell-through pricing and revenue sharing contracts and lowest for those under linear pricing contracts.

Tables 2 and 3 summarize the numbers of titles offered by studios, and taken by stores, under different contract types. The majority of titles in our data were offered under linear pricing contracts; approximately 70% were also offered under revenue sharing contracts. No full-line forcing contracts were offered in the first year of our data; a total of 10 were offered in year 2, 18 in year 3 and 39 in year 4. Table 3 shows that stores on average took many more titles on LP contracts than on other contract types.

Finally, Table 4 provides information on the size distribution of stores choosing different types of contracts. Stores are categorized into ten tier sizes, with tier 1 containing the smallest and 10 the largest stores. We begin by calculating the percent of each store's titles that were adopted under each contract type. We then break down this distribution into quintiles and report, in the first panel of the table, the average store size (tier) for each quintile. The results demonstrate that stores that accept very few titles on LP contracts (the lowest quintile) are the small stores - these choose to take a relatively high proportion of their titles on RS contracts. The stores that accept a high proportion of their titles on LP contracts are on average larger. This is consistent with the

adverse selection effect noted above: large stores tend to be located in high-demand markets and therefore expect high demand for their titles. LP contracts are most profitable for stores in these cases. The pattern for FLF contracts is similar to that for LP: larger stores are more likely to accept a high proportion of their titles on FLF contracts.

The second panel of the table looks at these patterns in more detail. We ask what percent of stores in the lowest quintile of % of titles adopted under LP contracts are in store tiers 1-3. We then normalize by the percent of all stores that are in those tiers. The result (a figure of 1.35) indicates that small stores are over-represented in the first quintile of LP contracts. Overall, small stores are over-represented in the first and second quintiles of LP contracts, the first quintile of FLF contracts and the third, fourth and fifth quintiles of RS contracts. The reverse pattern holds for large stores: these are over-represented in the fifth quintiles of LP and FLF contracts and in the first and second quintiles of RS contracts.

4 Reduced Form Evidence

We now discuss preliminary evidence and patterns from the data. In particular, we ask whether reduced form analyses can provide any evidence on the importance of the efficiency, market expansion and leverage effects of full-line forcing contracts.

4.1 Retailer Performance Across Contract Type

First we test the prediction that retailers who expect a relatively low draw of demand for a particular title will choose a revenue sharing contract while retailers who expect high demand for that title will choose linear pricing. Full-line forcing contracts are not necessarily predicted to be correlated with low demand. The summary statistics above indicate that large stores (which tend to have high demand) are most likely to choose LP contracts, small stores are more likely to choose RS contracts and the stores choosing FLF are similar to those choosing LP. We expect a similar pattern here. We regress store revenues on an indicator for the adoption of a revenue-sharing contract, an indicator for the adoption of a full-line forcing contract and title fixed-effects at the store-title level. Consistent with our prediction, we find that revenues are approximately \$86 lower under revenue-sharing than under linear pricing contracts (standard error of 1.38) and that revenues under full-line forcing are not significantly different from those under linear pricing (coefficient of -0.94, standard error 5.64).[9]

Next we investigate in more detail which types of stores choose full-line forcing contracts. A logit regression of a dummy for participation in these contracts on observable store and studio characteristics indicates that larger stores and those in suburban areas are more likely to adopt full-line forcing contracts. All stores become more likely to adopt full-line forcing over time as the contracts are rolled out by studios. Stores facing more competition from a Blockbuster Video are less likely to adopt full-line forcing.

Finally, we would like to investigate whether the introduction of revenue sharing and full-line forcing contracts had a positive effect on market coverage. The simplest statistic to consider is the percent of the average studio's titles that is taken by the average store (on non-FLF contracts).

[9] We also examine the correlation between retailer profitability and the presence of quantity restrictions. We expect that quantity restrictions imposed on retailers under full-line forcing contracts will reduce retailer profits on average. We regress retailer profits on an indicator for binding quantity restrictions and theatrical box office and store fixed effects at the store-title level, considering only observations for which a full-line forcing contract was selected. We identify the expected effect: the store-title observations that are constrained by the minimum quantity requirement earn \$384 less in profits than unconstrained observations (with a standard error of 4.2).

This figure is approximately 40%, indicating that, if the studios and stores choosing FLF contracts are randomly selected from the full sample, then the market expansion effect is substantial. In fact the studios offering FLF have similar or even lower uptake rates than other studios. We conduct a regression analysis to investigate the selection of stores into this contract type. We exclude studios that never offer FLF contracts and exclude store-months in which the store took a FLF contract from some studio. Our regression therefore compares stores that take FLF, in non-FLF months, to stores that never take FLF contracts. We regress the number of titles and the number of tapes per title on an indicator for "take FLF in some other month". We find a positive and significant effect on tapes per title (a coefficient of 3.07, standard error 0.24) but no significant effect on the number of titles taken. This suggests that the stores that choose FLF contracts take a higher inventory per title than other stores but do not on average take a larger number of titles from FLF studios in the absence of FLF contracts. The market expansion effect (at least in terms of the range of titles available) may be substantial.[10]

4.2 Full-line Forcing and Competing Products

Our final reduced form analysis investigates the leverage theory: that full-line forcing can have anticompetitive effects in the upstream market by reducing retailers' orders from other studios. We might expect this effect to generate a negative correlation between the adoption of full-line forcing contracts by a retailer and the orders (or rentals) of products from other, non-bundling studios. However, most of the theories that generate such predictions consider full bundling rather than mixed bundling. In our application large stores' selection into different contractual forms may alter the intuition.

Table 5 presents the results of regressions of the number of titles and the number of tapes per title taken from non-FLF studios on an indicator for whether or not a retailer participated in the FLF contract of another studio during the same month.[11] The naive correlation shows a strong positive effect, consistent with selection of large stores into full-line forcing contracts. (There is an interesting contrast here with the evidence in the previous section. The stores choosing FLF contracts are larger than other stores and take more titles from non-FLF studios than other stores, but do not initially take more titles from the studios offering the FLF contracts. This may indicate that studios choose to offer FLF contracts because they are under-represented in large retailers.)

We then add store fixed-effects to control for selection. The coefficients on the number of titles ordered and the number of tapes per title fall substantially, to 0.09 and 0.75 respectively. However, both are still positive and significant, implying that, when we consider variation within-retailer, stores that take FLF contracts from one studio use the advantage provided by the low cost per

[10] We also regress the percent of stores taking a title on contract types. However the results should be interpreted with care for two reasons. First, while the availability of revenue sharing contracts can expand the set of retailers taking a particular title by reducing the base price per tape, studios may choose to offer revenue sharing contracts only for titles for which they expect demand to be low (since these are the titles for which stores are likely to choose this contract type). The coefficient on "RS offered" in a simple regression may therefore be negative. Second, full-line forcing contracts, which have more favorable terms than revenue sharing contracts, probably expand the market if all other terms remain the same. However, if a high proportion of the stores taking the title take it under a FLF contract, this indicates low quality because few stores are actually choosing the title (as opposed to choosing the entire portfolio of the studio). We might therefore expect a negative regression coefficient on "percent on FLF". We regress market coverage on indicators for contract types and our results are consistent with this intuition. (The results of this regression are different from those of the first analysis of this section, where FLF contracts were associated with relatively high demand, because identification comes from variation across titles rather than across stores within a particular title.) A structural model is needed to understand these effects more fully.

[11] For the moment the data used here and in the demand analysis includes only zip codes in New England. Analyses covering all Regions of the US will be added as a next step.

tape to *increase* their portfolio of titles from other studios. This goes in the opposite direction from the leverage effect.

5 Overview of the Structural Model

The summary statistics and reduced form analyses provided some evidence that FLF contracts may affect the efficiency of contract types chosen for particular titles. The analysis is also consistent with the market expansion effect and indicates that the leverage effect may be small or even negative. A structural model is needed to correct for the selection problem arising from stores choosing which contract types to take. This issue makes it difficult to predict the effect of introducing new FLF contracts from the reduced form results alone.

The modeling approach we propose has three elements. First, we estimate a demand system that parsimoniously captures the demand interactions between titles and across title categories. Since the impact of FLF contracts is to change the composition of the choice set, the inventory of each title and the price per rental, the focus of this demand system will be to capture the impact of adding or removing a title from the consumer's choice set, changing the number of tapes on the shelf and changing the price per rental.

The second step is to use moment inequalities to infer the store's cost of holding inventory according to the overall size of the store. The use of moment inequalities over contract choice means that the issue of selection into different contractual forms is explicitly modelled and thus should not hinder identification.

The third step is to use the estimated model to run counterfactual experiments to infer the impact of FLF contracts on the division of the surplus between studios and stores, and to assess the competitive impacts of the partial adoption of FLF contracts across the industry.

6 A Model of Demand

6.1 Demand Methodology

The data provide information on the number of rentals and the total revenues for each title-store in each week. We aggregate this weekly information to the month level for two reasons. First, stockouts can lead to shifts in observed weekly transactions which are unrelated to true demand; allowing consumers to substitute across weeks within each month mitigates this problem. Unfortunately we do not observe periods of stockouts, which can include tapes that are lost or returned late. This is primarily a limitation that results from the rental nature of the product. Thus it is difficult to implement the corrected demand estimator proposed in Conlon and Mortimer (2007) to account for stockouts explicitly. Second, we account for the changing set of competing titles due to the release of new titles over time: this would not be feasible in a weekly framework[12]. Our methodology is as follows. For any title released in month one, we summarize over weeks 1 through 4 to generate month 1 demand[13]. Similarly, we summarize over weeks 5 - 8 to generate month 2 demand, weeks 9 - 13 to generate month 3 demand, and weeks 14 - 17 for demand in month 4. Finally we aggregate all remaining weeks into a "months 5 and above" observation. Approximately 84% of all rentals

[12] Using weekly demand when the choice set changes every week would require that we estimate over 35 different choice sets for each title if we allowed for four months of activity per title. This is computationally impossible for titles that are held by a small number of retailers, and difficult even for widely-held titles, when we wish to incorporate sensible decay patterns.

[13] We replace missing or negative values for revenues or transactions with zeros. Average prices are constructed by dividing monthly revenues by the number of transactions in the month.

occur in the first 4 months after a title's release to video[14]. We construct prices at the monthly level by dividing monthly revenues by monthly transactions. We observe very little variation in price within box office class-contract type groups, either for studios or for stores. We will assume throughout our model that price is fixed within these cells[15].

We define the title's competitors in each month as the titles that were released during the previous 4 months including the current month. This implies an assumption that titles released more than 4 months ago have weak substitution with current releases. Only these titles are included in the analysis for the relevant month[16,17]. We group titles according to genre (action/adventure, children/family, comedy, drama, horror, romance and sci fi) and box office class (A versus B versus C). Industry discussion indicate that A titles are likely to be more heavily advertised and displayed more prominently than B or C titles.

We estimate a nested logit model of demand with nests defined as genre/box office class groups[18]. The demand equation is:

$$u_{ijmt} = \delta_{jmt} + \zeta_{igmt} + (1-\sigma)\varepsilon_{ijmt} \tag{1}$$

where i indexes consumers, j titles, m stores, t months and g the genre/class group of the title, ζ_{igmt} is an idiosyncratic preference term common to all titles in group g and ε_{ijmt} is an idiosyncratic preference term specific to consumer i and the product indexed by jmt. Cardell (1997) gives conditions such that $[\zeta_{igt} + (1-\sigma)\varepsilon_{ijmt}]$ has an extreme value distribution with $\sigma \in [0,1]$ parameterizing the correlation of the idiosyncratic preferences within group ($\sigma = 0$ means no correlation; $\sigma = 1$ means perfect correlation). Price varies across titles, geographic markets and months. The term δ_{jmt} is specified as:

$$\delta_{jmt} = \delta_j(1+\gamma z_m) + \eta_m + \theta_t(1+\beta x_j) - \alpha_1 p_{jmt} + \alpha_2 \frac{p_{jmt}}{y_m} + \xi_{jmt} \tag{2}$$

where δ_j is a title fixed effect, η_m is a store fixed effect, θ_t is a month fixed effect, p_{jmt} is the average price per rental of the tape in month t and y_m is the median income level in the store's market (zip code). The last term ξ_{jmt} captures any unobservable quality of renting title j in market m in month t. This could include things such as local promotions of a particular movie in a month.

[14] Note that titles released in the last week of a month will be tracked for just one week in the first month rather than 4, which will bias down the demand estimates for those titles. Fortunately, there appears to be no correlation between this and studios, genres, or any other observable characteristic of movies, and based on industry discussions, we assume that this form of truncation is random. In addition, the "month 5+" revenues for titles released later in our time period will be smaller than those for titles released earlier. [Check: dropping month 5+ observations didn't affect our demand estimates?]

[15] Industry conversations indicate that retailers view the price of a new release as being essentially fixed, but that different contract types imply different numbers of tapes. A higher inventory implies an increased length of rental (and lower price per day) and therefore fewer late fees. We capture this effect by using average revenues per rental as our price variable. Our inequalities methodology assumes that stores essentially follow industry rules for average prices within contract type and box office class.

[16] Our dataset includes titles released between months 1 and 52 of our panel. Titles released between months 1-4 and between months 49-52 compete with those released in months -3 to 0 and 53-56 respectively, which we do not observe. We therefore exclude months 1-4 and 49 and above from the final demand and inequalities analysis, ensuring that we include only months for which we observe the full choice set.

[17] We choose to pool the data rather than estimating demand separately in each month because the variation in choice sets offered across months enables us to identify a detailed set of interactions with the decay rate; see below. This approach also requires fewer normalizations: if we estimated month-by-month, each month would have an outside good which would need to be normalized to zero to enable cross-month comparisons. The cost of our approach, which uses a nested logit specification, is that we estimate a single σ parameter rather than letting this vary across months.

[18] This can be interpreted as a random coefficients model with the random coefficients on group dummies. See Berry (1994) for a discussion. Since genre and box office class are the main sources of differentiation between titles this seems a natural structure for modeling heterogeneity in consumer preferences.

We interact title fixed effects with store characteristics: these describe the demographics of the store's market. The variables are the per cent white, the per cent single and the per cent with children. We therefore permit each store to predict the demand for a particular title based on the demographics of local consumers[19].

The decay rates θ_t capture two effects. The first is the simple idea that demand for a title falls over time as advertising and word-of-mouth "buzz" decrease. The second is a durable goods issue: if a consumer rents a particular title in month 1 he is unlikely to be in the market for the same title in month 2[20]. We would ideally account for this effect by including title-month fixed effects, allowing for a completely flexible decay rate for each title; unfortunately the number of titles is too large for this to be feasible. Instead we interact month fixed effects with title characteristics (box office class, genre, rating (G, PG, PG13 and R+) and double and triple interactions of these three groups of variables)[21]. This implies constraining the decay rate to be the same for all titles in a particular box office class-genre-rating cell[22]. Finally, we also interact the decay rate with the store's inventory level for the particular title. This accounts for the fact that different contract types have quite different average inventory levels due to differing base costs per tape. A higher inventory level implies a higher number of tapes on the shelf, fewer stockouts and therefore probably higher demand and potentially a different decay rate. This will be important in the inequalities analysis discussed below.

Integrating out the idiosyncratic preference terms yields the following equation for estimation:

$$\ln(s_{jmt}) - \ln(s_{0mt}) = \delta_j(1+\gamma z_m) + \eta_m + \theta_t(1+\beta x_j) - \alpha_1 p_{jmt} + \alpha_2 \frac{p_{jmt}}{y_i} + \sigma \ln(s_{jmt/gmt}) + \xi_{jmt} \quad (3)$$

where $s_{jmt/gmt}$ is the share of title j within group g at store m in month t. The outside option (with share s_{0mt}) is doing something other than watching a new release movie. Its share is calculated from a market share assumption: we assume that the market size is equal to 4 movie rentals per household per month in the zip code of the store.

One further aspect of the data complicates the estimation process: we very rarely observe more than one store per zip code (although we do know the number of stores that exist in each zip code). We therefore cannot explicitly include the whole choice set in the demand estimation. We address this by treating each store as if it is the only one we observe in its market. If N stores actually exist in the market (according to the phone book) we assign $\frac{1}{N}$ of the total population to the observed store; we model demand for the store as coming from just that subset of consumers. This implies an assumption that stores in the same market are identical and have independent populations of potential customers; a change in characteristics might attract more customers from that population but would not steal business from other stores. The same assumption will be used in the inequalities analysis: each store evaluates its alternative contracts and portfolios without predicting potential responses by other same-market stores.

[19] We could also have interacted the store fixed effects with title characteristics. We choose not to do this partly because our title characteristics are not very informative - see below for a discussion. In addition, the implied effect, that the "quality of a store" differs across types of movies - would identify essentially the same effect as the title fixed effect - store characteristic interactions: that stores serving different demographic groups expect different movies to be popular.

[20] There is also a potential seasonality effect: a title released in December may have different demand from one released in June. This effect is absorbed into the title fixed effects.

[21] We include only interactions for which there are non-trivial numbers of observations. For example, there is only one PG action/adventure rated movie so we combine that cell with PG13 action/adventure movies.

[22] There is one further issue which we would ideally account for by including title-month fixed effects. If title A was introduced in month 4, it competed with and therefore affected demand for title B in month 7. It therefore had an impact on residual demand for title B in months 8-10. These interactions between months would be perfectly accounted for if we had a fully flexible time trend for each title.

We could alternatively have included all observed stores in each market in the estimated demand system and extended it to include all the stores that actually exist in the market assuming that those we did not observe were identical to those in the data. We would then have simulated the change in demand for store m's titles when all stores simultaneously changed their contracts and portfolios, probably assuming a symmetric equilibrium. However, this methodology would have been significantly more complicated to implement. We justify our methodology by assuming that store competition occurs through location and an average price measure. Once a consumer enters a particular store he is very unlikely to shop around for different stores on that particular day[23]. The relevant dimension of competition, particularly since we are considering bundling, is that across movie studios within a store rather than that across stores. We model the former carefully but do not go into details on the latter.

Of course this simplification may lead to biased results. This seems most likely if, in reality, stores choose particular contract types in order to steal business from their competitors. However the fact that retailers in the same market choose the same contracts more than 90% of the time makes this argument less convincing[24]. The largest concern is with Blockbuster, which has FLF contracts for almost all titles and therefore frequently has a different contract type from its competitors. We treat Blockbuster like any other store in the demand equation (in that, if there are 2 non-Blockbuster and 1 Blockbuster stores in the market, then each observed store's demand is predicted assuming a population $\frac{1}{3}$ of the total in the market). We would like to include a Blockbuster dummy variable to account for the fact that the equal allocation of potential customers across stores is not quite right in this case; this variable is absorbed into the store fixed effects[25].

Three variables in the demand model are likely to be endogenous: the price variable, inventory and $s_{jmt/gmt}$, the share of the title within its group. Since the demand model includes both store and title fixed effects we are concerned about endogeneity only through unobservables that change over time and affect changes in prices, in inventory and in the $s_{jmt/gmt}$ term. We instrument for inventory using the average inventory for titles in the same store-box office-contract type group that were released in other months. The assumptions needed to make this a valid instrument are that overall inventory for a particular group of movies is related to store shelf space (i.e. to store-specific costs) and that other titles in the same group that were released at different times have demand shocks that are not correlated to those of this title. The instrument will probably be invalid if demand shocks are correlated over time. We tried using other instruments such as contract type but encountered problems because the numerous fixed effects in the model leave very little variation to be used for instrumenting.

We instrument for $s_{jmt/gmt}$ using two variables: the log of the average number of movies of the same type (same box-genre-store group) in the month, where the average is across other stores in the same size tier that offer the relevant title, and the average of $\ln(s_{jmt/gmt})$ for the same title-month pair across stores of the same tier[26]. The former instrument is correlated with the number

[23] Over time, if one store improves its offering it will gain market share. However, the fact that we very rarely observe two or more stores per market means we do not have enough data to identify this effect.

[24] That is, if one store switches to FLF its competitors will also switch, so it cannot assume that the new contract will differentiate it from the other stores in the area. The potential for there to be multiple equilibria may cause problems here, since other equilibria besides the symmetric outcome may be possible in some regions of the parameter space. Like many previous authors, we do not attempt to address the multiple equilibria problem in this paper.

[25] One problem still remains. If a store chooses FLF in order to steal business from Blockbuster then the coefficient on the dummy variable should change in the counterfactuals discussed below. We cannot account for this given the available data.

[26] Tiers are defined by Rentrak for the purpose of defining stores' max and min quantity requirements. We assume that they are exogenous to the demand equation modeled here. In all cases we take advantage of the full variation in the data by taking averages over stores in all regions, even when the demand model is run separately for different

of competitors to this title in this store. We take an average over other same-tier stores to account for any demand shocks that might affect both the store's portfolio choice and demand for title j. The second instrument is clearly correlated with $\ln(s_{jmt/gmt})$: it is a valid instrument under the assumption that demand shocks, which might affect the share variable, are not correlated across markets.

We tried numerous instruments for price, including measures of variable costs and average prices of other similar titles. None of the instruments were successful. The issue is that, after including store, title and month fixed effects, the only unobservable we need to instrument for is at the store-title level. There is little variation in price at this level. We therefore conduct our analysis without instrumenting for price. We report in Section 6.2 the OLS results and those that instrument for inventory and the $\ln(s_{jmt/gmt})$ variable.

Some titles are observed to have zero revenues (i.e. zero rentals) in one or more months for a particular store. We drop zero revenue observations where positive revenues have not yet been observed since it seems likely that these zeros are caused by the store introducing the title after its release date. We also drop zero revenue title-months if no positive revenue months are seen later in the panel since the store may have permanently removed these titles from its shelves. However, we do not drop zero title-months in stores with positive revenues in both earlier and later months: we interpret these as true instances of zero demand and include them in our demand analysis[27,28].

It is worth noting here that there were other potential demand methodologies. We would ideally have interacted title and store fixed effects in the nested logit; unfortunately the number of parameters to be estimated would then have been infeasibly large. Alternatively we could have estimated a random coefficients model. However, this would have implied replacing the (title or store) fixed effects in the model with (title or store) characteristics. The characteristics available to us are not sufficiently informative for this to be a useful approach[29].

6.2 Demand Results

We report results for New England in Table 6. The specification also includes title and store fixed effects and interactions between title fixed effects and store characteristics (percent of the market who are white, percent single and percent with children) and between month fixed effects and title characteristics (box office class, genre and rating and interactions between these); the results are not reported due to space constraints. Column 1 of the Table reports results for the OLS regression. Column 2 adds instruments for within-group share and Column 3 also instruments for inventory.

The R^2 is approximately 0.80 in all three models. This good fit with the data is particularly useful since our supply side estimation will stay within-sample in terms of titles and stores, allowing stores to deviate only in terms of contract choices. We will therefore use all the estimated fixed effects in our inequalitites and counterfactuals.

The price coefficient in the OLS regression is negative and significant. The coefficient on price divided by median income in the zip code is positive implying that video rentals are an inferior

regions.

[27] These zero-demand observations are most common for full-line forcing contracts, consistent with the idea that low-quality titles, for which zero demand is most likely, are most often taken under full-line forcing. If we dropped these observations we could bias our estimated demand for these titles upwards, implying a positive bias on the estimated store returns from full-line forcing contracts.

[28] We predict the price of these zero-revenue observations using the average of the prices for the closest previous and later non-zero-revenue months. Our usual method of dividing monthly revenues by monthly transactions will not work in these cases.

[29] In the next section we regress the sum of the estimated title and store fixed effects on characteristics: the highest R^2 was only 0.52.

good. This makes some sense: as wealth increases, consumers may choose alternative costlier leisure activities rather than watching movies at home. The estimated decay rates are also intuitive: month 2 demand is higher on average than that in month 1 because observed revenues are left-truncated in month 1 for titles released mid-month. Demand falls in months 3 and 4 and rises again in month 5 because this last observation also includes all subsequent revenues from the title. The inventory coefficient is positive implying that first-month demand increases with the number of tapes on the shelf. Not surprisingly, this generates a reduction in demand in later months (because residual demand is lower). The coefficient on within-group share, σ, is approximately 0.66.

Instrumenting for within-group share reduces the σ coefficient. This is consistent with the existence of demand shocks that affect both within-group share and total demand. Adding instruments for inventory reduces the coefficients on inventory and the interactions between inventory and the decay rate. There are two potential endogeneity stories here. First, if demand is expected to be high for a particular title then stores will choose high inventory levels, implying a positive bias on all inventory coefficients. Second, heavy advertising of a title in month 1 might lead stores to expect consumers to be impatient, demanding access to the title in month 1 rather than in later months. In this case the unobservable would lead to high inventory levels and to high demand in the first month; instrumenting should reduce the inventory-month interactions for month 1 only. The results are consistent with the first intuition.

The magnitudes of the price and price/income coefficients in the full model imply an average price elasticity of demand of -0.14: a one standard deviation increase in price translates to a 3% reduction in market share (or a 0.016 percentage point reduction, from an average share of 0.48%). The effect on inventory on demand is much larger. A one standard deviation increase in inventory implies a 24% increase in market share (or a 0.12 percentage point increase) in month 1.

Table 7 sets out the results of a regression of the store-title quality levels estimated in the nested logit on store and title characteristics. Our dependent variable is the estimated value of $\left[\hat{\delta}_j(1+\hat{\gamma}z_m)+\hat{\eta}_m+\hat{\theta}_t(1+\hat{\beta}x_j)\right]$. The independent variables are title characteristics (quarter of release to video, box office category, genre, rating and interactions of these variables), store characteristics (demographics of the market, the number of households in the market and an indicator for markets where Blockbuster Video is active), interactions between title and store characteristics and the same $\theta_t(1+\beta x_j)$ term that was included in the nested logit. The goal is two-fold: first to check that title and store characteristics have the expected signs and second to demonstrate the inability of these characteristics to explain the majority of variation in the data.

The results are intuitive. Box office category A titles have higher estimated quality than those in categories B and (particularly) C. Action/adventure movies (the omitted genre category) and comedies have higher demand than other genres; children's movies, romances and science fiction movies have particularly low demand. PG13 movies have higher demand than those with other ratings. Markets with a high percent female consumers have low demand for video rentals; those with a high proportion of family heads who are single mothers or fathers have particularly high demand and those with a high proportion of family heads who are single without children have particularly low demand. The Blockbuster dummy is positive and significant, probably indicating that Blockbuster chooses to enter only high-demand markets[30]. The R^2 on these regressions is only 0.5: even with a very flexible functional form our title and store characteristics are able to explain only half of the variation in the data. This is the reason for using a nested logit framework, in

[30]The coefficient on the number of households is negative and significant, implying that large markets where Blockbuster is not located have low demand. The coefficient on median income is positive and significant. This conflicts with the conclusion from the nested logit results, that video rentals are an inferior good. However, when we exclude the "percent rural" and "percent suburban" variables, which are negatively correlated with income, the median income coefficient becomes negative.

which we can feasibly include both title and store characteristics, rather than adopting a random coefficients model.

7 The Supply Side: Moment Inequalities

7.1 The Store Profit Equation

Having estimated a detailed demand model, the final piece of information needed to analyze stores' choices of contract types is the cost of holding inventory. As noted in the introduction, this includes rent, restocking costs, and also the opportunity cost of holding multiple tapes of a particular title rather than reserving shelf space in case higher-quality titles are released in the future. This opportunity cost may be particularly high for FLF contracts, since the retailer is required to commit to purchasing tapes up to a year in advance without knowing what other, more-popular titles might be released by other studios in the meantime. A high cost would imply that taking the full-line forcing contract, with its requirement that the store must buy every title produced by the studio during the year, would be likely to prompt the store to drop titles from other studios (the leverage effect). It would also make the market expansion effect more likely since stores would be less willing to stock the entire product line of a particular studio unless forced to do so by the full-line forcing contract.

We use the method of moments inequalities estimator developed in Pakes, Porter, Ho and Ishii (2006) to estimate inventory holding costs. That paper shows how to use the inequality constraints resulting from a Bayes-Nash equilibrium assumption in both single-agent and multiple-agent games to generate conditions that can be used for estimation and inference. The intuition in our case is very simple: we assume that each store's profit from its observed portfolio of titles and choice of contract types must be greater than its profit from any of its alternative choices. We use this assumption to write down a series of inequality constraints. The demand specification will model the change in the number of rentals caused by the change in inventory holdings, prices and the consumer's choice set that result from a contract type deviation. This, together with the price change and change in the number of tapes purchased and the purchase price, will determine the profit change up to the inventory holding cost. The resulting inequalities will be sufficient to place bounds on this cost.

Our first step is to predict the total return to the store from its contracts with all studios over the four year period covered by the data. First we use the estimated coefficients from the demand model to predict the market share of each title for each store in the market:

$$s_{jmt}(\hat{\delta},\hat{\eta},\hat{\theta},\hat{\alpha},\hat{\sigma},\hat{\xi}) = \frac{e^{(\hat{\delta}_j+\hat{\eta}_m+\hat{\theta}_t-\hat{\alpha}p_{jmt}+\hat{\xi}_{jmt})/(1-\hat{\sigma})}}{D_{gmt}^{\hat{\sigma}}\left[\sum_{gmt} D_{gmt}^{(1-\hat{\sigma})}\right]} \tag{4}$$

where:

$$D_{gmt} = \sum_{k\in J_{gmt}} e^{(\hat{\delta}_j+\hat{\eta}_m+\hat{\theta}_t-\hat{\alpha}p_{jmt}+\hat{\xi}_j)/(1-\hat{\sigma})} \tag{5}$$

for J_{gmt} the set of all products in group g that are sold by this particular store m in month t (other stores are excluded under the assumption that each store essentially operates in an independent market).

Next we consider the return to the store for each title: this is the revenue earned throughout the months after its release less the total payment to the studio. We denote the return from title j under the three contract types as follows:

1. Under linear pricing the return for title j is $r_{jm}(.) = \left(\sum_{t=t_j}^{t_j+4} q_{tjm} p_{tjm}\right) - F_j c_{jm}$. Here c_{jm} is the capacity of the title (the number of tapes purchased), q_{tjm} is the number of rentals and t indexes time (in months) since the release date t_j.

2. Under revenue sharing we write $r_{jm}(.) = y_j^{RS}\left(\sum_{t=t_j}^{t_j+4} q_{tjm} p_{tjm} - u_j^{RS} c_{jm}\right)$, where y_j^{RS} is the portion of revenues kept under RS.

3. If the store chooses a full-line forcing contract it has to buy all titles produced by the studio during the following twelve months. It receives slightly better terms than those under revenue sharing: $r_{jm}(.) = y_j^{FLF}\left(\sum_{t=t_j}^{t_j+4} q_{tjm} p_{tjm} - u_j^{FLF} c_{jm}\right)$.Thus $u_j^{FLF} \leq u_j^{RS}$ and $y_j^{FLF} \geq y_j^{RS}$.

We also need to model capacity constraints and quantity restrictions. The number of titles "sold" (i.e. rented out) is constrained by the inventory of the title, c_{jm}, and the number of rentals per tape, τ_{jm}. Additional constraints, in the form of minimum and maximum quantity restrictions on inventory purchases, are also set by the studio for RS and FLF contracts (at the store-title level). We denote these constraints as $\underline{c}_{jm}$ and $\bar{c}_{jm}$ respectively. Then the quantity that would be rented out in the absence of quantity restrictions is:

$$\hat{q}_{jmt} = \min\left(Ms_{jmt}(.), \tau_{jm} c_{jm}\right) \tag{6}$$

The quantity actually rented out is given by:

$$\tilde{q}_{jmt} = \min\left(Ms_{jmt}(.), \tau_{jm} \tilde{c}_{jm}\right) \tag{7}$$

where

$$\tilde{c}_{jm} = \max\left(\underline{c}_{jm}, \min\left(c_{jm}, \bar{c}_{jm}\right)\right) \tag{8}$$

accounts for the effect of the quantity restrictions.

The above implies that the return to the store from a particular title, over the four-year period covered by the data, is given by:

$$\begin{aligned} r_{jm}^{obs}(.) \;=\; & I_{jm}^{LP}\left(\left(\sum_{\tilde{t}=t_j}^{t_j+4} \tilde{q}_{\tilde{t}jm} p_{\tilde{t}jm}\right) - F_j \tilde{c}_{jm}\right) \\ & + I_{jm}^{RS}\left(y_j^{RS}\left(\sum_{\tilde{t}=t_j}^{t_j+4} \tilde{q}_{\tilde{t}jm} p_{\tilde{t}jm} - u_j^{RS} \tilde{c}_{jm}\right)\right) \\ & + I_{jm}^{FLF}\left(y_j^{FLF}\left(\sum_{\tilde{t}=t_j}^{t_j+4} \tilde{q}_{\tilde{t}jm} p_{\tilde{t}jm} - u_j^{FLF} \tilde{c}_{jm}\right)\right) \end{aligned} \tag{9}$$

where time is measured in months. As before we consider the first 4 months of the lifetime of each title plus a fifth observation for months 5 and above. The indicator functions I_{jm}^{LP} equal 1 if that contract is chosen and 0 otherwise.

Given this function $r_{jm}(.)$, we can write the store's profit from its observed contracts as:

$$\begin{aligned} \pi_m^{obs}(.) \;=\; & \sum_s \sum_{j \in J_s}\left(r_{jm}^{obs}(F, u, y, \bar{c}, \underline{c}, \hat{\delta}, \hat{\eta}, \hat{\theta}, \hat{\alpha}, \hat{\sigma}, \hat{\xi}, \tilde{c}, k) - C_m^{tier} \tilde{c}_{jm}\right) \\ & + \eta_m + \rho(\tilde{c}_{ms}, k_{ms}) + \varepsilon_{ms} \end{aligned} \tag{10}$$

where J_s is the set of titles produced by studio s over the 44-month time period and C_m^{tier} is the inventory cost of holding the title (which we allow to vary by store size tier). We assume that $\tilde{c}_{jm} = 0$ if $I_{jtm}^0 = 1$, i.e. when the store chooses not to stock the title. η_m is a store fixed effect, k_{ms} is the contract type (a vector with one element per title for this store-studio couple) and $\rho(\tilde{c}_{ms}, k_{ms})$ is the effect of the store's choice of contracts at the end of the four-year period on its profits after that period[31]. [We plan to estimate a more detailed reduced form function for inventory costs, including independent variables that may be correlated with opportunity costs such as the number of competitors in the store's market and the percent of recent hit movies that were released by this studio. This analysis has not yet been completed; the remainder of the text considers only variation in costs across store size tiers.]

It is possible that inventory holding costs differ across stores within store tier groups. We account for this by introducing a cut-off condition on inventory. If a particular contract would require the store to take more inventory than a cut-off defined as the maximum inventory ever taken by the store in any month in our data, then the store adjusts the inventory so that the total number of tapes taken falls below the cutoff. This is an assumption that each store has a fixed capacity. Below that level all stores' inventory holding costs are the same but stores cannot exceed their maximum capacity levels.

7.2 The Inequality Estimator

Now consider the store's choice of contracts. Take as an example a title t' released by studio s' for which the store chose a LP contract. It could instead have chosen a RS contract; it could also have chosen, at the time when this title was released, to switch to a FLF contract with the studio for the following year. We assume that:

$$\pi_m^{obs}(.) \geq \pi_m^{alt}(.) \tag{11}$$

for the observed and any alternative contract choices[32]. We therefore infer from the observed data that:

$$\pi_m(k_{ms'}^{LP}(t')) \geq \pi_m(k_{ms'}^{RS}(t')) \tag{12}$$

where $k_{ms'}^{LP}(t')$ indicates that the t'th element of $k_{ms'}$ is a LP contract. This equation implies the following inequality (assuming that title t' has zero demand by the end of the 4-year period in the data and therefore that the $\rho(.)$ term is differenced out[33]):

$$\Delta\pi_m^{s',t'}(.) = \sum_s \left[\sum_{j \in J_s} \{\Delta r_{jm}(k_{ms'}^{LP}(t'), k_{ms'}^{RS}(t')) - C_m^{tier} \Delta\tilde{c}_{jm}(k_{ms'}^{LP}(t'), k_{ms'}^{RS}(t'))\} + \Delta\varepsilon_{ms'} \right] \geq 0 \tag{13}$$

Here the difference function $\Delta\tilde{c}_{jm}(k_{ms'}^{LP}(t'), k_{ms'}^{RS}(t')) = \tilde{c}_{jm}^{obs} - \tilde{c}_{jm}^{alt} = \tilde{c}_{jm}(k_{ms'}^{LP}(t')) - \tilde{c}_{jm}(k_{ms'}^{RS}(t'))$, and similarly for $\Delta r(.)$. The returns from the observed and the alternative portfolios are calculated

[31] As a robustness test we could choose alternative portfolios whose end-of-period contracts are the same as those observed in the data. Both η_m and $\rho(\tilde{c}_{ms}, k_{ms})$ would then be precisely differenced out of our inequalities.

[32] We consider only alternative contracts that were offered by the studio for the relevant title and only titles that are in our data for at least five months (except in the case of a switch to or from a FLF contract, where we include all titles released in the relevant year).

[33] Note that when considering FLF contracts, if the contract has not expired by the end of our panel, our alternative contracts will return to FLF at the end of the data. This is not quite correct since the contract would then have longer left to run than does the observed contract. This will add noise to the estimates since the $\rho(.)$ terms may not exactly cancel out in this case.

from the model (even though the observed portfolio return is observed) to ensure comparability in the counterfactual[34]. Each observed choice of contract implies a similar inequality.

We form inequalities for estimation by taking an expectation conditional on the instruments $z_{ms'}$, where s' is the studio whose contracts were switched by the store. We define these instruments such that $E(\varepsilon_{ms'} \mid z_{ms'}) = 0$. This together with equation (13) implies that:

$$E(\Delta\pi_m^{t',s'}(.) \mid z_{ms'}) = E\left\{\sum_s \sum_{j\in J_s} \left(\Delta r_{jm}^{t',s'}(.) - C_m^{tier}\Delta\tilde{c}_{jm}^{t',s'}(.)\right) \mid z_{ms'}\right\} \geq 0. \tag{14}$$

The variables in $\pi_m(.)$ that will change across alternative contract types are the contract terms, the indicator functions I_{jm}, prices p_{jtm}, capacities c_{jm} and technology (rentals per tape) τ_{jm}. The terms of the potential contracts, $(F_j, y^{RS}, u^{RS}, y^{FLF}, u^{FLF})$, are calculated as the modal values over all stores for that contract type and title[35]. Our assumptions regarding prices and quantities are as follows. We note that prices vary only slightly between contract types within a store. The average mean within-store price of an A title is \$2.88 for RS contracts and \$2.84 for LP. The equivalent prices for B titles are \$2.79 and \$2.80; those for C titles are \$2.73 and \$2.73 respectively. The variation is even smaller within contract group. We therefore do not directly model a price change after the change in contract types. Instead we use the average price for each month for the particular box office class-store-contract type combination being considered[36].

Similarly, we do not formally model the firm's choice of c_{jm} and τ_{jm} for every title and contract type. We define the quantity $\tilde{q}_{tjm}$ as in equation (7). The first term, $Ms_{tjm}(.)$, represents consumer demand for the title in month t. We predict this using the estimated demand coefficients, the titles offered by the store under the relevant contract type, and the price and inventory choices for this contract type and title, defined as averages over other titles in the same store-box office class-contract type-month. The inventory level is also constrained by the maximum and minimum quantity restrictions for that title as defined in equation (8)[37]. The last term, $\tau_{jm}\tilde{c}_{jm}$, is the maximum number of rentals the store can offer for this title given the contract type. We interpret this as the store's inventory level for the title under the relevant contract type multiplied by its maximum τ_{jm} (the maximum number of rentals per tape). This maximum τ_{jm} is defined as the highest τ observed for titles in the same store-box office class-contract type. The inventory level is

[34] In fact we calculated 8 possible returns from observed contract choices, using every possible combination of observed/expected price, demand and maximum supply.

[35] In fact they are constrained by Section 2 of the Clayton Act to be the same for all stores for a particular title. We take a model value because a small number of stores negotiate special deals such as volume discounts with particular studios. These are classed as second degree price discrimination and are therefore not illegal. We assume that stores do not expect to be able to negotiate such deals.

[36] Our price measure is the average revenue per rental: it therefore incorporates the variation in rental periods (and therefore in price per day) and late fees that come from inventory variation across contract types. We assume that stores take this variation as given when choosing contracts. We do not have a clean measure of rental periods that can be compared across stores so do not have the data to model the choice of price per day or of rental period for each title.

[37] We define these values as the modal values for that title and contract type across same-tier stores. If the relevant title-contract-tier group is empty we fill in values using neighboring tiers.

the same value used as an input into expected demand[38,39].

It is worth noting here the distinction between the different methods of forming expectations used in our analysis. When stores choose their contract types, the contract terms (split, upfront fee, wholesale price and maximum/minimum quantity restrictions) are defined by the studio and perfectly observed by the store. We use the modal values for the relevant title-contract type across stores (in cases where regulations require the studio to charge all stores the same amount) or across same-tier stores (in other cases, i.e. for minimum/maximum quantity restrictions) in order to remove any special terms (such as quantity discounts) that are negotiated by a small number of stores. We predict expected prices using averages over titles within the same store-box office-contract type-month since there is less variation within-store across titles than there is across stores for a particular title (see Mortimer (2007) for evidence on this). [40]. Expected inventory is treated analogously, except that it does not vary by month.

Where a title is observed to have zero transactions in a particular month, we follow a methodology consistent with that used in the demand model. Zero transactions at the beginning or end of the panel for a particular title are interpreted as being caused by the store choosing not to offer the particular title: we therefore set expected price and expected transactions equal to zero. Zero transactions in middle months are again interpreted as true zero demand: expected prices are non-zero and expected transactions take the values predicted by the demand model[41].

The last step is to choose the alternative contracts that will define the inequalities used for estimation. We use the following framework. First, we note that only 7 out of the 53 studios in the data ever offer FLF contracts. If a studio does not offer any FLF contracts in a particular year, then we know that FLF was not an option for the store. We define the store's alternative to the observed contract for any particular title t' from that studio-year to be switching from LP to RS or vice versa. For each t' we calculate $r_m^{altt'}(.) = \sum_s \sum_{j \in J_s} (r_{jm}^{altt'}(.))$, the store's total return when it switches the contract for title t' from LP to RS or vice versa, holding all other contracts and inventory levels fixed[42]. The calculation incorporates the revenue from all titles offered by all

[38] If a store takes a title under the FLF contract that it did not take before, we assume it purchases the minimum number of tapes required by the studio (rather than the average for that store-box-contract type). If the store-box-contract group is ever empty we again use the minimum number of tapes required by the studio as the expected inventory level. We predict price and τ_{jm} in this case using other contract types. Price for a title taken on a FLF contract that has never been taken before by the store is defined as the minimum of the average prices in the same store-box office group under LP, RS and STP contracts. (We use a minimum because titles newly taken under FLF have lower average quality than those observed to be taken by the store under other contract types.) Prices for titles taken on LP or STP contracts are defined as the maximum of the average prices in the same store-box group under RS, FLF and STP contracts; those for titles taken on RS or FLF contracts (where the store is observed to take the title under a different contract type) are the average of the average prices under the other three contract types. Finally, in all these cases we define maximum τ as the maximum of the average prices under the other three contract types.

[39] When considering the observed contract choice, our "observed demand" is calculated from the estimated demand coefficients together with the observed price and inventory levels. The "observed maximum number of rentals" is the maximum τ_{jm} observed for same-store-box-contract type titles multiplied by the observed inventory level. The expected values are calculated using exactly the same methodology as those for alternative contract types.

[40] We could have considered titles in the same store-genre-box office-contract type-month, consistent with the nest definitions in the demand model, but encountered problems with small sample sizes in some cases. The other expectation used in our model is an average across same-tier stores for the same title, used to define instruments in the demand model.

[41] We make this assumption for both observed and alternative contracts. This implies an assumption that the store does not change the amount of time each title is offered to consumers when it changes contract types.

[42] If the alternative contract choice would force the store to hold a total storewide inventory level higher than that observed for the store in any month in the data, we assume that the store's inventory would equal that maximum cutoff provided it implies an inventory level for the title that is above the minimum quantity restriction of the contract; otherwise the alternative contract is defined as dropping the title.

studios in all years in the data, since changing a single contract may affect demand for other-studio titles, even if these are offered in later months[43]. We generate the equation for estimation by converting the expectations in equation (14) into sample averages over stores. We also average over alternative contracts t' in a particular studio-year before interacting with the instruments since the store may maximize profits at the studio rather than the title level. This implies the following equation for estimation:

$$\Delta\bar{\pi}_{ys'}^{noFLF} = \frac{1}{M}\sum_{m}\left((r_m^{obs} - C_m^{tier}\tilde{c}_m^{obs}) - \frac{1}{Q_{ys'}}\sum_{t'\in(s',y)}(r_m^{altt'} - C_m^{tier}\tilde{c}_m^{altt'})\right) \otimes g(z_{ms'}) \geq 0 \qquad (15)$$

where y indexes years, s' indexes studios, $Q_{ys'}$ is the number of titles offered by studio s' in year y, $g(.)$ is any positive-valued function of the instruments, M is the number of stores in the data, r_m is the sum of r_{jm} over all titles and the total store-level inventory holding cost for a particular set of contracts is written as:

$$C_m^{tier}\tilde{c}_m = \sum_s \sum_{j\in J_s} C_m^{tier}\tilde{c}_{jm}(.).$$

We therefore have one moment per studio-year-instrument triple. The identified set of parameter values is the set of parameters that satisfy the implied system of inequalities. If there are no feasible parameters we use a method of moments methodology, minimizing the Euclidean distance by which the inequalities are violated.

Our methodology is slightly different in cases where the studio does offer a FLF contract in a particular year. In this case, if the relevant store ever takes a FLF contract from the relevant studio, we consider its choices for the duration of that contract. We define its alternative as taking all titles that were previously part of the FLF contract on RS contracts[44]. If the relevant store never takes a FLF contract from the relevant studio, we consider its choices for the 12 months after FLF was first offered. The alternative is taking all the studio's titles for that year on a FLF contract[45]. We calculate $r_m^{altys'}(.)$, this time defined as the store's predicted return when it changes all contracts from studio s' throughout year y. Then we form the following moments to add to those from non-FLF studio-years:

$$\Delta\bar{\pi}_{ys'}^{FLF} = \frac{1}{M}\sum_{m}\left[\left((r_m^{obs} - C_m^{tier}\tilde{c}_m^{obs}) - \left(r_m^{altys'} - C_m^{tier}\tilde{c}_m^{altys'}\right)\right) \otimes g(z_{ms'})\right] \geq 0. \qquad (16)$$

This creates one additional moment for each of the 7 studios that offer FLF contracts for each instrument.

[43] In fact the demand framework only allows a change in contract for title j to affect the within-group share and therefore demand for title k in months where they overlap in consumers' choice sets. It seems reasonable to assume that title k's demand in months before j is released will be unaffected by a change in j's contract type, assuming that consumers do not predict this change. If title k is active after title j has left the dataset, we assume that its demand in these later months is unaffected by j's contract change.

[44] Most stores take a FLF contract for at least 12 months. There are a few cases where the store drops a FLF contract after less than 12 months, either entering a test or trial program or exiting the contract early because of credit problems. We assume that the store expected the FLF contract to generate positive profits compared to its alternatives; if in reality store profits fell we assume this was due to unexpectedly high inventory costs (contained in our ε_{ms}). We assume that a move from FLF to RS contracts would not push the store's inventory above its maximum cutoff since the price per tape would increase and the store's profits per rental would fall. If a store ever goes on a FLF contract, then off, then on again, we reverse all of its FLF activity with the relevant studio.

[45] If this takes the store's inventory above the cutoff level we allow the store to reduce the number of tapes per title down to the minimum quantity restriction set by the studio, starting with box office category C titles (earliest-release date first, using descending order of inventory as a tie-breaker if necessary) and continuing until total inventory falls below the cutoff.

In both cases we hold the portfolio of titles fixed when contract types change[46]. Of course in reality the store may change both its portfolio of titles offered by this studio and the set of titles offered by other studios when it changes contract types: these are the market-expansion and leverage effects discussed above. However, we do not need to model the store's portfolio choices here in order to consistently estimate the inventory holding cost. The simpler inequalities that hold title portfolios fixed are also valid and are sufficient for our purposes. We model portfolio choices in the counterfactual analyses considered below.

The instruments $z_{ms'}$ (defined at the store-studio level) are required to be uncorrelated with $\varepsilon_{ms'}$, the unobservable in the profit equation, and correlated with the capacity chosen by the store. The unobservable includes variation in inventory holding costs and other store costs that is not observed by the store but that will affect its total costs when it alters its contracts with studio s'. It could also include store prediction error regarding the prices for which the store will be able to sell used tapes or of the proportion of tapes that will break before they can be sold. Potential instruments might include demographic characteristics of the market or the store's zipcode; the number of stores in the market; store tier size or the number/percent of this studio's titles that are in box office class A.

The inequality method will lead to biased estimates if the ε term contains any variables that differ across contract types and are observed by the store. The most troubling of these is a difference in the restrictions placed by studios on stores' sales of used tapes. A title that is obtained on a LP contract will be sold at a price set by the store at the end of its rental life; the store retains 100% of the revenues from these sales. However, if the store obtains a title on a RS or FLF contract it has to purchase a larger number of tapes, implying fewer rentals per tape, and is required to pay a certain proportion of the revenues from used tape sales back to the studio. This proportion may vary between RS and FLF contracts. This variation in requirements will bias our results if it affects stores' contract choices. However, we do not accurately observe the contract-specific requirements and therefore cannot control for them in our estimation. It is reassuring to note that sales of used tapes make up a fairly low proportion of each store's revenues, especially for B and C titles[47].

In addition, the unobservable cannot include either econometrician measurement error or retailer prediction error in variables that affect demand or supply, or any effect of the heterogeneous outside option on the demand side that is not absorbed by the market fixed effects included there, because the nonlinearity introduced by the supply side quantity constraints implies that these unobservables will not be zeroed out when we take expectations conditional on the instruments.

Are there other possible endogeneity problems? We do not know of any other payments from store to studio or other store costs which are known to the store but which we do not observe in the data. It is possible that studios offer unobserved perks attached to choosing FLF contracts; however, these are likely to be minor items like free posters for the store windows and are therefore unlikely to influence contractual choices. Stores may have credit constraints with a particular supplier that affect their contract choices: Rentrak sells tapes under RS and FLF contracts but those under LP contracts are supplied by wholesalers, so if a store has credit problems with Rentrak it may be forced to choose a LP contract for all of its titles. The timing of stores' receipt of tapes could be important - for example, the choice of a FLF contract would be more attractive if the

[46] The only portfolio change occurs when a store takes a new FLF contract: it then takes all titles offered by the studio in the following year, which may imply taking on new titles. In that case we define unobserved quality of the new titles to be the minimum ξ_{jmt} in the store-box-genre-month group. [As a robustness test we use the 25th percentile.] If there are no other titles in this group we use the average in the store-box-month.

[47] A LP title might break even on rentals and then sell for perhaps \$8 per tape. RS and FLF titles are more profitable in terms of rentals but produce lower revenues for the retailer upon sale, perhaps \$2 per tape.

store received tapes sooner here than under LP/RS agreements. However, in reality all titles are shipped to stores on the release date, whatever the contract, and contract choices are made several months before this date. Similarly, we could be concerned about the endogeneity of $\bar{c}_{jm}$ and $\underline{c}_{jm}$, both of which are set by the studio on a title-by-title basis. Any unobservable that affects the store's choice of contract for title j may also affect the studio's choice of quantity restrictions. Many studios choose these quantity restrictions using a formula based only on the title's box office sales and the size of the store[48]. Studios are prevented from making deals with particular stores by the Robinson-Patman Act. Endogeneity here therefore seems unlikely.

7.3 Results

8 Counterfactual Analyses

- Consider the effects of FLF contracts on the number of titles offered, mix of studios, prices, consumer welfare, store and studio profits.
- Then note what we can conclude about the reasons why these contracts are offered at all.
- Can we uncover learning effects by comparing stores' willingness to take (newly-introduced) FLF contracts to their willingness to move between RS and LP contracts?

9 Discussion and Conclusion

[48] We observe this to be true for FLF; we surmise it works similarly for RS contracts.

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Table 1: Summary Statistics

Contract	Linear Pricing	Revenue Sharing	Full-Line Forcing	Sell-Through Priced
Avg Terms				
Upfront Fee	66.82	8.48	3.60	15.17
	(5.59)	(1.07)	(1.24)	(1.64)
Retailer's Share of Revenue	100%	45.95%	59.01%	100%
	(-)	(2.98%)	(2.00%)	(-)
Avg No. of Rentals				
Month 1:	49.58	67.46	52.13	91.01
	(78.47)	(100.7)	(88.39)	(125.5)
Month 2:	64.87	70.38	60.01	83.97
	(90.21)	(100.3)	(80.54)	(100.2)
Month 3:	38.87	35.40	32.39	39.22
	(51.57)	(49.06)	(44.18)	(46.38)
Month 4:	25.13	22.26	20.48	21.94
	(31.77)	(29.73)	(26.73)	(25.16)
Month 5+:	69.54	60.06	57.29	78.73
	(102.8)	(88.53)	(81.13)	(136.0)
Avg Rental Price				
Month 1:	2.67	2.69	2.71	2.71
	(0.61)	(0.52)	(0.63)	(0.58)
Month 2:	2.85	2.80	2.90	2.89
	(0.61)	(0.56)	(0.60)	(0.63)
Month 3:	2.85	2.80	2.89	2.96
	(0.66)	(0.60)	(0.67)	(0.75)
Month 4:	2.85	2.80	2.88	2.97
	(0.70)	(0.64)	(0.70)	(0.86)
Month 5+:	2.82	2.72	2.91	2.98
	(0.74)	(0.70)	(0.76)	(0.90)
Avg Rentals per Tape				
Month 1:	5.63	4.27	4.13	5.13
	(4.42)	(2.89)	(3.13)	(4.73)
Month 2:	7.73	4.78	5.38	5.20
	(4.92)	(3.22)	(3.71)	(3.74)
Month 3:	5.06	2.53	3.38	2.60
	(3.78)	(1.89)	(2.85)	(2.14)
Month 4:	3.56	1.66	2.45	1.61
	(2.94)	(1.33)	(2.41)	(1.66)
Month 5+:	13.52	5.04	7.28	6.82
	(14.32)	(5.07)	(9.00)	(8.84)
Avg Inventory	8.81	14.60	12.53	18.20
	(13.92)	(17.64)	(17.33)	(21.73)

Notes: Average contract terms, rentals, prices, inventories and store sizes for titles taken under each contract type. Averages are across store-title pairs. Standard deviations in parentheses. Data source: Rentrak Corporation, January 1, 1998 to June 30, 2002.

Table 2: Summary Statistics (Cont.)

Contract	Linear Pricing	Revenue Sharing	Full-Line Forcing	Sell-Through Priced
Total No. of Titles Offered by Studios				
Year 1:	219	150	0	27
A Titles:	30	24	0	15
B Titles:	36	25	0	6
C Titles:	153	101	0	6
Year 2:	195	143	10	24
A Titles:	32	30	1	14
B Titles:	40	36	2	6
C Titles:	123	77	7	4
Year 3:	221	173	18	21
A Titles:	41	39	4	15
B Titles:	43	39	3	1
C Titles:	137	95	11	5
Year 4:	195	122	39	26
A Titles:	33	20	9	16
B Titles:	49	23	5	3
C Titles:	113	79	25	7

Notes: Average number of titles offered by stores under each contract type. Titles may be counted in more than one column. The primary source of data summarized in this table is Rentrak Corporation. Data were gathered from January 1, 1998 to June 30, 2002.

Table 3: Summary Statistics (Cont.)

Contract	Linear Pricing	Revenue Sharing	Full-Line Forcing	Sell-Through Priced
Number of Stores				
	7107	6687	4896	6926
Avg No. of Titles Taken by Stores				
Year 1:	95.86	23.02	-	19.31
	(45.20)	(24.76)	-	(7.81)
A Titles:	19.23	4.88	-	11.58
	(7.70)	(3.58)	-	(4.45)
B Titles:	22.92	4.92	-	4.06
	(10.08)	(5.42)	-	(1.89)
C Titles:	53.71	13.21	-	3.68
	(30.18)	(16.95)	-	(2.00)
Year 2:	68.36	20.11	3.64	14.90
	(44.62)	(21.68)	(3.23)	(7.95)
A Titles:	14.25	7.01	0.37	8.82
	(8.86)	(6.13)	(0.48)	(4.41)
B Titles:	19.67	6.76	1.06	3.85
	(11.90)	(7.61)	(0.96)	(2.42)
C Titles:	34.43	6.34	2.21	2.24
	(25.95)	(9.28)	(2.22)	(1.61)
Year 3:	95.63	18.35	6.04	14.23
	(55.63)	(23.37)	(3.92)	(6.93)
A Titles:	23.05	7.30	1.53	11.09
	(12.38)	(7.31)	(1.01)	(5.31)
B Titles:	25.43	5.23	0.86	0.74
	(13.69)	(7.40)	(0.67)	(0.44)
C Titles:	47.15	5.82	3.65	2.40
	(31.88)	(9.96)	(2.69)	(1.49)
Year 4:	85.38	13.79	10.01	17.22
	(40.80)	(17.41)	(7.35)	(7.51
A Titles:	19.60	5.56	3.27	12.11
	(9.10)	(5.32)	(2.10)	(5.02)
B Titles:	32.07	3.54	0.97	2.06
	(13.77)	(5.27)	(0.99)	(1.30)
C Titles:	33.71	4.69	5.77	3.05
	(20.41)	(7.73)	(4.69)	(1.64)

Notes: Average number of titles of each contract type taken by stores in each year. Standard deviations in parentheses. The primary source of data summarized in this table is Rentrak Corporation. Data were gathered from January 1, 1998 to June 30, 2002.

Table 4: Summary Statistics (Cont.)

Contract		Linear Pricing	Revenue Sharing	Full-Line Forcing	Sell-Through Priced
Ave store tier					
Quintile 1		2.52	5.24	2.91	4.75
Quintile 2		3.07	4.94	4.18	4.64
Quintile 3		3.46	3.16	4.47	4.03
Quintile 4		4.83	3.01	4.01	2.91
Quintile 5		5.11	2.70	4.54	2.31
Quintile	% of quintile				
1	Tier 1-3	1.35	0.22	1.19	0.62
	Tier 7-10	0.20	1.13	0.24	1.50
2	Tier 1-3	1.13	0.50	0.63	0.48
	Tier 7-10	0.33	1.39	0.60	0.99
3	Tier 1-3	0.99	1.10	0.57	0.68
	Tier 7-10	0.50	0.38	0.93	0.43
4	Tier 1-3	0.38	1.16	0.79	1.17
	Tier 7-10	0.88	0.33	0.82	0.38
5	Tier 1-3	0.43	1.30	0.62	1.41
	Tier 7-10	1.56	0.42	1.06	0.09

Notes: Panel 1 breaks the percent of each store's titles adopted under a particular type of contract into quintiles and reports the average store size in each quintile. Tiers are ranked from 1 to 10 where 10 is largest. Panel 2 reports the percent of stores in each quintile of percent of titles adopted under a particular contract type that are in store sizes 1-3 and 7-10 respectively. These numbers are normalized by the percent of all stores that are in the relevant set of tiers. Numbers over 1 indicate that this type of store is over-represented in the relevant quintile for this contract type. The primary source of data summarized in this table is Rentrak Corporation. Data were gathered from January 1, 1998 to June 30, 2002.

Table 5: Competing Products and Full-line Forcing

	No. Non-FLF Titles Taken		No. Tapes per Non-FLF Title	
Naive	0.18	(0.01)	4.52	(0.12)
Add Store F.E.'s	0.09	(0.01)	0.75	(0.14)
No. Obs.	47,481			

Notes: Regression of the numbers of titles or tapes per title from non-FLF studios on an indicator for whether a retailer participated in the FLF contract of another studio in the same month. Data source: Rentrak Corporation, North East Region only. Standard errors reported in brackets.

Table 6: Demand Results

	OLS	IV 1	IV 2
	Coefft (S.E.)	Coefft (S.E.)	Coefft (S.E.)
Price	-.085 (.007)	-.086 (.008)	-.086 (.008)
Price/Income	1.672 (.269)	1.675 (.307)	1.737 (.312)
Month 2	.083 (.028)	.107 (.030)	.126 (.031)
Month 3	-.305 (.028)	-.354 (.030)	-.331 (.030)
Month 4	-.587 (.029)	-.678 (.031)	-.656 (.032)
Month 5+	-.002 (.029)	.076 (.031)	.105 (.031)
Inventory	.0146 (.0003)	.0162 (.0003)	.0158 (.0004)
Inv*Month 2	-.003 (.0004)	-.003 (.0004)	-.004 (.0004)
Inv*Month 3	-.006 (.0004)	-.006 (.0004)	-.008 (.0004)
Inv*Month 4	-.009 (.0004)	-.010 (.0004)	-.011 (.0004)
Inv*Month 5	-.009 (.0004)	-.010 (.0004)	-.012 (.0004)
σ	.662 (.002)	.544 (.003)	.545 (.003)
N	366429	366429	366429
R^2	0.83	0.78	0.78

Notes: Results of nested logit demand analysis. IV1 instruments for the within-group share only. IV2 instruments for both within-group share and inventory. All specifications include title and store fixed effects, interactions between title fixed effects and store characteristics (the percent in the market with kids, the percent single and the percent white) and interactions between month fixed effects and title characteristics (the box office group, genre, rating and interactions of these variables).

Table 7: Demand Results: Second Stage Regressions

	OLS Coefft (S.E.)	IV 1 Coefft (S.E.)	IV 2 Coefft (S.E.)
Release date:			
Quarter 2	0.065 (0.005)	0.068 (0.005)	0.064 (0.005)
Quarter 3	-0.008 (0.005)	-0.007 (0.005)	-0.009 (0.005)
Quarter 4	0.010 (0.005)	0.001 (0.005)	0.001 (0.005)
Box Office:			
B	-0.954 (0.054)	-0.886 (0.054)	-0.891 (0.056)
C	-1.555 (0.047)	-1.475 (0.048)	-1.483 (0.049)
Genre:			
Child/Family	-0.551 (0.063)	-0.400 (0.065)	-0.407 (0.074)
Comedy	0.295 (0.059)	0.382 (0.060)	0.378 (0.060)
Drama	-0.077 (0.030)	-0.019 (0.031)	-0.020 (0.031)
Horror/Suspense	-0.003 (0.041)	0.012 (0.043)	0.011 (0.043)
Romance	-0.539 (0.059)	-0.405 (0.061)	-0.407 (0.062)
Science Fiction	-0.907 (0.076)	-0.751 (0.077)	-0.749 (0.072)
Rating:			
PG	-0.047 (0.040)	-0.004 (0.041)	-0.003 (0.042)
PG13	0.132 (0.066)	0.234 (0.068)	0.234 (0.068)
R, NC17, NR	0.075 (0.075)	0.169 (0.077)	0.168 (0.077)
Market characteristics:			
Median age	-0.010 (0.001)	-0.010 (0.001)	-0.010 (0.001)
Median income	0.006 (0.0004)	0.005 (0.0004)	0.005 (0.0004)
Number of households	-2.6e-5 (5e-7)	2.7e-5 (5e-7)	–2.5e-5 (5e-7)
Percent white	0.018 (0.0004)	0.018 (0.0004)	0.018 (0.0004)
Percent black	-0.007 (0.001)	-0.007 (0.001)	-0.007 (0.001)
Percent female	-0.117 (0.003)	-0.117 (0.003)	-0.116 (0.003)
Percent single mother with kids	0.051 (0.002)	0.048 (0.002)	0.052 (0.002)
Percent single father with kids	0.121 (0.005)	0.119 (0.005)	0.119 (0.005)
Percent single male	-0.199 (0.008)	-0.201 (0.008)	-0.202 (0.009)
Percent single female	-0.077 (0.006)	-0.074 (0.006)	-0.080 (0.006)
Percent married with kids	-0.044 (0.001)	-0.044 (0.001)	-0.044 (0.001)
Percent with Bachelor's	0.016 (0.0002)	0.016 (0.0005)	0.016 (0.0005)
Blockbuster in market	0.499 (0.005)	0.500 (0.005)	0.492 (0.005)
Percent rural	0.012 (0.0002)	0.012 (0.0002)	0.012 (0.0002)
Percent suburban	0.012 (0.0001)	0.012 (0.0002)	0.012 (0.0002)
N	366429	366429	366429
R^2	0.49	0.47	0.46

Notes: Regression of estimated quality (including title fixed effect-store characteristic interactions, store fixed effects and all decay rate interactions) from nested logit on title and store characteristics. IV1 instruments for the within-group share only. IV2 instruments for both within-group share and inventory. Omitted category for Box is A; for Genre is Action/Adventure; for Rating is G. All specifications include interactions between title and store characteristics and between month fixed effects and title characteristics.