Relational Adaptation under Reel Authority

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Abstract

We study ongoing relationships in which parties must repeatedly tailor decisions to the state of the world, but typically have different preferred decisions. Our theoretical analysis shows how *relational adaptation* (i.e., self-enforcing agreements that facilitate efficient adaptation), combined with formal contracting, induces state-dependent decision-making that improves upon the expected payoffs under either formal contracting or relational contracting alone. Our empirical analysis focuses on formal revenue-sharing contracts between movie distributors and exhibitors that allow the exhibitor wide leeway about whether to show the movie and in what time slots. These formal contracts are often informally renegotiated *after* the movie has finished its run—i.e., long after any adaptation decisions have been taken by the exhibitor. Our empirical setting is attractive because we observe: (i) the formal revenue-sharing contract terms; (ii) informal renegotiations of the formal contract terms that occur after all decisions have been made; and (iii) proxies for both the state of the world (potential revenues from alternative movies competing for the same time slots) and the adaptation decisions (what movies were actually shown, and whether on dedicated or shared screens). Our theoretical and empirical results suggest that formal contracts can be the foundation for informal relationships that achieve efficient adaptation in fluctuating environments.

Key words: adaptation, renegotiation, relational contracts, revenue sharing, movie contracts.

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1. Introduction

Adaptation to changing circumstances is a fundamental goal of economic systems. This issue was explored long ago in celebrated work on contingent claims and rational expectations in competitive markets—e.g., Arrow (1953) and Grossman (1981)—but surfaces as importantly in managed settings. For example, Barnard (1938: 6) argued that "The survival of an organization depends upon the maintenance of an equilibrium of complex character in a continuously fluctuating environment." And Williamson (1991: 278) went further, addressing not only activities within organizations but also managed relationships between firms, concluding that "adaptability is the central problem of economic organizations."

Although Arrow and Grossman show that competitive markets might achieve efficient adaptation, decades of work—from Barnard to Williamson and beyond—on managed adaptation within and between firms emphasizes the opposite possibility. Williamson (2000: 605) summarized the literature with: "maladaptation in the contract execution interval is the principal source of inefficiency." In response to this inefficiency, Williamson (1975: 107) followed Simon (1951) and Macaulay (1963) by arguing that "incomplete contracting with informal enforcement" can play an important role in ameliorating maladaptation, again in managed relationships both within and between firms.

Yet, the fact that parties utilize "informal enforcement" does not mean that they will eschew formal contracts. To the contrary, Klein (2000: 68) argued that "transactors are not indifferent regarding the [formal] contract terms they choose to govern their self-enforcing relationships." More specifically, parties often sign formal contracts that both limit their temptations to renege on informal understandings in some states of the world and exacerbate these temptations in other states; see Klein and Murphy (1988) and Klein (1996, 1999) for examples.

This paper studies ongoing relationships in which parties must repeatedly tailor decisions to the state of the world, but typically have different preferred decisions. In our theoretical setting, we show how formal contracting combined with *relational adaptation* (i.e., self-enforcing agreements designed to facilitate efficient adaptation) can induce state-dependent decision-making that improves upon the expected payoffs under formal contracting or relational contracting alone. In our empirical setting, we observe (i) the formal contract; (ii) informal renegotiations of the formal contract that occur after all decisions have been made; and (iii) proxies for the state of the world and the adaptation decisions. Together, our theoretical and empirical results suggest that formal contracts can be the foundation for informal relationships that achieve efficient adaptation in fluctuating environments.

To analyze how firms use both formal and self-enforcing agreements to adapt to changes in their environment, we exploit an attractive empirical setting: revenue-sharing contracts between distributors and an exhibitor in the movie industry. When the distributor (for our purposes, the owner of the movie) and the exhibitor (in our setting, the owner of multiple theaters) are separate firms, they often sign a formal contract to share the box-office revenues generated by the movie. These formal contracts are usually signed well before the movie's release, so they specify the weekly sharing rates if the movie is shown, but they do not require the exhibitor to show the movie in any given week, nor do they dictate how many times a day, in what time slots, on what screens, or against what other movies the movie may be shown. Therefore, once the movie (or, since there may be multiple copies of the same movie, the "reel") arrives at a theater, the *reel authority* rests with the exhibitor, not with the distributor.[1]

Because the formal revenue-sharing contracts are signed well before the movie's release, many factors that may influence how the parties would like the exhibitor to exercise its authority are uncertain when the contract is signed, but will be resolved during the life of the contract. For example, the movie in question may under-perform, while another movie arriving later may over-perform, creating an opportunity cost for the exhibitor: she may prefer to show the movie in question fewer times per day, or in less favorable time slots, or not at all. At the same time, the distributor may prefer that the movie in question be shown on

[1] See Hanssen (2002), Filson et al. (2005), and Gil and Lafontaine (2012).

a superior screen and in many time slots—not just for the revenue thus generated, but also for merchandizing and other benefits that accrue to the distributor, and for the competitive benefits from displacing other distributors' movies.

Given the large number of both uncertainties and decisions that may become relevant in a given week, it may not be surprising that formal revenue-sharing contracts signed well before the movie's release often are renegotiated. What is striking, however, is that this renegotiation occurs *after* the movie has finished its run, weeks after the exhibitor has taken any adaptation decisions—such as foregoing the temptation to show the movie in question on a worse screen or in fewer time slots.[2] The renegotiation is therefore *not* a simultaneous quid pro quo—such as an exhibitor agreeing to show the movie in question on its original screen and in its original time slots, in exchange for an immediate payment from the distributor. Rather, Caves (2002: 167) interprets such ex post renegotiations as reflecting "the balancing of equities over time that commonly occurs between partners in repeated transactions." More abstractly, the renegotiation is an informal (i.e., "relational") payment that may be linked to the earlier adaptation decisions.[3]

We conclude this Introduction with an overview of the paper and then a review of related literatures. Section 2 then describes the institutional setting, Section 3 develops a simple relational-contract model, and Section 4 tests for relational adaptation in the data. Section 5 concludes.

1.1 Overview

We explore relational renegotiations using weekly data on contract terms and box-office outcomes from 26 movie theaters in Spain. Specifically, we combine Gil's (2013) data on contracted and renegotiated revenue shares with new screen-by-screen box-office data during 18 months between January 2001 and July 2002. These combined datasets allow us to

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[2] For example, Squire (1992: 343) quotes Loews Theater chairman Alan Friedberg: "The real dance goes on once box-office figures are a matter of record . . . reasons generally related to expenses are offered on both sides—sometimes leading to acrimonious debate—as to why one party should ultimately receive a greater share than the original deal would allow. In the end, agreement is reached and payment is made." See also Filson et al. (2005) and Cones (1997) for the US and Gil (2013) for Spain.

[3] Cones (1997), Chapter 5 (especially pp. 42-51) provides substantial anecdotal evidence that these "clandestine transactions" occur weeks or months after the theater engagement has been completed, and would likely "not hold up in court if challenged" by other gross and net profit participants such as producers or actors (but that such challenges are rare).

analyze both richer dependent variables and richer independent variables than in previous work. For example, our dependent variables include two types of continuation decisions: not only the decision to show a reel for an additional week, but also the decision to show the reel as the only movie showing on a given screen (hereafter, a "dedicated" screen) versus as one of two or more movies showing on that screen (hereafter, a "shared" screen). Furthermore, our data allow us to develop proxies for exhibitor opportunity costs: reels available to the exhibitor that could be shown instead of, or on a screen shared with, the movie in question.

In our data, ex post renegotiations (if they exist) always favor the exhibitor: that is, the distributor gives the exhibitor a larger share of the box office revenues than specified under the formal contract—a renegotiation we henceforth call a "discount." We document that both formal contracts and relational discounts vary for the same movie across theaters and weeks, as well as across movies within a single theater-week.

We motivate our empirical analysis of relational renegotiation in distribution contracts by developing a simple model, where a single distributor and a single exhibitor sign a formal revenue-sharing contract before the movie has been released, when there is uncertainty about the exhibitor's opportunity cost (e.g., the box-office revenues of an alternative movie). We demonstrate that relational renegotiation of formal sharing rates may achieve efficient adaptation: ex post discounts reward the exhibitor for showing the distributor's movie more than would have been induced by the formal contract alone. Applying established results from multi-unit auctions to our setting implies that, to achieve efficient adaptation, the ex post discounts should be positively related to opportunity cost—measured by the highest anticipated box-office revenues of (a) reels from the prior week that could have been shown, but were not, and (b) reels shown on shared screens that could have been shown on dedicated screens, but were not.

While stylized, our model suggests three predictions. First, renegotiation should occur more frequently, and the resulting discounts should be larger, when the exhibitor's opportunity cost of showing the reel is larger. This opportunity cost includes the revenues that the exhibitor would have earned either by dropping the reel in favor of another or by reducing the number of times that the reel is shown in order to show another more frequently. Second, these discounts should induce the exhibitor to continue reels that she would otherwise drop, or continue a reel on a dedicated screen that she would otherwise have assigned to a shared screen. Third, distributors who have stronger relationships with the exhibitor should pay larger discounts, and the exhibitor should be more willing to continue showing those distributors' movies even when the opportunity costs are large.

We test these hypotheses and find empirical support for all three. In these tests, we control for potential differences across theaters using theater fixed effects, and for distributor- or movie-specific factors affecting renegotiations across all theaters in a given week using reel-week fixed effects.[4] Consistent with our first hypothesis, we find that both the incidence and magnitude of the relational discounts for continued reels are positively and significantly related to our proxies for exhibitor opportunity costs. Consistent with our second hypothesis, we find that these discounts affect continuation decisions: the exhibitor's decision to continue a reel when faced with high opportunity costs is correlated with larger and more frequent discounts after the reel-run is completed. Finally, consistent with our third hypothesis, we find reels with high opportunity cost are more likely to be continued when they come from distributors with a history of providing discounts on such reels.

1.2 Literature

This paper contributes to several literatures. First, we join the empirical literature on *contract renegotiation*. Goldberg and Erickson (1987) provided early evidence of price and quality renegotiation in the context of long-term contracts for petroleum coke. More recently, Benmelech and Bergman (2008) find that US airlines are able to renegotiate their lease obligations when their financial position is poor and the liquidation value of their fleet is low because the low liquidation value causes the lessors to accept renegotiation rather than repossess the aircraft. Similarly, Cai, Li, and Zhou (2010) study renegotiation of incentive contracts in the Chinese banking industry and show that, despite ex post renegotiation, formal incentive contracts affect worker effort. Compared to these recent empirical papers, in our setting renegotiation is a unilateral transfer from the distributor to the exhibitor that occurs after all decisions about the movie have been taken, not as a simultaneous quid pro

[4] Theaters often show the same movie on multiple screens, which requires separate agreements for each reel. In our data, we define the reel with the highest box-office revenues to be the "first reel," the reel with the second-highest revenues the "second reel," and so on. Our estimates with reel-week fixed effects thus compare the n^{th} reel of a given movie in one theater to the n^{th} reel of the same movie in other theaters during the same week.

quo: the distributor would be unwilling to reduce its revenue share if there were not a valuable future relationship with the exhibitor.

Second, we join the theoretical literature on contract renegotiation. Hart and Moore (1988) consider a static model in which parties renegotiate in response to new information. In their setting (unlike ours), renegotiation is enforced by courts and the renegotiated decision is always efficient, though renegotiation may lead to inefficient *ex ante* investments. Aghion, Dewatripont, and Rey (1994) show that, in the Hart-Moore setting, players who can commit to a protocol for renegotiating contracts can induce both efficient investments and efficient decisions. Their paper is further from our setting than Hart-Moore is, because now players use courts to enforce not just the renegotiated contract (as in Hart-Moore) but also the protocol for such renegotation, whereas in our setting renegotiations are unilateral concessions and courts play neither of these roles. Put differently, both of these papers focus on incentives for *ex ante* effort, whereas we consider potential *ex post* inefficiencies that arise because promises are backed by a relational rather than formal contract. Finally, Hart and Moore (2008) is closer to our paper, because they consider *ex post* inefficiencies—either from failing to trade when trade would be efficient, or from "shading" when a party is "aggrieved" by transaction terms that fall short of the party's "reference point." In this Hart-Moore paper, renegotiation reduces the first source of inefficiency (from failing to trade) but may exacerbate the second (from shading). This Hart-Moore paper differs from our setting because they have shading following (indeed, induced by) renegotiation, whereas in our setting renegotiation occurs *after* the movie has finished its run, weeks after the exhibitor has taken the decisions that would correspond to shading.

Third, we connect with theory and evidence on why long-term contracts may optimally be incomplete: to facilitate *adaptation* (possibly without renegotiating the formal contract). For example, see Masten and Crocker (1985) and Crocker and Masten (1988, 1991), who study natural gas, and Crocker and Reynolds (1993), who study defense procurement.[5] Our paper emphasizes the distributor's valuable future relationship with the exhibitor, whereas the formal models in these papers analyze adaptation in one-shot transactions such as take-or-pay contracts.

[5] For additional work emphasizing adaptation, see Poppo and Zenger (2002) on information services, Mukherji and Francis (2008) on automotive supply chains, and Forbes and Lederman (2009) on airlines.

Fourth, our paper relates to the literature on *relational contracting* and the interplay between relational and formal contracts. Macaulay (1963) and Macneil (1978) are early contributions to this literature from sociology and law, respectively. In economics, Bull (1987), MacLeod and Malcomson (1989), and Levin (2003) established the theoretical literature on relational contracting; Baker, Gibbons, and Murphy (1994) did likewise for the interplay between formal and relational contracting; and McMillan and Woodruff (1999) provided early empirical work. See Malcomson (2013) and Gil and Zanarone (2015) for surveys of theory and evidence, respectively.

Fifth, our paper contributes to a nascent empirical literature that explores the *decisions* that relational contracts induce. For example, Macchiavello and Morjaria (2015) use a single, unanticipated shock as a source of variation for the actions flower growers and buyers take; in contrast, we use frequent variation in opportunity costs, so we observe (for a fixed distributor-exhibitor pair) variation in not only relational payments but also the decisions induced by these payments across a wide set of theaters, movies, and weeks.

Sixth, we join those studying formal *distributor-exhibitor contracts* in the movie industry, especially the ex post renegotiation of these contracts. Regarding formal contracts, Hanssen (2002) studies the transition from flat-fee to revenue-sharing contracts in movies due to the introduction of sound, and Raut et al. (1998) argue that revenue-sharing contracts may deliver superior performance at cheaper administrative cost.[6] More recently, three papers offer different explanations for the choice of revenue-sharing formal contracts, and all explore ex post renegotiations of these contracts: Filson, Switzer, and Besocke (2005) interpret two-sided ex-post renegotiation of formal revenue-sharing terms as achieving ex post settling up; Gil and Lafontaine (2012) argue that formal revenue-sharing contracts help achieve state-dependent pricing, thereby reducing the need for and expected cost of renegotiation; and Gil (2013) views ex post renegotiations as ex post settling up for movies that do worse than expected. Our paper joins these three in exploring the use of revenue-sharing contracts and ex post renegotiation. Building on these papers, we then develop and exploit additional data and theory regarding both the exhibitor's opportunity cost and the

[6] Dana and Spier (2001), Cachon and Lariviere (2005) and Mortimer (2008) study formal revenue-sharing contracts in the video retail industry and show that revenue-sharing contracts are valuable when demand is uncertain. They do not explore ex post renegotiation in distribution contracts to video stores.

exhibitor's exercise of reel authority (e.g., moving a reel from a dedicated to a shared screen).

Finally, there is work studying an exhibitor's exercise of *reel authority*. For example, Swami, Eliashberg, and Weinberg (1999) study the optimal allocation of movies to screens, proposing an algorithm to help exhibitors make "effective and timely decisions regarding theater screens management." They compare the results of their algorithm to practice and argue that their algorithm can lead to a 40% improvement in exhibitor profits. The results we borrow from multi-unit auction theory are a complementary approach to this problem: the auction can be seen as decentralizing the allocation decisions to the bids of the distributors, rather than centralizing them via the algorithm of the exhibitor.

2 Exhibitor-Distributor Contracts in Spain

2.1 Institutional Background

Our empirical analysis is based on distributor-exhibitor contracts from a large exhibitor owning movie theaters throughout Spain. Although the eventual contracts between distributors and exhibitors in this market are simple—defined as a share of the box-office revenues to be paid to the distributor—Gil (2013) documents that the negotiation process leading to this simple contract can be complex and begins months before the movie is released.[7]

The first step in this negotiation process occurs months prior to the determination of a release date for a movie, when a distributor and an exhibitor reach an agreement on the total number of copies (or "reels") per movie that the exhibitor will show in all theaters owned by that exhibitor. Since the release week of the movie is not yet determined, distributors and exhibitors do not yet formally agree on which theaters will show what movies or on the number of reels per movie in each theater. Second, once the release date is determined, the distributors and exhibitors negotiate which specific theaters will screen each reel. Third,

[7] Filson, Switzer, and Besocke (2005) analyze distributor-exhibitor contracts from a U.S. movie exhibitor owning 13 theaters in the St. Louis area. Consistent with our Spanish data, Filson, et al. show that contracts typically include a sliding scale of distributor sharing rates that decline with the age of the movie. However, they also document that their contracts are sometimes piece-wise linear, where the exhibitor receives a higher share (e.g., 90%) after exceeding some weekly box-office threshold; this alternative payment mechanism appears to be relevant primarily for blockbusters early in their run. This alternative payment mechanism does not exist in our data.

sometime between a month and a week before the release date, the revenue-sharing rate is negotiated for each theater, reel, and week, and the parties sign a formal contract specifying these rates. The contract is thus signed before the release date but specifies sharing rates sometimes for eight or more weeks after the release date, so there is substantial uncertainty when the contract is signed about what revenues might be available from showing alternative movies many weeks after this movie is released. Renegotiation then occurs (long) after uncertainty has been resolved.

To illustrate these features of our data, Figure 1 provides the evolution of formal and relational (i.e., renegotiated) sharing rates for two theaters showing the John Nash biopic, "A Beautiful Mind" (or, "Una Mente Maravillosa" in Spain), released in Spain on February 22, 2002 (nine weeks after its release in the United States). The figure shows that—for this particular movie in these two theaters—the distributor's average formal share decreased over the movie's run, and the likelihood and size of the exhibitor's negotiated discount increased. In particular, the formal sharing rate for the distributor decreased by 5% every two weeks, from 60% in week 1 to 40% by week 10. The movie played for 7 weeks in Theater 5 and for 10 weeks in Theater 20.[8] Theater 5 started receiving negotiated discounts from the formal sharing rate in week 2; discounts ranged from 5% in week 2 to 15% in week 7. Theater 20 received no discounts in the first seven weeks before receiving discounts of 5% and 10% in weeks eight and nine, respectively.

Table 1 illustrates two continuation decisions—whether to continue showing a particular reel in a particular theater for an additional week and, if so, whether to show the reel on a dedicated or a shared screen—for the 22 theaters in our sample showing "A Beautiful Mind" between February 22 and April 19, 2002.[9] The first row shows the distributor's formal sharing rate for the first nine weeks, which decline over time and (for this particular movie) were the same across all theaters in a given week.[10] The remaining rows report the negotiated discounts (if any) for the weeks the movie was shown in a given theater.

8 Theater names are concealed to preserve confidentiality.

9 In cases where the theater showed the movie on multiple screens (i.e., had multiple reels), the discounts in the table are those associated with the "first reel" (which we define as the reel with the highest box-office revenues).

10 In our data, approximately 75% of 1,085 movie weeks (for the highest-revenue reel of each movie) have the same formal contracted share across theaters; in 25% of movie weeks the contracted share varies across theaters during the same week.

Discounts in **bold** indicate theater-weeks in which "A Beautiful Mind" shared a screen with at least one other movie during a prime-time slot (i.e., excluding matinees and late-night showings). Table entries of "n/c" (for "no contract") reflect cases where the movie's run extended beyond its original formal.

From Table 1, one theater stopped showing "A Beautiful Mind" after six weeks, eight after seven weeks, three after eight weeks, and ten after nine or more weeks. All 22 theaters dedicated a single screen to the movie over its first four weeks; by the fifth week, 9 of the 22 theaters added another movie to the same screen. The table shows that, for the case of this particular movie: (1) discounts vary across theaters during a given week; (2) discounts are more likely (and are typically higher) later in the run; (3) screen sharing is more likely later in the run and is often (but not always) associated with discounts. These three stylized facts are not specific to "A Beautiful Mind;" rather, they are broadly representative of the movies in our sample.

2.2 An Overview of Relational Renegotiation and Adaptation

While the formal contract specifies the distributor's revenue share in the event the reel is shown, decision rights over whether to show the movie, or how often and in what time slots, are retained by the exhibitor. In our theoretical and empirical analysis, we consider two types of exhibitor continuation decisions. The first is whether to continue showing a particular reel in a particular theater in a prime-time slot for an additional week (also during prime time).[11] The second is whether to show a particular reel during all the prime-time slots on a given screen, or to share prime-time slots on that screen with another movie.[12]

There is a fundamental conflict of interest between the distributor and the exhibitor with respect to both kinds of continuation decisions—dropping a movie entirely, or moving it from a dedicated to a shared screen. Once a reel is produced and sent to a theater, the distributor's opportunity cost of an additional screening at that theater is negligible and the distributor will therefore prefer the reel to be shown in as many time slots as possible

[11] As discussed in Section 4.1 below, we proxy for "prime-time slot" by excluding theater-reel-weeks with fewer than 100 weekly attendees.

[12] The exhibitor also has other continuation decisions that we do not analyze, such as showing a movie in a screen with more seats or fewer seats, showing a 3-D vs. 2-D version of the movie, showing the movie on alternate days, moving a movie in a prime-time slot to a matinee or after midnight, and so on.

(assuming that the marginal box-office or merchandizing revenue for each additional screening is strictly positive).[13] On the other hand, the exhibitor's opportunity cost of showing the reel on a given screen in a given time slot equals the exhibitor's profit from the best alternative reel that could be shown instead, which will be strictly positive as long as the exhibitor has fewer screens than available reels. Therefore, an exhibitor facing high opportunity cost will be tempted to discontinue the distributor's reel or to show it in fewer or worse time slots than those preferred by the distributor.

Box office revenues for most movies will decline over the course of a movie's run, so the fact that the distributor's formal share of box-office revenue falls (and the exhibitor's contracted share rises) during the run provides the exhibitor with incentives to continue showing movies as they age (and continue showing them in multiple time slots). However, since the formal contract is signed before the movie is released and before the success of the movie or the exhibitor's opportunity cost is known, there will be situations where it would be efficient for the exhibitor to continue showing the distributor's movie, but the exhibitor is not willing to do so based on only the formal contract. More specifically, new information affecting the efficient continuation decisions—such as unanticipated box office revenues, new releases that might perform better or worse than expected, and so on—emerges continuously during the run of a movie. We hypothesize that the role of the observed ex post renegotiations is to facilitate efficient adaptation as uncertainty is resolved: the anticipation of a future discount provides incentives for the exhibitor to incorporate new information in its current continuation decisions.

If the observed renegotiations occurred on a weekly basis, at the time the exhibitor decided which reels to show on which screens and in which time slots, one might interpret the renegotiations as a simultaneous (and likely contractible) quid pro quo—such as the exhibitor agreeing to continue showing the movie in question in exchange for an immediate payment (i.e., discount) from the distributor. However, the renegotiations we observe occur

[13] The distributor might also prefer that the reel be transferred to a theater with higher expected revenues from additional screenings. However, with the exception of some "limited release" movies (i.e., movies shown in selected theaters in advance of a national release), there is typically an excess supply of reels after the initial release week (as theaters begin discontinuing the reel), so the distributor's opportunity cost of an additional screening in any particular theater is essentially zero.

weeks after the end of the reel's run, so the exhibitor's continuation decisions are not tied to contemporaneous payments.

Given that renegotiations occur long after the exhibitor's continuation decisions, one might interpret the renegotiations as ex post settling up of financial terms. That is, suppose that the parties write and implement an enforceable contract specifying the exhibitor's continuation decisions as a function of variables observed during the reel's run, but the parties allow the financial terms (as opposed to the continuation decisions) to depend on variables not observed until after the reel's run. This interpretation is consistent with the setting we have described thus far, but we later present two kinds of evidence against this interpretation: first, the exhibitor's continuation decisions depend on many of the same variables associated with renegotiation of financial terms ex post (Table 6); and second, the exhibitor's continuation decisions during a reel's run are associated with renegotiated financial terms after the reel's run (Table 7).

To the extent that the exhibitor's continuation decisions during the reel's run are affected by *anticipated* non-contractual discounts granted by the distributor after the reel's run, the parties may be using a relational contract to provide incentives for continuation decisions. One might then conjecture that some distributors have stronger relationships with the exhibitor than other distributors have, producing distributor-specific relationships between continuation decisions during the run and renegotiated terms after the run. We provide such evidence below (Table 8).

3. A Simple Model

This section begins by developing a simple model of formal and relational contracting between an exhibitor and a distributor. At the time of formal contracting for a given movie, there is uncertainty about the exhibitor's opportunity cost of showing that movie (i.e., uncertainty about the revenues the exhibitor could earn by showing a movie from an unmodeled second distributor). After formal contracting for the given movie, but before the exhibitor decides whether to show that movie, the distributor takes a costly, observable, non-contractible action that affects the revenue generated if the exhibitor shows that movie. (The distributor's action can be interpreted as advertising for the movie, or as refraining from also selling the movie to an unmodeled second exhibitor in the same market.) After uncertainty for the given movie is resolved, the exhibitor decides whether to show that movie, and first-best adaptation then means that the exhibitor shows the movie if and only if her revenue exceeds its opportunity cost.

The distributor has an ongoing sequence of movies that the exhibitor may show, one in each period. If the parties are sufficiently patient, they can achieve first-best adaptation without any formal contract, using relational payments from the distributor to the exhibitor if the exhibitor takes first-best decisions. We therefore focus on relational contracts if players have intermediate patience. The optimal contract combines formal and relational contracting: *after* a given movie has finished its run, the parties may renegotiate the formal contract so that the exhibitor earns a "discount" relative to the formal terms. This discount compensates the exhibitor for showing the distributor's movie more than would have been induced by the formal contract alone, and thereby induces the exhibitor to continue some movies that she would have instead dropped due to a high opportunity cost. The distributor can pay smaller relational discounts if she offers a generous formal contract, but in that case she is more tempted to engage in privately beneficial actions that undermine total box-office revenue.

Our relational-contracting model in Section 3.1 considers only a single distributor and assumes that the exhibitor's opportunity cost is exogenous. In Section 3.2 we consider how competition among multiple distributors determines the exhibitor's opportunity cost of showing a given distributor's movie. This discussion borrows established results about multi-unit auctions to consider the exhibitor's decisions over multiple screens and multiple time slots: for a particular theater, given all the movies it might show (and their anticipated box-office revenues), what is the efficient allocation of movies to screens and time slots, and what prices induce this allocation?

In principle, one could imagine a full model with multiple distributors, analyzing how formal and relational contracts interact to determine the allocation of movies to screens and time slots. We do not attempt this task here. Instead, we take from our one-distributor model an understanding of why the parties might write a formal contract ex ante, only to renegotiate it after the movie has finished its run, and we then borrow results about multi-unit auctions to understand what pricing (via formal contracting ex ante, followed by relational renegotiation ex post) would induce the efficient allocation of movies to screens and time slots.

3.1. Relational Adaptation Supported by Formal Contracting

We consider a repeated game between two players: an exhibitor (E) and a distributor (D), each with discount rate *r*. The distributor has a movie that would produce box-office revenue v if shown by the exhibitor. The timing of the stage game is: (1) D offers a formal (i.e., court-enforceable) revenue-sharing contract that consists of a salary $s \in \mathbb{R}$ and a sharing rate $\beta \in [0,1]$, meaning the exhibitor earns fraction β of the movie's realized box office; (2) D publicly chooses $a \in \{0,1\}$, where a is observable but not contractible and $a = 0$ generates a private benefit to the distributor of $K > 0$; (3) E's outside option, $x \in \mathbb{R}_+$, is publicly drawn from distribution $F(x)$ with density $f(x)$; (4) E chooses either to show D's movie (d = 1) or to take her outside option (d = 0); and (5) D can pay E or vice-versa, with $b \in \mathbb{R}$ denoting the net payment to E.

Payoffs are $ad(1-\beta)v + (1-a)K - s - b$ for the distributor and $ad\beta v + (1-d)x + s + b$ to the exhibitor. Note that the movie has no box-office revenue if either (i) the exhibitor does not show it ($d = 0$) or (ii) the distributor does not take the costly action ($a = 0$). The former is immediate; think of the latter as a simple model of either lack of marketing effort by the distributor or the distributor's decision to show another reel of this movie at an (unmodeled) exhibitor close to the (modeled) exhibitor. Assuming that $E[\max\{v, x\}] > E[x] + K$, the first-best decision rule, maximizing $(1\text{-}d)x + dav$, is $a = 1$ in each period, with d = 1 if and only if $x \leq v$.[14]

The goal of this model is to understand why the parties might write a formal contract ex ante, only to renegotiate it after the movie has finished its run. Several potential enrichments might add realism but are unlikely to overturn this message. First, the exhibitor actually has many decisions besides whether to show a movie—such as how often, at what times, on which screen, with what alternative movies showing on other screens at the same

[14] Without the formal contract (β) and the distributor's moral hazard (*a*), this static model would be an elemental "adaptation" model. See Gibbons (2005) on how Simon (1951) and Williamson (1971) launched this approach. See Baker, Gibbons, and Murphy (2011) for a repeated-game model of relational adaptation where the parties can choose the allocation of formal decision rights (but not a formal contract) to help enforce their relational contract.

times, and so on. Second, the movie's box-office revenue is of course both uncertain and a richer function of both the exhibitor's and distributor's actions than is reflected in the binary decisions d and a. Third, both parties may have payoffs beyond their share of the movie's revenues—such as from concessions for the exhibitor and merchandising for the distributor.

Other potential enrichments to the model could threaten our intended lesson from the model and hence need to be discussed. First, the timing above assumes that neither x nor d is contractible. In reality, both x and d probably are contractible, but at a cost. If d were contractible but x not, then some aspects of the optimal formal contract might change, but relational contracts would still be necessary to achieve efficient adaptation. However, if x were contractible, then formal revenue-sharing could depend on x; for example, the sharing rule $\beta(x) = \frac{x}{v}$ would exactly compensate the distributor for her realized opportunity cost, which would induce efficient adaptation while preserving the distributor's incentive to choose $a = 1$, without any need for relational contracting. However, this argument imagines x to be *costlessly* contractible; at the other extreme, our results hold unaltered if it is feasible but extremely costly to write a contract that is contingent on x. For intermediate costs of contracting on x, the spirit of our results holds (see Appendix 2): the parties use relational discounts to avoid the cost of contracting on x; instead, they write a non-contingent formal contract ex ante (i.e., β independent of x) and renegotiate it ex post to achieve efficient adaptation, just as in our simple model.

Turning from interpretation to analysis, in the one-shot version of this repeated game, the equilibrium is simple. Neither party will make a payment other than $b = 0$, so the exhibitor will show the movie if and only if doing so is more profitable than taking her outside option, $\beta a v \geq x$. First-best adaptation requires $\beta = 1$, in which case the distributor would choose $a = 0$. Therefore, either $a = 0$ or the distributor's optimal formal contract in the one-shot game is $\beta^{OS} < 1$. The latter holds if and only if there exists a $\beta \in [0,1]$ such that

$$\int_0^{\beta v} (1-\beta) v f(x) dx \geq K,$$

in which case the equilibrium share β^{OS} equals the largest β that satisfies this inequality. The up-front payment in the one-shot game s will then hold the exhibitor to her outside option, $E^{OS} \equiv E[x]$, while the distributor will earn surplus $D^{OS} = \int_0^{\beta^{OS}v}(v - x)f(x)dx - K$.

We now turn to the repeated game. First-best is unattainable in the one-shot game, so relational contracting can improve efficiency in the repeated game. Specifically, if a relational contract can deliver appropriate payments conditional on *x* and *d*, it can improve efficiency by inducing the exhibitor to show the movie for at least some *x* satisfying $\beta v < x < v$. Consistent with our empirical setting, such payments ($b > 0$) are provided after the exhibitor chooses d.

Given that players have deep pockets and actions are observable, we focus on optimal stationary contracts (i.e., on the equilibrium path, players choose the same actions each period), which are optimal by an argument adapted from Levin (2003). We also restrict attention to equilibria that use Nash threats (i.e., following a deviation, the parties revert to the equilibrium of the one-shot game described above).[15]

Consider the following candidate equilibrium. On the equilibrium path, in each period: the distributor offers a formal contract β, described below; the distributor chooses $a = 1$; the exhibitor observes *x* and chooses $d = 1$ if $x \leq \bar{x}$ for some $\bar{x} \leq v$ (and $d = 0$ otherwise); and the distributor pays the exhibitor $b(x) \geq 0$ if $x \leq \bar{x}$ and $d=1$ (and $b = 0$ otherwise). Define V^D and V^E as the expected payoffs to the distributor and exhibitor, respectively, from this equilibrium. Results from Levin (2003) can be adapted to prove that there exists an optimal relational contract in which $V^E = E^{OS} = E[x]$. Consequently, the exhibitor is unwilling to make any relational payment, so $b \geq 0$ for all *x*. After any deviation, the parties receive payoffs D^{OS} and E^{OS} in all future periods.

This equilibrium must satisfy three incentive constraints. First, the exhibitor must be willing to choose $d=1$ whenever $x \leq \bar{x}$: for such *x*,

$$\beta v + b(x) \geq x. \tag{3.1}$$

[15] The assumption of Nash threats is without loss if $D^{OS} = K$. Otherwise, the assumption influences punishment payoffs following a deviation but does not affect the remainder of our analysis.

Second, the distributor must be willing to pay $b(x)$: for all $x \leq \bar{x}$,

$$-b(x) + \frac{1}{r} V^D \geq \frac{1}{r} D^{OS}. \tag{3.2}$$

Define $S^* \equiv V^D + V^E$ and $S^{OS} \equiv D^{OS} + E^{OS}$ as total surplus in this relational contract and in the one-shot equilibrium, respectively. Then combining (3.1) and (3.2) implies that, in the relational contract that maximizes total surplus,

$$\bar{x} = \min\{v, \beta v + \frac{1}{r}(S^* - S^{OS})\}. \tag{3.3}$$

Finally, the distributor must be willing to choose $a = 1$:

$$K \leq \int_0^{\beta v} (1-\beta) v\, f(x) dx + \int_{\beta v}^{\bar{x}} (v - x) f(x) dx + \frac{1}{r}(S^* - S^{OS}). \tag{3.4}$$

The smallest relational discount that satisfies (3.1) is $b(x) = \max\{0, x - \beta v\}$, which maximally relaxes (3.2) and (3.4). In the optimal relational contract, β^* equals the largest β that satisfies (3.4), because $\bar{x}$ and hence total surplus are increasing in β. For our empirical predictions, it suffices to note that S^*, $\bar{x}$, and $b(\bar{x})$ are increasing in $\frac{1}{r}$.

Our equilibrium matches the stylized facts in our empirical setting and is optimal among those that rely on Nash threats, but other relational contracts are equally efficient. For example, the exhibitor might earn rent in the repeated relationship, in which case the formal contract might occasionally be renegotiated in favor of the distributor (i.e., $b < 0$). Alternatively, the distributor might compensate the exhibitor with attractive future contracts rather than discounts. If we did not restrict attention to Nash threats, then optimal relational contracts might be strictly more efficient than the equilibrium described above. However, while allowing harsher punishments might improve equilibrium surplus, they would not affect the basic features of on-path play. In particular, for any punishment payoffs (and for corresponding patience levels *r*), an optimal relational contract with our three empirical predictions exists.

3.2. Connecting the Model to the Data

Our relational-contracting model suggests that we should observe a discount from the formal contract when the exhibitor's outside option is large relative to her contracted box-office revenue from the distributor's movie. We must enrich this intuition in two ways to apply it to our empirical setting. First, we derive the exhibitor's opportunity cost by considering multiple distributors: the exhibitor foregoes the revenue from the movies offered by other distributors when she chooses to show the focal distributor's film. Second, we consider the adaptation decisions that might be influenced by the relational contract: not only which movies will be shown in the theater but also which movies will be shown on which screens at which times (and, hence, against what competition). We address these enrichments by focusing on a static allocation problem—for a particular theater, given all the movies it might show (and their anticipated box-office revenues), what is the efficient allocation of movies to screens and time slots, and what prices will induce this allocation?

Suppose there are D distributors (with distributor d having M_d movies) bidding to have the exhibitor show those movies in one or more of T time slots. The exhibitor has $S < \sum_d M_d$ screens, so not every movie can be shown on a dedicated screen. We simplify by assuming that (a) for a given movie, one showing of the movie in any time slot on any screen would generate identical revenue, and that (b) for all movies, the additional box-office revenue generated by an additional showing is proportional to the value of the film's first showing but decreasing in the number of showings at a rate that is common across all movies.

In contrast to Section 3.1 (and the realities of our empirical setting), in this subsection we temporarily assume that distributor payments can be made contingent on the exhibitor's allocation of movies to screens.[16] Consequently, the distributors compete in a multi-unit auction, where each "unit" is a single showing on one screen and distributor d can purchase at most TM_d units. This static model allows us to endogenize the exhibitor's opportunity costs.

We analyze a multi-unit Vickrey auction to solve for the efficient allocation of movies to screens and time slots, as well as the prices that will induce this allocation. In this auction, each bidder submits TM_d bids. The highest ST bids are awarded showings; a bidder who

[16] More precisely, as noted above, the exhibitor controls many decisions: what movies to show on what screens at what times (and, hence, against what competition). If each theater were to run an auction each week, the items being auctioned would thus be more complex than in our simplified discussion here. Furthermore, if a theater were to run a single auction before the movie begins its run, rather than a different auction each week, the dimensionality of this complex vector of decisions would increase not only to account for the different weeks in a movie's run but also to account for the different possible opportunity costs from not showing other movies. In short, we are not surprised that none of these auctions occur in practice.

wins t showings pays a price equal to the t largest losing bids submitted by *other* bidders. This auction can be solved with standard techniques; see Krishna (2009), Propositions 13.1 and 13.2.

Bidders have a weakly dominant strategy to bid their true valuations in this auction. A distributor with a single movie therefore submits a vector of T bids, in which the first bid is the box office generated by a single showing of that movie, the second bid the marginal value of a second showing, and so on. If distributor d has $M_d > 1$ movies, then his bid consists of a vector that orders movie-showings in terms of the marginal box-office revenue those additional showings would generate. For example, suppose $M_d = 2$ and the first showing of movie 1 is more valuable than the first showing of movie 2. Then d's first bid equals the box office revenue for the first showing of movie 1, his second bid equals the maximum of the marginal revenue of the second showing of movie 1 and the revenue of the first showing of movie 2, and so on.

In equilibrium, each distributor pays a price equal to the difference in box-office revenues between the first-best allocation and the allocation that would result if none of that distributor's movies were shown. Consequently, a focal distributor's total payment depends on the box-office revenue that would have been generated by additional showings of other distributors' movies that are either (i) dropped, or (ii) currently being shown fewer than T times (i.e., sharing a screen with another movie), since these are the movies that might receive additional showings if the focal distributor disappeared. Thus, if a distributor's payment depends on any dropped movie's value, then it depends on the most valuable dropped movie owned by another distributor; similarly, if the payment depends on the value of any movie that is sharing a screen, then it depends on the value of the best movie owned by another distributor that is sharing a screen.[17]

Thus far in this sub-section, we have focused on distributors' bids in the multi-unit auction, ignoring ex ante formal contracts. To connect this analysis to the data, we reintroduce formal contracts in the simplest possible way: we assume that the distributors'

[17] The discussion thus far has ignored producers. That is, we have implicitly assumed that the distributor is the owner of all the movies he distributes. At the other extreme, one could ignore the distributor and focus on producers, who would bid against each other if they negotiated directly with the exhibitor. In that case, the hypothesis becomes that the discount should depend on the most valuable dropped movie owned by another producer and on the most valuable movie owned by another producer that is sharing a screen.

bids in the auction are always greater than the payment by the distributor specified in the formal contract, so that the bonus paid by renegotiating the formal contract is simply the difference between the bid and the original formal payment.[18]

The above discussion motivates our three empirical hypotheses. Our first prediction is that, conditional on a movie being continued, more and larger discounts should be given to the exhibitor when his opportunity cost x of showing the focal movie is large. This prediction is motivated by the expression $b(x) = \max\{0, x - \beta v\}$ derived from (3.1). When $x < \beta v$, the exhibitor will continue the movie (i.e., set $d = 1$) based on the formal contract alone without ex post renegotiation. When $\beta v < x \leq \bar{x}$, the movie will be continued only if the exhibitor anticipates an ex post discount no less than $x - \beta v$. When $x > \bar{x}$, the movie is discontinued and no discount is paid. Therefore, conditional on continuation, both the frequency of negotiation and the magnitude of the discount are increasing in x.

Our second prediction is that discounts paid after a movie finishes its run induce relational adaptation during the run provided that $\beta v < x \leq \bar{x}$. In particular, while the exhibitor will continue movies when $x < \beta v$ without such a discount, we predict that the exhibitor continues showing a movie with some probability when $x > \beta v$ because she anticipates receiving a future discount.

Our third prediction derives from a comparative-static calculation involving the continuation surplus in the relational contract, $\frac{1}{r}(S^* - S^{OS})$. Holding the formal revenue βv fixed and below x, the probability that a movie is continued is increasing in continuation surplus; that is, $\Pr\{\rho < x < \bar{x} | \beta v = \rho\}$ is increasing in $\frac{1}{r}(S^* - S^{OS})$, holding all else fixed. To the extent that different distributors have heterogeneous values for their relationship with the exhibitor, we should expect that, *conditional* on βv, distributors who value their relationships more are more likely to have their movies continued. This effect should be particularly large for movies that would not be continued based on the formal contract alone:

[18] In the context of our repeated-game model, introducing multiple distributors raises the possibility of collusion. Imposing this subsection's static model in a repeated-game setting implicitly assumes that distributors do not collude. Indeed, it makes an even stronger assumption: if the exhibitor were to deviate by showing the "wrong" distributor's movie, then that distributor would be willing to renegotiate the contract *ex post* to compensate the exhibitor for her deviation. That is, distributors do not punish—and in fact might reward—the exhibitor for a deviation in one of her *other* relationships.

$\beta v > x$. Moreover, because the largest equilibrium discount equals $b(\bar{x}) = \frac{1}{r}(S^* - S^{OS})$, the *maximum* discount offered by a distributor should be positively related to the continuation value of that distributor's relationship with the exhibitor.

4. The Determinants of Relational Renegotiation

4.1. Data and Summary Statistics

We explore the incidence and magnitude of ex post renegotiations in distributor-exhibitor contracts using detailed weekly data from a single Spanish exhibitor during 18 months between January 2001 and July 2002. During that period, the exhibitor owned 188 screens in 26 theaters located in 16 different cities in 11 Spanish provinces. We combine Gil's (2013) data on contract terms (both formal and renegotiated sharing rates for reels that are shown) with reel-level weekly data on attendance and box-office revenues.[19] Across the 18 months of the sample, we were able to match contract and box-office data for 435 movies, 5,436 reel-runs, and 19,551 theater-reel-weeks. In addition, and again beyond the data in Gil (2013), our data identify the specific screens on which a movie is shown in a given theater, allowing us to analyze whether the exhibitor showed the movie on a dedicated or a shared screen.

Both our theoretical model in Section 3 and our empirical approach emphasize the exhibitor's outside option (i.e., the best alternative reel that could be shown in place of the distributor's reel on a given screen in a given time slot). For the outside option to be relevant, the theater must be capacity constrained (i.e., screens must be fully utilized). While the capacity-constraint assumption is reasonable for movies shown in "prime time" (early to late evening), it is less likely to hold for movies shown in daytime matinees or after midnight. Unfortunately, our data do not include specific show times or screenings per week. To proxy for prime-time movies, we gathered detailed show-time data from local newspapers for twelve theaters in Barcelona and Madrid between January and June 2001. As described in Appendix 1, a movie is likely to have been shown in prime-time if it attracts at least 100 weekly attendees: less than 5% of the movies in our show-time data that were shown during

[19] Gil (2013) had access to only theater-level (not reel-level) weekly box-office revenues and so used a two-step estimator to approximate box-office revenue per movie (not per reel) in any given week. Our new data include weekly reel-level revenues for each theater, eliminating the need for Gil's approximation.

prime time fall below this cut-off, while 67% of movies showing only outside of prime time do. We therefore exclude theater-reel-weeks with fewer than 100 weekly attendees from our data, leaving us with 391 movies, 4,931 reel-runs, and 16,398 theater-reel-weeks.[20]

Table 2 presents sample means for selected variables used in our analysis: Panel A summarizes data from our entire sample, while Panel B excludes theater-reel-weeks with weekly attendance less than 100. Sample means are reported separately for three types of contracts in our data: (1) reels that have a formal revenue-sharing contract for their entire run; (2) reels that begin with a formal contract, but switch exactly once to no longer having such a contract; and (3) reels whose contracts do not fit the previous categories, including reels that have no formal contract, reels that start with no contract but eventually have a formal contract, and reels that switch between having a contract or not more than once. Our analysis focuses on ex post renegotiation of formal contracts, so our focal movies include those theater-reel-weeks from the first two categories that include a formal revenue-sharing contract. We measure the exhibitor's opportunity cost using all available theater-reel-weeks.

As shown in Panel B of Table 2, the average formal share of box office revenues going to the distributor is 53.5% and 50.8% in Categories 1 and 2, respectively.[21] Approximately 58% of the theater-reel-weeks in Category 1 were renegotiated, and the average discount for renegotiated reels was 10.5%. Similarly, while only 64.4% of theater-reel-weeks in Category 2 had formal contracts, 31.6% of observations in this category (i.e., 31.6 / 64.4 = 49% of theater-reel-weeks with formal contracts) were renegotiated, and the average discount for renegotiated reels was 8.2%.

Figure 2 shows the distribution of observed discounts for the 5,476 theater-reel-weeks with observed discounts in Category 1 and Category 2 of Table 1, Panel B. As shown in the figure, 5,385 of the observed discounts (98.3% of all observed discounts) are exactly at 5% (n=2095), 10% (n=1658), 15% (n=1078), 20% (n=424), or 25% (n=130). Nine reel-weeks (0.16% of the sample) have discounts exceeding 25%, and another nine had negative discounts of -5% (that is, final distributor sharing rates were 5% larger than the contracted

[20] (Unreported) robustness tests show that the results below are not sensitive to the specific threshold used as a proxy for prime-time movies, provided that the threshold exceeds 25.

[21] Category 2 may comprise successful movies extended beyond the initial contracting period: reels in this category had longer average run lengths (8.9 weeks vs. 4.0 weeks), higher average weekly box office revenues (€5658 vs. €4090), and higher average weekly attendance (1329 vs. 974) compared to reels in Category 1.

rate). We believe these nine negative discounts are coding errors and so exclude them from the analysis.

Finally, Panels A and B in Table 2 also report the fraction of theater-week-reels that are shown on shared (rather than dedicated) screens: about 50% for the full sample in Panel A and about 30% after dropping theater-week-reels with attendance below 100 in Panel B. As an example of how this number is calculated, suppose a theater has 5 screens and 6 reels, with 4 reels on dedicated screens and 2 sharing the final screen. Then 33% of the reels are shown on shared screens. Screen-sharing is prevalent in our data, which suggests that movies shown on shared screen are an important part of the exhibitor's opportunity cost. Indeed, Figure 3 shows the distribution of "Reels per Screen," defined as the number of reels shown in a theater in a given week (after excluding reels attracting fewer than 100 weekly attendees). While the number of reels shown equaled the number of screens in 743 of the 1955 "theater-weeks" of our sample (38%) (suggesting that each reel had a dedicated screen), there were more reels than screens in 1173 (60%) of our movie weeks.[22] The data therefore suggest that exhibitors face a non-trivial opportunity cost from showing movies on dedicated screens in most theater-weeks in our sample.

4.2. Testing Relational Adaptation under Reel Authority

Section 3 highlights three predictions that we can test empirically. First, conditional on a movie being continued, more and larger discounts should be given to the exhibitor when his opportunity cost x of showing the focal movie is large. Second, the anticipation of future renegotiation outcomes influences current continuation decisions (in particular, decisions over whether to continue showing a reel at all, and whether to continue showing a reel on a dedicated screen). Third, these discounts and continuation decisions should vary positively with the distributor's continuation value of his relationship with the exhibitor. In this section, we provide empirical evidence supporting each of these predictions.

[22] There were fewer reels than screens in 39 (2%) of our theater weeks, presumably reflecting refurbishing, maintenance, reels excluded based on our 100-attendee threshold, or (in one instance) the pre-opening weekend of a new 16-screen theater in which only 2 of 16 screens were utilized.

4.2.1. *Prediction 1a: Opportunity Costs Affect Renegotiations*

Our first prediction has two testable components (both conditional on movies being continued): (i) the probability of renegotiation increases in the opportunity cost x, and (ii) the expected discount (conditional on renegotiation) increases in the opportunity cost x. To motivate our tests of the first component, recall from Section 3.1 that formal contracts are renegotiated if

$$\beta v < x < \bar{x}, \quad (4.1)$$

where $\bar{x} = \beta v + \frac{1}{r}(S^* - S^{OS})$ is the largest opportunity cost for which $d = 1$ (i.e., the reel is continued), β is the exhibitor's contracted share of box-office revenues, and x is a measure of the opportunity cost. Since reels with $x > \bar{x}$ are discontinued (and dropped from our sample), and reels with $\beta v > x$ are continued without renegotiation, renegotiation for continued reels occurs when $x > \beta v$. While we can measure βv using box-office revenues and contractual sharing rates, testing Prediction 1a requires an empirical measure of the opportunity cost, x.

As suggested by the multi-unit auction in Section 3.2, the exhibitor's opportunity cost of showing the distributor's reel for one additional week includes (i) the anticipated box-office revenues the best-dropped reel would have earned if it had not been dropped, and (ii) the *additional* anticipated box-office revenues the best-shared reel would have earned if it had been shown on a dedicated screen (i.e., in all Prime Time slots). Of course, we cannot directly observe these opportunity costs. We use the best-dropped reel's revenues from the previous week to proxy for (i), which is likely an overestimate of the opportunity cost because revenues predictably decrease over time. Similarly, we proxy for (ii) with the reel's observed revenues from the current week; we therefore likely overestimate this opportunity cost, since movies presumably exhibit decreasing marginal revenue from additional showings.[23]

We test whether renegotiation is correlated with opportunity cost by estimating the following linear probability model:

$$Pr(Renegotiate_{itw}) = \alpha_1 D_{itw}^{Best\ Dropped} + \alpha_2 D_{itw}^{Best\ Shared} + \gamma_{iw} + \eta_t + \varepsilon_{itw} \quad (4.2)$$

[23] In effect, we are assuming that, within a theater-week, if a distributor has multiple movies, each is from a different producer.

where $Renegotiate_{itw}$ is an indicator variable equal to one if the formal contract for reel i in theater t in week w is renegotiated at the end of its run, $D_{itw}^{Best\ Dropped}$ is an indicator variable equal to one if the box-office revenue of the best-dropped reel from the prior week exceeds the contracted revenue from the focal reel, $D_{itw}^{Best\ Shared}$ is an indicator variable equal to one if the box-office revenue of the best-shared reel in the current week exceed the contracted revenue from the focal reel, γ_{iw} is a reel-movie-week fixed effect to control for common factors that are specific to a particular movie in a particular week, and η_t is a theater fixed effect to control for time-invariant theater-specific factors (such as location, managerial talent, or other factors).

To illustrate the intuition behind our fixed-effects approach, Table 3 returns (for the last time) to “A Beautiful Mind,” now focusing on the seventh week after the movie's release. For each theater showing this movie this week, the numbered columns of the table show (1) box-office revenue for this movie this week (or the highest-grossing reel if the movie was played on multiple screens), (2) our proxy for revenues from this week's best-dropped movie, (3) our proxy for revenues from this week's best-shared movie, and (4) the renegotiated discount, if any, for this movie this week. The observations are sorted by box-office revenues; Theater 1 is not included because (as evident from Table 1) the movie was discontinued in that theater after Week 6.

Even within this single movie-week, Table 3 shows substantial variation across theaters in box-office revenues, which range from €441 to €13,172. Importantly, opportunity costs vary as well: revenues for the best-dropped movie this week range from €701 to €6,531 (where missing values reflect theaters with no dropped reels from the prior week), and revenues for the best-shared movie this week range from €1,480 to €15,300 (where missing values reflect theaters that showed all reels on dedicated screens during the current week). The incidence and size of renegotiated discounts varies as well: twelve theaters had discounts while nine did not, and these twelve discounts ranged from 5% to 15%.

Our fixed-effects approach exploits the variation within movie-weeks to analyze the relation between discounts, revenues, and opportunity costs. To do so, the regressions below include reel-movie-week fixed effects, which control for (i) differences between a movie's first reel in a given theater (defined as the reel with the highest revenues) and additional reels of the same movie, (ii) the national (or international) success of the movie, and (iii) predictable depreciation in box-office revenues over time (which varies considerably across movies) or any other factors affecting all reels of the same movie in the same week. Therefore, our empirical analysis compares first reels with other first reels of the same movie at different theaters, and similarly for second reels and so on. The identifying variation comes not only from variation in box-office revenues across theaters during the same week, but also from variation in opportunity costs across theaters within a week, since different theaters will have different best-dropped and best-shared reels.

Consider, for example, Theaters 12 and 10 in Table 3. Both had nearly identical box-office revenues in Week 7 (€2,306 for Theater 12 and (€2,360 for Theater 10). But, while Theater 10's best-dropped reel had prior-week revenues of €3,700 (suggesting a high opportunity cost of showing "A Beautiful Mind" for another week), Theater 12 did not drop any reels from the prior week, and thus faced a lower opportunity cost of continuing "A Beautiful Mind." We would therefore predict that Theater 10 would receive a higher discount, and the results (15% for Theater 10 and 5% for Theater 12) are consistent with our prediction. Similarly, Theaters 7 and 6 had nearly identical box-office revenues, but Theater 6 had higher opportunity costs and received a higher discount.

Table 4 reports results from estimating (4.2) where the dependent variable is a dummy variable equal to one if the contract is renegotiated (and zero otherwise), and the key independent variables are dummy variables equal to one if $x > \beta v$, where x is defined as the box-office revenues from the best-dropped reel in column (1) and from the best-shared reel in column (2). Column (3) includes both measures of x as regressors. The sample size varies across columns because not all theater-reel-weeks have best-dropped or best-shared reels. We run linear probability models instead of probit because probit would not accommodate the large number of fixed effects in our regressions. We cluster standard errors at the theater-week level because continuation and screen-sharing decisions are likely related across all reels showing in a given theater during a week.

Consistent with our first prediction, the probability of renegotiation is positively and statistically significant related to our indicator variables in all three regressions. From our results in column (3) of Table 4, we find that on average a reel is 9.8 percentage points more likely to have its contract renegotiated if revenues of the best-dropped movie in the previous week are larger than the exhibitor's revenues in the current week for the focal movie. Similarly, the likelihood of renegotiation increases by 2.9 percentage points when the revenues of the best-shared movie in the current week are higher than the focal movie's current revenues in the given theater.

4.2.2. *Prediction 1b: Opportunity Costs Affect Discounts*

The smallest *percentage* discount satisfying equation (3.1) is

$$\frac{b}{v} = \max\left\{0, \frac{x}{v} - \beta\right\}, \tag{4.3}$$

Therefore, conditional on $b > 0$, the observed percentage discount is positively related to the ratio of opportunity cost to box-office revenue, $\frac{x}{v}$, and negatively related to the exhibitor's formal share, β. We test whether the level of discounts are affected by opportunity costs by estimating the following OLS regression:

$$\frac{b_{itw}}{v_{itw}} = \alpha_1 \frac{x_{itw}^{Best\ Dropped}}{v_{itw}} + \alpha_2 \frac{x_{itw}^{Best\ Shared}}{v_{itw}} + \alpha_3 \beta_{itw} + \gamma_{iw} + \eta_t + \varepsilon_{itw} \tag{4.4}$$

where $\frac{b_{itw}}{v_{itw}}$ is the difference between the final share and contracted share to the exhibitor, and the independent variables are measures of $\frac{x_{itw}}{v_{itw}}$ (where we predict a positive sign) and the exhibitor's contracted share, β_{itw} (where we expect a negative sign). As in (4.2), the regression includes both reel-movie-week and theater fixed effects.

Table 5 reports results from ordinary least-square regressions from estimating (4.4). Analogous to Table 4, column (1) of Table 5 defines $\frac{x_{itw}}{v_{itw}}$ as the ratio of the revenues of the best-dropped reel in week t-1 to the box-office revenue of the focal movie in week t, while the independent variable $\frac{x_{itw}}{v_{itw}}$ in column (2) is the revenues of the best-shared reel in week t divided by the box-office revenues of the focal movie in week t. Both measures of $\frac{x_{itw}}{v_{itw}}$ are regressors in column (3). We cluster standard errors at the theater-week level for the same reasons as Table 4.

Consistent with (4.3), the magnitude of the discount is positively and significantly related to both opportunity-cost ratios in all three regressions, and negatively and significantly related to the exhibitor's contracted share. Results from column (3) in Table 5 show that a ten-fold increase in the ratio between revenues of the best-dropped movie and the focal movie is positively associated with an increase in discount of 4.1 percentage points. Similarly, a ten-fold increase in the ratio between revenues of the best-shared movie and the focal movie is associated with an increase in discount of 1.5 percentage points. Finally, a decrease of 5% in the formal sharing rate of a movie in a given week is associated with an increase in discount of 3.1 percentage points.

4.2.3. Prediction 2: Current Continuations affect Future Discounts

In our model of relational contracting, a reel is continued if the outside option x is not too large: $x \leq \bar{x}$. If $x > \beta v$ as well, then the exhibitor would discontinue the reel in the absence of an expected relational bonus, so the distributor must pay $b > 0$. In that case, the expectation of future discounts influences the exhibitor's continuation decision.

Testing this theoretical link between current continuation decisions and future discounts is challenging for several reasons. First, such a test would compare movies that are continued to those that are dropped, but our data include discounts only for movies that are actually continued. Second, unlike the stylized bilateral model in Section 3.1, every reel is potentially the outside option for every other reel, and the outside option emerges endogenously as the best reel not continued. In particular, the opportunity cost of continuing a movie (or continuing a movie on a dedicated screen) depends on the number of new reels arriving at a theater and the expected future revenues of older reels.

We use a two-stage approach to test indirectly the hypothesis that future discounts affect current decisions. The first stage estimates a reel's continuation probability as a function of a "reel at risk" variable that equals 1 if a reel is among the n worst-performing reels in a given week, where n is the number of new reels released at the theater in the following week. "Reel at risk" contains information about both x and v and can be interpreted as a proxy for the event $v \leq x$. If it were perfectly correlated with $v \leq x$, then no reel that is "at risk" would ever be continued. However, "reel at risk" is an imperfect proxy that is likely to equal 1 when x is relatively large, and in particular when $x > \beta v$. Hence, a reel at risk is less likely to be continued, but conditional on continuing is more likely to be accompanied by a discount. That is, if we restrict attention to those reels that are actually continued, then the fitted values from our first stage should be negatively correlated with the frequency and magnitude of observed discounts.

The second stage of our estimation tests this prediction. Because we do not observe contractual terms (including discounts) for those reels that are dropped, this stage must restrict attention to those reels that are actually continued. For these reels, we show that discounts are both more frequent and larger if the exhibitor continues a reel that our first stage predicted was likely to be dropped. In short, expected future renegotiations influence adaptation decisions, in the sense that "unexpectedly" continued movies are more likely to be renegotiated.

This logic also applies to the exhibitor's decision to continue a movie on a dedicated rather than shared screen. In that case, we define a reel as "at risk" if it is one of the *n* reels with the lowest revenue *among those reels that are shown on dedicated screens*. Then the first stage estimates the probability that a given reel is continued on a dedicated screen rather than a shared screen, and the second stage compares this estimated likelihood to the observed discount for those reels that are actually continued on a dedicated screen.

Table 6 reports first-stage estimates from probability models that regress continuation decisions on "reel at risk," the number of new releases coming to the theater in week t+1 (which we expect to be negatively correlated with continuation, since there are fewer screens to allocate among the reels shown in the current week), and the revenues of the reel in week t. Columns (1) and (3) report results from logistic regressions that include fixed effects for the 26 theaters in our sample; while columns (2) and (4) report results from linear probability models that include both 26 theater and 1310 reel-week fixed effects.[24] Columns (1) and (2) define a "reel at risk" as one of the *n* lowest-revenue reels in a week and consider the decision to either continue a reel or drop it entirely. Columns (3) and (4) consider the decision to continue a reel on a dedicated or shared screen, so restrict attention to reels that are shown at least once in week t+1. We define "reel at risk" in terms of the *n* lowest-revenue

[24] Columns (2) and (4) are based on linear probability regressions because logistic results cannot be obtained given the large number of fixed effects.

reels that are currently on a dedicated screen (whether continued or not in week t+1). Consistent with the argument above, the probability that a reel is continued for another week (or continued on a dedicated screen) is lower if that reel is "at risk." The expected continuation probability is also increasing in current-period revenues and decreasing in the number of new releases coming to the theater in week t+1.

The second stage of our estimation uses the estimates from the linear probability models in columns (2) and (4) of Table 6 to analyze whether future renegotiations are related to current continuation decisions.[25] Panel A of Table 7 groups theater-reel-weeks into quintiles based on predicted continuation probabilities from column (2) of Table 6 and gives the average frequency and magnitude of subsequent renegotiations for each group.[26] Recall that Panel A of Table 7 includes only those theater-reel-weeks for which the reel is shown in both week t and week t+1. Therefore, observations in the lowest quintile of Panel A should be interpreted as reels that were continued in spite of being predicted not to be continued, while observations in the highest quintile are reels that were expected to be continued and were, indeed, continued.

As is evident from Panel A of Table 7, the frequency of renegotiation, the average discount (including theater-reel-weeks with no discount), and the average positive discount (excluding theater-reel-weeks with no discount) all decline monotonically across quintiles. The table entries in each column are all significantly different from each other at the 1% level or better, with only two exceptions: the first and second quintiles in column (1) are significantly different from each other at the 5% level, and the third- and fourth-quintile in column (3) are significantly different from each other at the 10% level. We interpret these results as strong evidence that the exhibitor's decision to "unexpectedly" continue a reel is correlated with larger and more frequent ex post discounts for that reel in that week.

Panel B of Table 7 performs the same exercise as Panel A, except that it uses column (4) of Table 6 to group theater-reel-weeks into quintiles based on the predicted likelihood that a movie is shown on a dedicated rather than shared screen. Panel B includes only theater-reel-weeks in which the reel is shown on a dedicated screen in both weeks t and t+1.

[25] Results using the results of the logistic estimates in columns (1) and (3) are qualitatively similar.

[26] These predicted continuation probabilities are perfectly correlated with the residuals from Table 6 because the dependent variable from Table 6 equals 1 for all observations included in Table 7.

Analogous to Panel A, observations in the lowest quintile are interpreted as reels that the first stage predicted would share a screen but were instead continued on a dedicated screen, while observations in the highest quintile are reels that the first stage estimated as likely to be continued on a dedicated screen and were, indeed, continued on a dedicated screen.

As in Panel A of Table 7, Panel B shows that the average discount (column (2)) declines monotonically across quintiles. The frequency of renegotiation (column (1)) also declines monotonically (except for a slight increase between the third and fourth quintiles), while the average positive discounts (i.e., after excluding zeros) in column (3) generally decline as well after the third quintile. The quantitative results in Panel B are not as strong as in Panel A: in columns (1) and (2), the first, second, and third quintiles are significantly different from the fourth, and fifth quintiles at the 5% level or better. In addition, Quintile 4 is significantly different from Quintile 5 at the 10% level in column (1), while Quintile 3 is significantly different from Quintile 5 at the 2% level in column (2); no other pairs are significantly different. In column (3), the first, second, and third quintiles are significantly different from the fourth and fifth quintile at the 10% level of better; no other pairs are significantly different. The results in panel B therefore provide additional (but somewhat weaker) evidence that future renegotiation outcomes are related to current continuation decisions—in this case, the decision to continue showing a reel on a dedicated screen.

Overall, our results in Table 7 suggest that the discounts for a given reel-week are an omitted variable in Table 6. While not a direct test, these results are consistent with the model's prediction that the exhibitor continues movies she would have otherwise dropped or moved to a shared screen because she anticipates receiving future discounts.

4.2.4. Prediction 3: Effects are Heterogeneous Across Distributors

While our stylized model in Section 3.1 focuses on one exhibitor and one distributor, multiple distributors typically compete for screens and time slots in practice. If different distributors value their relationship with the exhibitor differently, then a distributor who has a more valuable relationship is more willing to offer larger discounts, and consequently the exhibitor will be more likely to continue that distributor's movies. This effect should be particularly apparent if x is large relative to v, and in particular if $x > \beta v$ so that the movie would not be continued based on the formal contract alone.

To test empirically the prediction that the exhibitor is more likely to continue a movie from a distributor with whom she has a strong relationship, we construct a proxy for the strength of a given distributor's relationship with the exhibitor. The distributor pays a maximum discount equal to $b(\bar{x}) = \frac{1}{r}(S^* - S^{OS})$ in the optimal relational contract from Section 3.1, where the right-hand side of this expression is a measure of the value of the relationship. If we assume that (i) the maximum *observed* discount approximates $b(\bar{x})$, and (ii) $\frac{1}{r}(S^* - S^{OS})$ is roughly constant over time, then the maximum observed discount from each distributor should be positively related to the value of that distributor's relationship with the exhibitor.

We investigate the hypothesis that distributors with higher continuation value are more likely to have their movies continued by estimating a version of Table 6 (columns (1) and (2)) that includes proxies for continuation surpluses and the interaction between these proxies and the "reel at risk" variable. We use two proxies for distributor-level continuation surpluses: (1) the maximum discount (in Euros) observed in any week in any theater;[27] and (2) the maximum observed discount for across all theaters for any single movie. We restrict our analysis to the eight (of 26) distributors in our sample that make extensive use of formal contracts; these eight distributors account for 80% of the movies and 90% of the reel-weeks in our data.

Table 8 reports results from regressions showing the probability that an exhibitor showing a reel in week t will continue showing the reel in week t+1. Columns (1) and (3) report results from logistic regressions that include theater fixed effects, while columns (2) and (4) report results from linear probability models that include both theater and reel-week fixed effects. Columns (1) and (2) use the maximum discount paid by the distributor for any *single* movie-week at any theater as a proxy for the value of the relationship, while columns (3) and (4) use the maximum discount paid for a movie, summed across all weeks and all theaters. We proxy for continuation surplus using maximum observed discounts from the first half of the sample (January 2001 through September 2001), then use the second half of

[27] Discounts for multiple reels playing in the same theater are added together to obtain a total discount for the movie week.

the sample (October 2001 through June 2002) to estimate the impact of (our proxy for) continuation value on continuation decisions.

The coefficients on the continuation-surplus proxy are positive and significant in both columns (1) and (3) of Table 8, suggesting that exhibitors are more likely to continue movies from distributors who have historically paid high discounts. The coefficients on the interaction between the continuation-surplus proxy and "reel at risk" are also positive and significant in both (1) and (3), suggesting that this heterogeneity is especially relevant for movies that face attractive outside options. We interpret these results as providing evidence that the exhibitor is more likely to continue movies from distributors who are willing to pay large discounts rather than sacrifice the relationship.

Columns (2) and (4) of Table 8 include theater and movie-week fixed effects. Since each movie is associated with a single distributor across its entire run, the direct effect of our proxy is absorbed in the movie-week fixed effects in these regressions and we focus instead on the interaction term. The coefficients on the interaction terms in both columns (2) and (4) are positive and statistically significant. Overall, Table 8 suggests that distributors that appear to have strong relationships with the exhibitor are more likely to have their movies continued, especially in cases when doing so comes with a high opportunity cost.

To investigate whether the positive coefficients on the interaction terms in Table 8 reflect one or two outliers (that is, distributors with unusual estimated continuation surpluses), we re-estimate a version of columns (2) and (4) of Table 8 after replacing our proxies for continuation surplus with separate dummy variables for each of the eight (relevant) distributors in our sample.[28] As in Table 8, the regressions are based on the second half of our sample (October 2001 – June 2002). The estimated coefficients from the linear probability model with theater and reel-week fixed effects are reported in column (1) of Table 9, while columns (2) – (4) provide distributor-level summary statistics on number of reel-weeks and continuation surpluses. The distributors are ordered based on the estimated

[28] Only two additional distributors offered contracted reel weeks during our October 2001 – June 2002 estimation period. We omit these distributors because they each had only four reel-weeks of data in the first half of our sample (which we use to construct our continuation surpluses); each of the other eight distributors had at least 250 contracted reel-week observations from January 2001 through September 2001. Our results are robust to including these two additional distributors.

coefficient on the interaction term, which ranges from -0.0458 (for Distributor 1) to -.3556 (for Distributor 8).

Figure 4 depicts the relationship between the estimated distributor-specific interactions in Table 9 and our two proxies for continuation surpluses: the maximum discount observed in any week in any theater (Panel A), or the maximum observed discount for across all theaters for any single movie (Panel B). The vertical axis reflects the estimated interaction coefficient from Table 9, while the horizontal axis reflects continuation surpluses (in Euros). Each dot represents one of the eight distributors; the size of the "dots" in the scatter plots are based on the number of reel weeks during the October 2001 – June 2002 estimation period. The "fitted values" reflects the weighted least-squares regression line, with weights based on each distributor's reel weeks.

As evident from both panels of Figure 4, the relation between the distributor-specific interaction and our proxies for continuation surpluses is nearly monotonic. Consistent with our interpretation of Table 8, these results suggest that exhibitors are more likely to continue high opportunity-cost movies from distributors with whom they have a strong relationship, as measured by our proxies for continuation surplus.

5. Conclusion

This paper explores how firms use formal and relational contracts to adapt to fluctuations in their environment. In our model, relational contracts can induce efficient outcomes if a decision-maker is compensated for adapting her decisions to the state of the world in a way that maximizes total surplus, rather than her own private benefits. Formal contracts can facilitate such relational adaptation by reducing the parties' temptations to renege on informal payments.

We test this model using detailed data from the movie industry. This is a very attractive setting for studying relational adaptation between firms because we observe (i) the formal revenue-sharing contract terms, (ii) informal renegotiations of the formal contract terms that occur after all decisions have been made, and (iii) proxies for both the state of the world (potential revenues from alternative movies competing for the same time slots) and adaptation decisions (what movies were actually shown, and in what time slots).

As our model predicts, distributors offer ex post discounts to the exhibitor when the opportunity cost of showing that distributor's movie (or showing the movie on a dedicated screen) is large. Furthermore, we find that the incidence and size of renegotiations depend on not only these opportunity costs but also the exhibitor's exercise of its reel authority. Finally, we show that the exhibitor is more likely to continue movies from distributors with whom she has a strong relationship. Collectively, our results suggest that the parties use relational renegotiation to facilitate efficient adaptation.

We believe that relational-adaptation models can guide empirical work in many settings beyond movies. Section 1.2 mentioned existing empirical work on adaptation (if not necessarily relational adaptation) in industries as diverse as airlines, automotive manufacturing, defense procurement, flowers, and information services. In economies with strong contracting institutions, supply transactions in these and other industries typically involve formal contracts, but it has also long been recognized that firms' behaviors can be governed as much by relational contracts as by these formal ones (and in economies with weak institutions, and in sectors where novel transactions have out-paced enforcement, firms' behaviors can be governed almost entirely by relational contracts). The question then arises: what kind of relational-contracting model is appropriate?

Compare the relational-adaptation model in this paper to the more familiar model of relational incentive contracting. In the latter, the agent takes a hidden action, which influences a non-contractible output, which determines a relational bonus payment. In such an agency setting, it is almost never possible for empirical researchers to measure the action (which is typically unobserved even by the principal), it can be difficult to measure output (especially in team settings), and it may even be difficult to measure the bonus (if it is delivered in non-monetary terms, such as a relaxation of constraints or an increase in authority on an existing job).

In contrast, in the simplest relational-adaptation model, the agent makes an observable decision in response to an observable state of the world (where either the state or the decision is non-contractible, necessitating a relational bonus from the principal). As in our movie data, an empiricist studying supply transactions might be able to observe all the variables of interest (or close proxies for them): the state of the world, the decision, and any formal and relational payments. We therefore believe not that adaptation is a more frequent or important problem than incentives (although we do think the latter has received disproportionate attention in the theoretical and empirical literature), but rather that adaptation is an under-studied important problem that may be amenable to both theoretical modeling and empirical testing. In short, we hope future work will investigate ongoing supply relationships to further our understanding of the determinants and consequences of efficient adaptation.

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Figure 1. Contracted and Final Sharing Rates for "A Beautiful Mind" in Selected Theaters

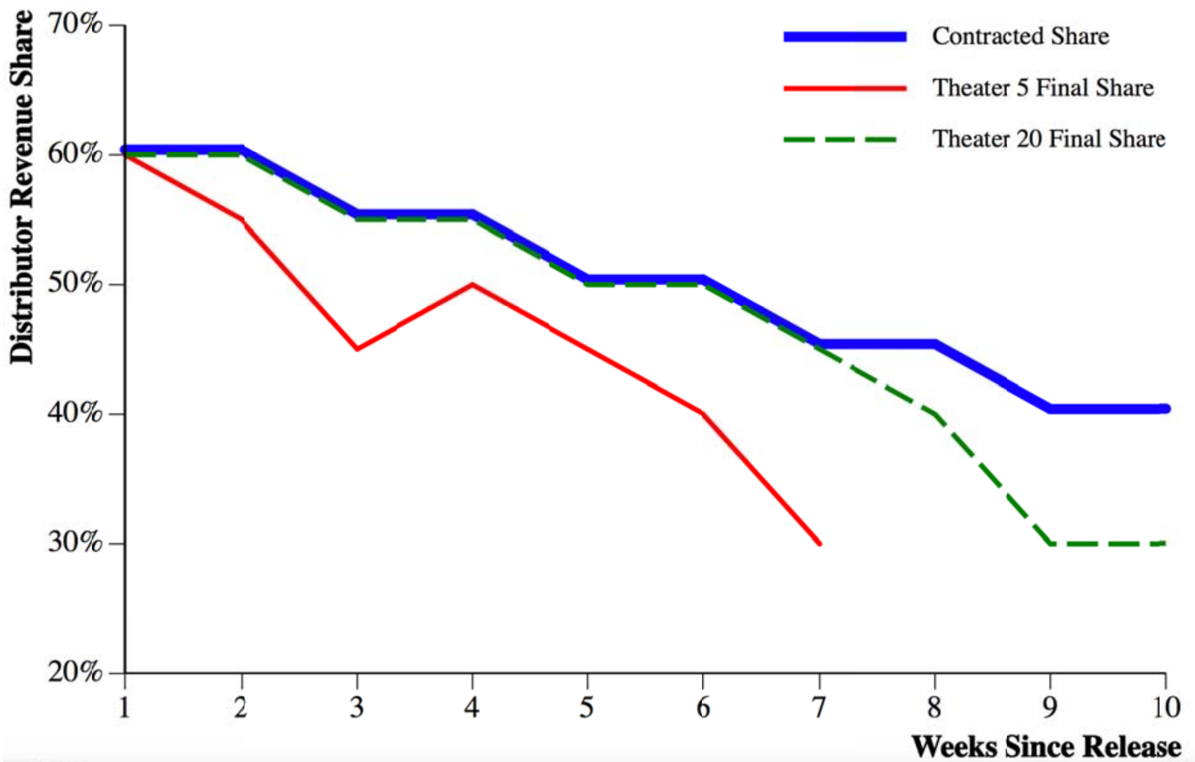
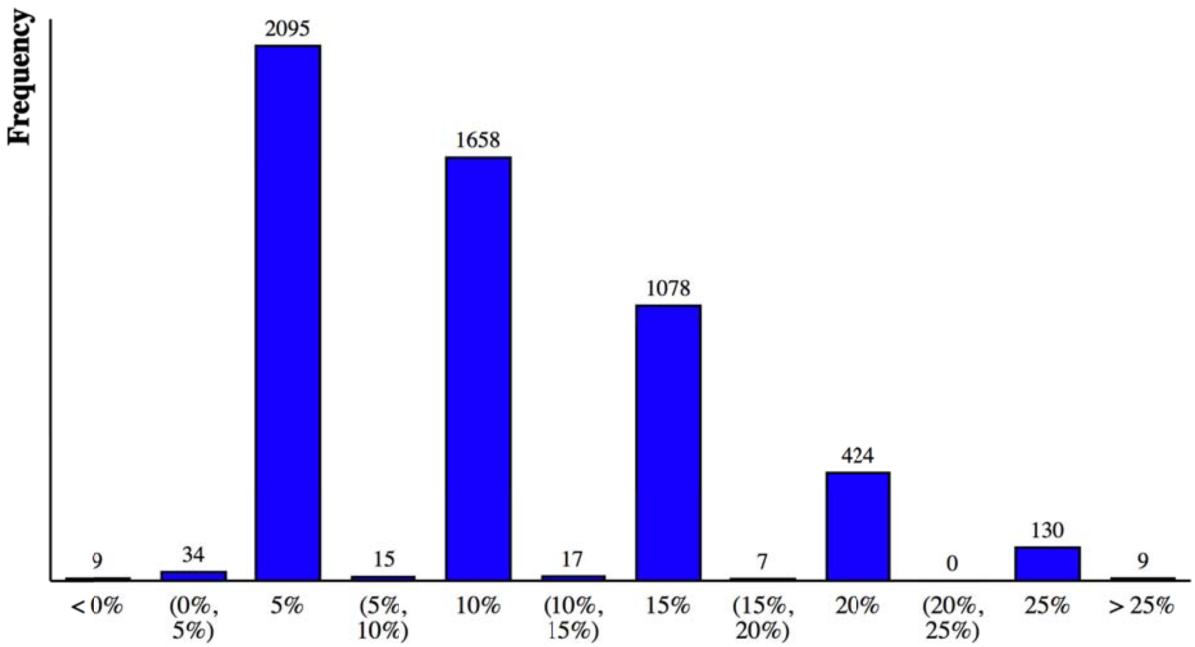
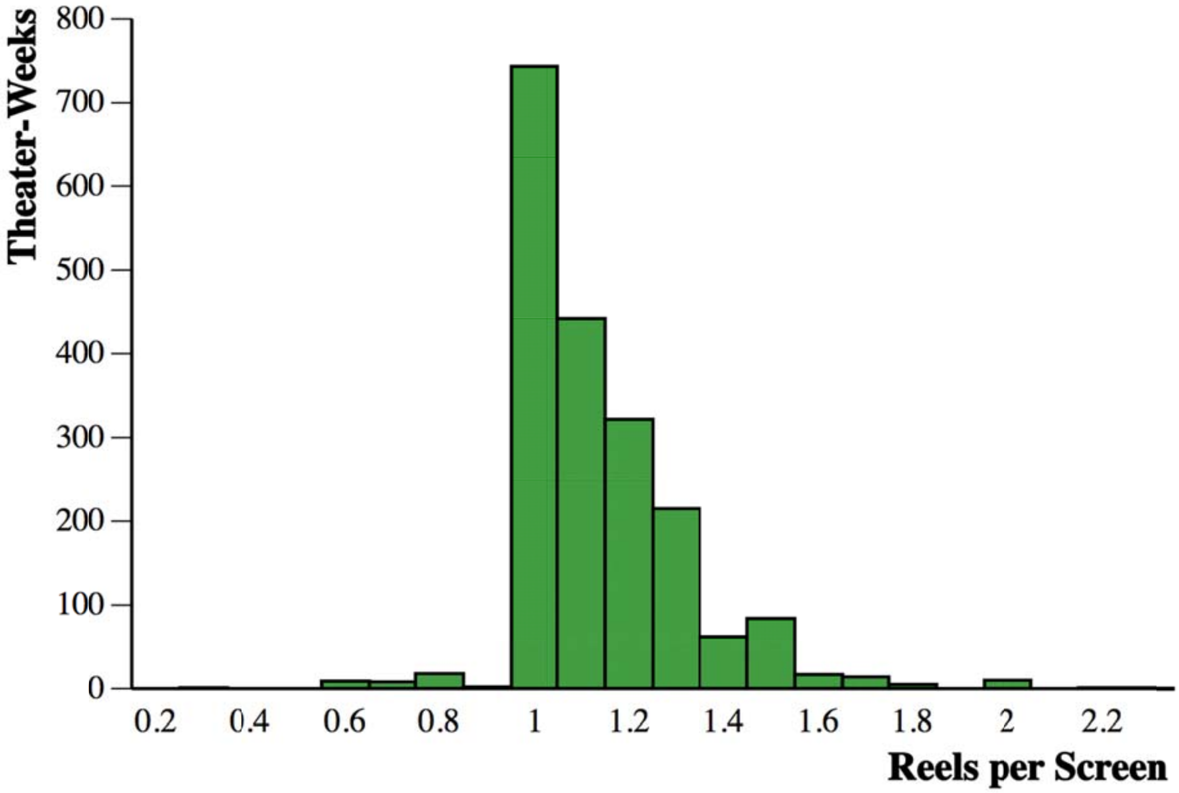


Figure 2. Frequency distribution for observed discounts



The sample in columns of all 5,476 renegotiated theater-reel-weeks with formal contracts throughout their runs or moving from formal contracts to no contracts during their runs.

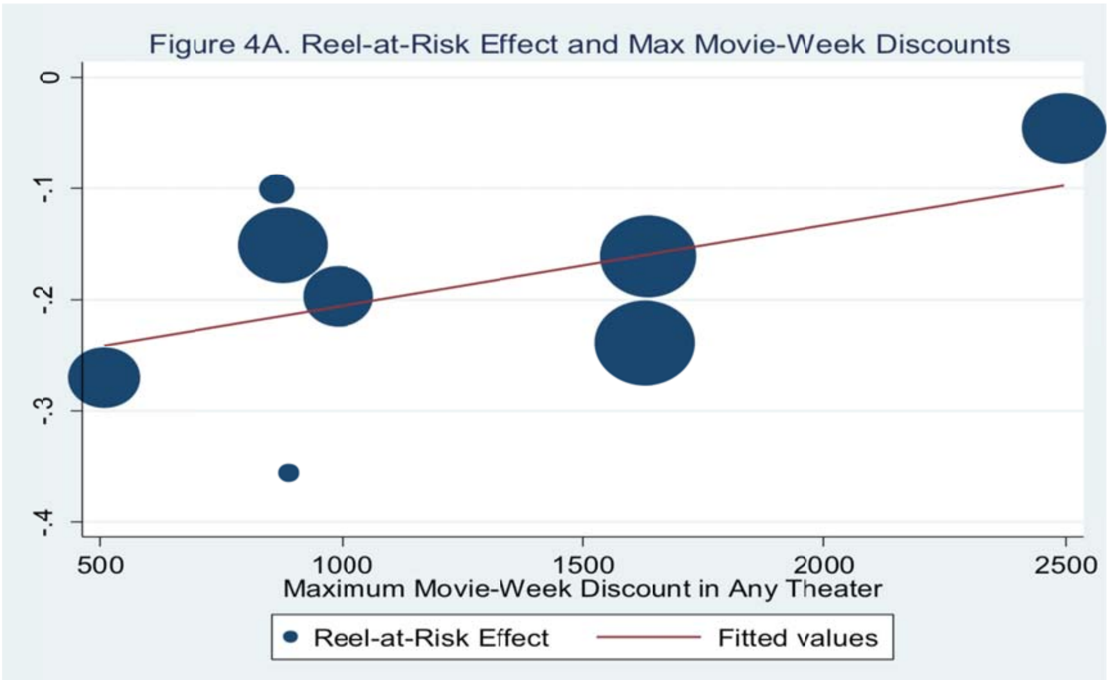
Figure 3. Distribution of Reels-Per-Screen in 1,955 Theater-Weeks



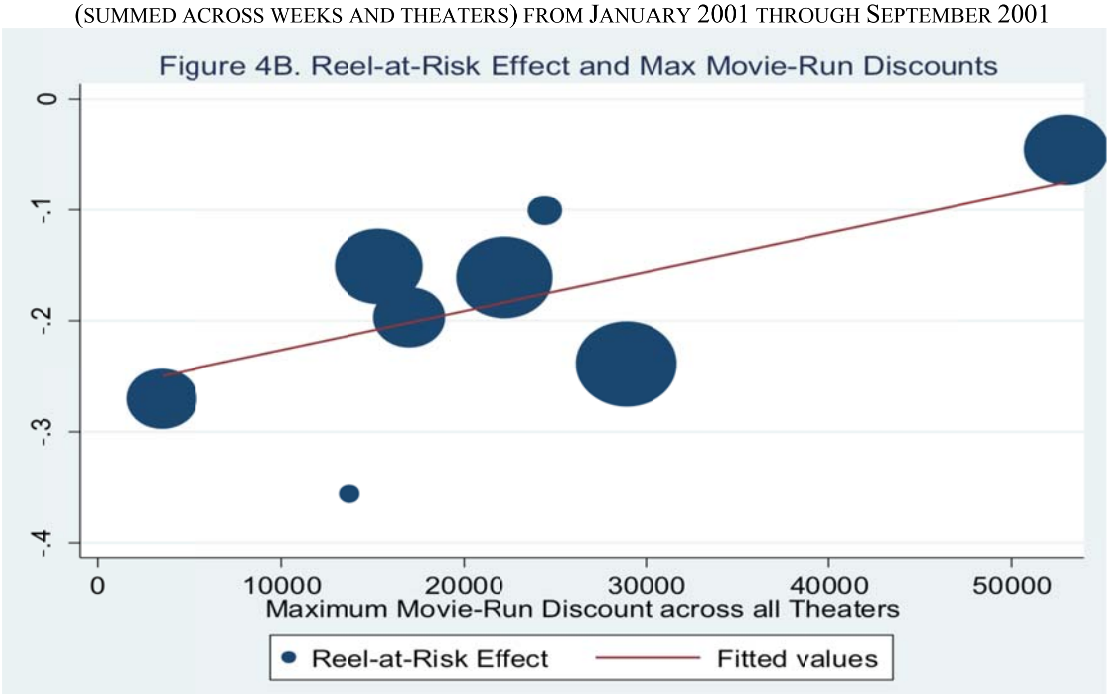
Note: Figure depicts the distribution of "Reels per Screen," defined as the number of reels shown in a theater in a given week, after excluding reels garnering fewer than 100 weekly attendees. Depicted distribution excludes the "pre-opening" weekend of a 16-screen theater occurring in the middle of our sample period, where only 2 of 16 screens (.125 reels per screen) were utilized.

Figure 4. Relation between estimated Distributor Effects and Proxies for Continuation Surpluses

PANEL A: CONTINUATION SURPLUS MEASURED AS THE MAXIMUM DISCOUNT (IN EUROS) OBSERVED IN ANY WEEK IN ANY THEATER FROM JANUARY 2001 THROUGH SEPTEMBER 2001



PANEL B: CONTINUATION SURPLUS MEASURED AS THE MAXIMUM DISCOUNT (IN EUROS) FOR ANY MOVIE (SUMMED ACROSS WEEKS AND THEATERS) FROM JANUARY 2001 THROUGH SEPTEMBER 2001



Note: The vertical axis is the estimated distributor-specific "reel at risk" interaction coefficients from column (1) of Table 9.

Table 1 Negotiated Discounts for "A Beautiful Mind," February 22, 2002 – April 19, 2002

Formal Sharing Rate:	*60%*	*60%*	*55%*	*55%*	*50%*	*50%*	*45%*	*45%*	*40%*
Theater	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
1	5%	10%	10%	15%	**10%**	5%			
2	10%	10%	10%	10%	**10%**	**15%**	**15%**		
3	5%	0%	5%	5%	10%	15%	**15%**		
4	0%	10%	5%	10%	**10%**	**15%**	**15%**		
5	0%	5%	10%	5%	5%	10%	15%		
6	0%	0%	0%	10%	**5%**	0%	**15%**		
7	0%	0%	0%	0%	0%	10%	10%		
8	0%	0%	0%	0%	0%	5%	**15%**		
9	0%	0%	0%	0%	**0%**	0%	**15%**		
10	0%	10%	10%	15%	**10%**	0%	**15%**	**15%**	
11	0%	5%	0%	5%	0%	0%	10%	**15%**	
12	0%	0%	0%	5%	**0%**	0%	**5%**	**15%**	
13	0%	0%	0%	0%	**0%**	0%	**5%**	**15%**	**n/c**
14	0%	0%	0%	0%	0%	0%	0%	5%	n/c
15	0%	0%	0%	0%	0%	0%	0%	5%	n/c
16	0%	0%	0%	0%	0%	0%	**0%**	**5%**	**n/c**
17	0%	0%	0%	0%	0%	0%	0%	0%	n/c
18	0%	0%	0%	0%	0%	0%	0%	0%	**n/c**
19	0%	0%	0%	0%	0%	0%	0%	0%	**n/c**
20	0%	0%	0%	0%	0%	0%	0%	5%	**10%**
21	0%	0%	0%	0%	**0%**	**0%**	**0%**	**5%**	**0%**
22	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note: Data reflect the first reel (i.e., the reel with highest box-office revenue) of "A Beautiful Mind" shown in 22 theaters over the first nine weeks since the movie's release. "Negotiated Discount" is the difference between the ex ante and ex post share of box office revenues paid to the distributor. Bold font indicates that the reel shared the screen with one or more movies during the week (where reels with fewer than 100 attendees in the week were excluded). The distribution of final run lengths for the ten theaters still showing "A Beautiful Mind" in the ninth week is 9 weeks (n=1), 10 weeks (n=2), 11 weeks (n=1), 12 weeks (n=1), 12 weeks (n=2) 14 weeks (n=2), and 16 weeks (n=1). The maximum "contracted" run length in our data (i.e., the number of weeks where we have contract data) is 10 weeks; the notation "n/c" denotes that the reel was shown but we do not have contract data.

Table 2. Sample Means for Selected Variables, by Type of Contract

PANEL A *All Theater-Reel-Weeks*	*Category 1* Under Contract for Entire Run *3,017 reels* *8,332 reel-weeks*	*Category 2* Switches once from Contract to No Contract *715 reels* *4,964 reel-weeks*	*Category 3* No Contract or Mixed Contract *1,704 reels* *6,255 reel-weeks*
Reel under contract?	100.0%	61.8%	20.6%
Contracted Distributor Share	53.2%	50.8%	51.7%
Contract Renegotiated?	58.9%	38.8%	46.2%
Renegotiated Discount (> 0%)	11.1%	8.9%	12.0%
Reel run length (weeks)	4.1	9.4	4.1
Reel shares screen?	54.4%	51.3%	54.4%
Weekly Box Office	€3448	€4624	€3643
Weekly Attendance	821	1091	851
PANEL B *Subsample of Theater-Reel-Weeks with Attendance ≥ 100*	*Category 1* Under Contract for Entire Run *2,974 reels* *8,275 reel-weeks*	*Category 2* Switches once from Contract to No Contract *498 reels* *3,451 reel-weeks*	*Category 3* No Contract or Mixed Contract *1,459 reels* *4,672 reel-weeks*
Reel under contract?	100.0%	64.4%	16.1%
Contracted Distributor Share	53.5%	50.8%	52.3%
Contract Renegotiated?	57.6%	31.6%	43.3%
Renegotiated Discount (> 0%)	10.5%	8.2%	12.0%
Reel run length (weeks)	4.0	8.9	5.4
Reel shares screen?	32.2%	29.8%	31.6%
Weekly Box Office	€4090	€5658	€4400
Weekly Attendance	974	1329	1026

Note: Observations correspond to theatre-week-reels. "Renegotiation" reflects reels that are under contract where the final ex post price paid to the exhibitor (as a share of box office revenues) exceeds the ex ante contracted share. Weekly box office revenues (in Euros) are exclusive of 7% VAT.

Table 3 Box Office Revenues, (Proxies for) Opportunity Costs, and Renegotiated Discounts for Week 7 of "A Beautiful Mind"

Theater	Box Office Revenues for "A Beautiful Mind"	Box Office Revenues for Best Reel in Prior Week Dropped in Current Week	Box Office Revenues for Best Shared Reel in Current Week	Renegotiated Discount
	(1)	(2)	(3)	(4)
3	€ 441	€ 1,330	€ 2,942	15%
2	€ 873	€ 1,403	€ 2,835	15%
4	€ 1,773	€ 2,267	€ 3,596	15%
9	€ 2,041	€ 701	€ 8,958	15%
8	€ 2,262	€ 1,450	€ 3,832	15%
12	€ 2,306	.	€ 3,232	5%
10	€ 2,360	€ 3,700	€ 2,094	15%
11	€ 2,514	€ 1,868	€ 6,658	10%
7	€ 2,631	€ 1,513	€ 1,480	10%
5	€ 2,636	€ 3,352	.	15%
6	€ 2,740	€ 4,845	€ 2,754	15%
13	€ 3,068	€ 4,308	€ 4,348	5%
16	€ 4,109	€ 4,204	€ 4,894	0%
14	€ 5,006	€ 2,404	€ 3,298	0%
20	€ 5,110	€ 4,536	€ 4,258	0%
17	€ 5,487	€ 4,232	€ 7,595	0%
15	€ 5,540	€ 1,860	€ 5,199	0%
19	€ 5,844	€ 6,531	€ 5,441	0%
18	€ 7,926	€ 3,096	€ 7,174	0%
21	€ 8,500	€ 5,824	€ 15,300	0%
22	€ 13,172	€ 1,018	.	0%

Table 4 Linear Probability Models for the Probability of Renegotiation

	Dependent Variable =1 if Contract is Renegotiated, 0 Otherwise		
	(1)	(2)	(3)
Dummy if (Best Dropped Reel)$_{t-1}$ > (β × Revenues$_t$)	.1033*** (9.83)		.0983*** (8.24)
Dummy if (Best Shared Reel)$_t$ > (β × Revenues$_t$)		.0402*** (3.40)	.0292** (2.47)
Theater Fixed Effects?	Yes	Yes	Yes
Reel-Week Fixed Effects?	Yes	Yes	Yes
R^2	.7053	.7066	.7152
Sample size	9,618	8,428	7,798

Note: t-statistics in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Standard errors are clustered by theater-week. Observations correspond to theater-week-reels. The dependent variable "Renegotiation" is a (0,1) dummy variable equal to 1 for reel-weeks where the final ex post price paid to the exhibitor (as a share of box office revenues) exceeds the ex ante contracted share.

Table 5 OLS Regressions for the Magnitude of the Negotiated Discount for Contracted Reels

	Dependent Variable = Ex Post Final Share less Ex Ante Contracted Share		
	(1)	(2)	(3)
Ratio of (Best Dropped Reel)$_{t-1}$ to (Revenues)$_t$	.00555*** (6.17)		.00408*** (3.92)
Ratio of (Best Shared Reel)$_t$ to (Revenues)$_t$		.00224*** (7.58)	.00147*** (4.15)
Contracted Share (β)	-.5672*** (-17.41)	-.5995*** (-16.47)	-.6192*** (-16.84)
Theater Fixed Effects?	Yes	Yes	Yes
Reel-Week Fixed Effects?	Yes	Yes	Yes
R^2	.7961	.8002	.8074
Sample size	9,618	8,428	7,798

Note: t-statistics in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Standard errors are clustered by theater-week. Observations correspond to theater-week-reels. The dependent variable is the difference between the final ex post price paid to the exhibitor and the ex ante contracted share. The contracted share (β) is the share of box-office revenues contractually guaranteed to the exhibitor. "Best Dropped Reel" is the highest box office revenues in the prior week for reels shown in week t-1 but not in week t. "Best Shared Reel" is the highest box office revenues in the current week of any reel shown in the current week (except the focal reel, if that reel were shared in the current week).

Table 6 Logistic and Linear Probability Models for Continuing Reel (or Continuing on an Dedicated Screen) for an Additional Week

Dependent Variables:	Reel Shown in week t Continued in week t+1		Reel shown on dedicated screen in week t continues on unshared screen in t+1	
	Logistic	Linear	Logistic	Linear
	(1)	(2)	(3)	(4)
Ln(1+New Releases in week t+1)	-1.041*** (-10.86)	-.0918*** (-6.28)	-1.246*** (-9.01)	-.1330*** (-6.48)
Ln(Revenues in week t)	1.952*** (32.34)	.2028*** (18.47)	1.221*** (12.18)	.1564*** (7.60)
Reel is among the *n* reels with lowest Revenues (where *n* is the number of New Releases in week t+1)	-.8137*** (-10.66)	-.1966*** (-13.76)	–	–
Reel is among the *n* reels on dedicated screens with lowest revenues (where *n* is the number of New Releases in week t+1)	–	–	-1.536*** (-19.22)	-.2037*** (-12.19)
Theater Fixed Effects?	Yes	Yes	Yes	Yes
Reel-Week Fixed Effects?	No	Yes	No	Yes
R^2 (or Pseudo R^2)	.3674	.6560	.2502	.5177
Sample size	10,498	10,498	6,036	6,036

Note: Dependent variables are (0,1) dummies indicating that the reel was continued (columns (1) and (2)) or continued on a dedicated screen (columns (3) and (4)). t-statistics (or asymptotic t- statistics) in parentheses; *, ** and *** denote significance at 0.10, 0.05 and 0.01 levels. Standard errors are clustered by theater-week. The sample in columns (1) and (2) consist of all reels with formal contracts throughout their runs or moving from formal contracts to no contracts during their runs. The sample in columns (3) and (4) consist of the same reels in columns (1) and (2) conditional on (a) shown during both week t and week t+1; and (b) shown on an dedicated screen in week t.

Table 7 Prevalence of Renegotiation and Average Discounts (conditional on Renegotiation) for Continuing Reels (or Continuing on Unshared Screen), by Predicted Continuation Probabilities

	Percentage Renegotiated	Average Discount	Average Discount (Discount > 0)
Panel A. Predicted Continuation Probability from Table 6, Column (2) (n=6,909)	(1)	(2)	(3)
Lowest Quintile (least likely to continue)	66.6%	7.6%	11.5%
Second Quintile	62.7%	6.7%	10.6%
Third Quintile	54.0%	5.2%	9.6%
Fourth Quintile	47.8%	4.4%	9.2%
Highest Quintile (most likely to continue)	39.0%	3.3%	8.4%
Panel B. Predicted Probabilities of Continuing on Unshared Screen (conditional on continuation) from Table 6, Column (4) (n=2,819)	(1)	(2)	(3)
Lowest Quintile (least likely to continue unshared)	48.0%	4.2%	8.7%
Second Quintile	46.6%	4.0%	8.7%
Third Quintile	39.0%	3.4%	8.8%
Fourth Quintile	39.4%	3.1%	8.0%
Highest Quintile (most likely to continue unshared)	34.6%	2.7%	7.9%

Note: Observations correspond to theater-week-reels. "Renegotiation" reflects reels that are under contract where the final ex post price paid to the exhibitor (as a share of box office revenues) exceeds the ex ante contracted share. "Discount" is the difference between the ex ante and ex post share paid to the distributor. Predicted Continuation Probabilities in Panel A are from the linear probability regressions in column (2) of Table 6, and reflect the probability that the exhibitor will show the reel for an additional week. Predicted Probabilities of Continuing on Unshared Screen in Panel B are from the linear probability regressions in column (4) of Table 6, and reflect the probability that the exhibitor will show only that reel on a given screen in week t+1, conditional on (a) showing the reel during both week t and week t+1; and (b) showing only that reel on a given screen in week t.

The table entries in each column in Panel A are all significantly different from each other at the 1% level or better with only two exceptions: the first- and second-quintile in column (1) are significantly different from each other at the 5% level, and the third- and fourth-quintile in column (3) are significantly different from each other at the 10% level.

The table entries in each column in Panel B are not all significantly different from each other. In both columns (1) and (2), the first and second quintiles are significantly different from the third, fourth, and fifth quintiles at the 5% level or better. In addition, Quintile 4 is significantly different from Quintile 5 at the 10% level in column (1), while Quintile 3 is significantly different from Quintile 5 at the 2% level in column (2); no other pairs are significantly different. In column (3), the first, second, and third quintiles are significantly different from the fourth and fifth quintile at the 10% level of better; no other pairs are significantly different.

Table 8 Logistic and Linear Probability Models for Continuing Reel for an Additional Week using data from Oct 2001 – June 2002, with Distributor Effects estimated using data from completed movie runs, Jan 2001 – Sept 2001

	Logistic	Linear	Logistic	Linear
	(1)	(2)	(3)	(4)
Ln(1+New Releases in week t+1)	-.9244*** (-7.23)	-.0844*** (-4.44)	-.9244*** (-7.19)	-.0838*** (-4.43)
Ln(Revenues in week t)	2.352*** (23.69)	.2064*** (13.32)	2.378*** (23.63)	.2065*** (13.33)
Reel-at-Risk: Reel is among the *n* reels with lowest Revenues (where *n* is the number of New Releases in t+1)	-1.687*** (-7.34)	-.2794*** (-2.99)	-1.496*** (-8.14)	-.2613*** (-7.66)
Maximum Discount (€000s) observed for Distributor in any week in any theater Theater	.2305** (2.98)	–	–	–
(Reel-at-Risk)× (Maximum Discount in any week in any Theater)	.6474*** (4.58)	.0764*** (2.99)	–	–
Maximum Discount (€000s) observed for any movie run from Distributor, summed Theaters	–	–	.0126*** (3.68)	–
(Reel-at-Risk)× (Maximum Movie-Weeks Discount for any movie run across Theaters)	–	–	.0293*** (4.84)	.00366** (3.43)
Theater Fixed Effects?	Yes	Yes	Yes	Yes
Reel-Week Fixed Effects?	No	Yes	No	Yes
R^2 (or Pseudo R^2)	.4067	.6697	.4100	.6700

Note: Dependent variable is a (0,1) dummy indicating that a reel shown in week t was continued to week t+1. Sample size is 5,185 for all regressions. t-statistics (or asymptotic t- statistics) in parentheses; *, ** and *** denote significance at 0.10, 0.05 and 0.01 levels. Standard errors are clustered by theater-week. The sample consists of all reels with formal contracts throughout their runs or moving from formal contracts to no contracts during their runs.

Table 9 Linear Probability Models for Continuing Reel for an Additional Week using data from Oct 2001 – June 2002, with Distributor-Specific Reel-at-Risk Interactions

			Continuation Surpluses (estimated using data from Jan 2001 – Sept 2001)	
	Linear Probability Estimates	# Contracted Reel Weeks (Oct 2001 – June 2002)	Maximum Movie-Week Discount in any Theater	Maximum Movie-Run Discount across all Theaters
	(1)	(2)	(3)	(4)
Ln(1+New Releases in week t+1)	-.0841*** (-4.47)			
Ln(Revenues in week t)	-0.3556 (-2.82)			
(Reel-at-Risk) × Distributor #1	-0.0458 (-1.24)	769	€ 2,496	€ 52,953
(Reel-at-Risk) × Distributor #2	-0.1012 (-0.92)	566	€ 508	€ 3,510
(Reel-at-Risk) × Distributor #3	-0.1508 (-3.75)	1061	€ 1,636	€ 22,245
(Reel-at-Risk) × Distributor #4	-0.1615 (-4.08)	571	€ 994	€ 17,008
(Reel-at-Risk) × Distributor #5	-0.1974 (-3.86)	41	€ 890	€ 13,726
(Reel-at-Risk) × Distributor #6	-0.2389 (-5.57)	121	€ 865	€ 24,487
(Reel-at-Risk) × Distributor #7	-0.2703 (-4.78)	899	€ 877	€ 15,361
(Reel-at-Risk) × Distributor #8	-0.3556 (-2.82)	1157	€ 1,629	€ 28,916
Theater Fixed Effects?	Yes			
Reel-Week Fixed Effects?	Yes			
R^2	.6711			

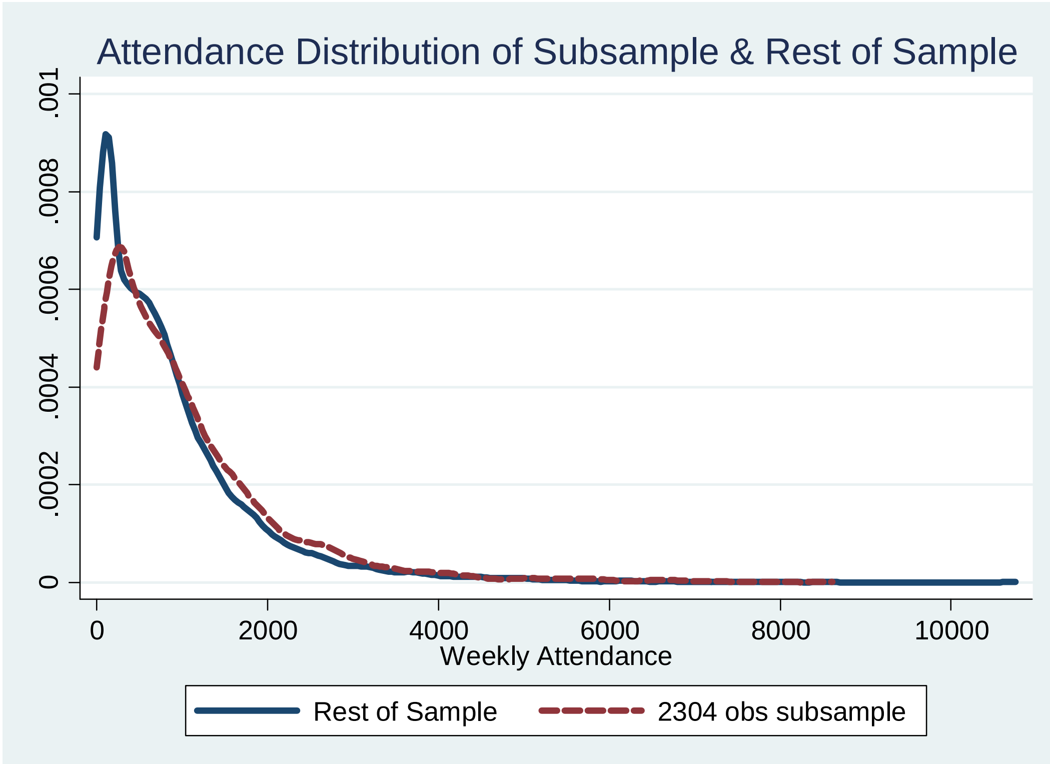
Note: Dependent variable in column (1) is a (0,1) dummy indicating that a reel shown in week t was continued to week t+1. Sample size is 5,185 for all regressions. t-statistics in parentheses; *, ** and *** denote significance at 0.10, 0.05 and 0.01 levels. Standard errors are clustered by theater-week. The sample consists of all reels from eight distributors with formal contracts throughout their runs or moving from formal contracts to no contracts during their runs.

APPENDIX 1

Attendance Threshold

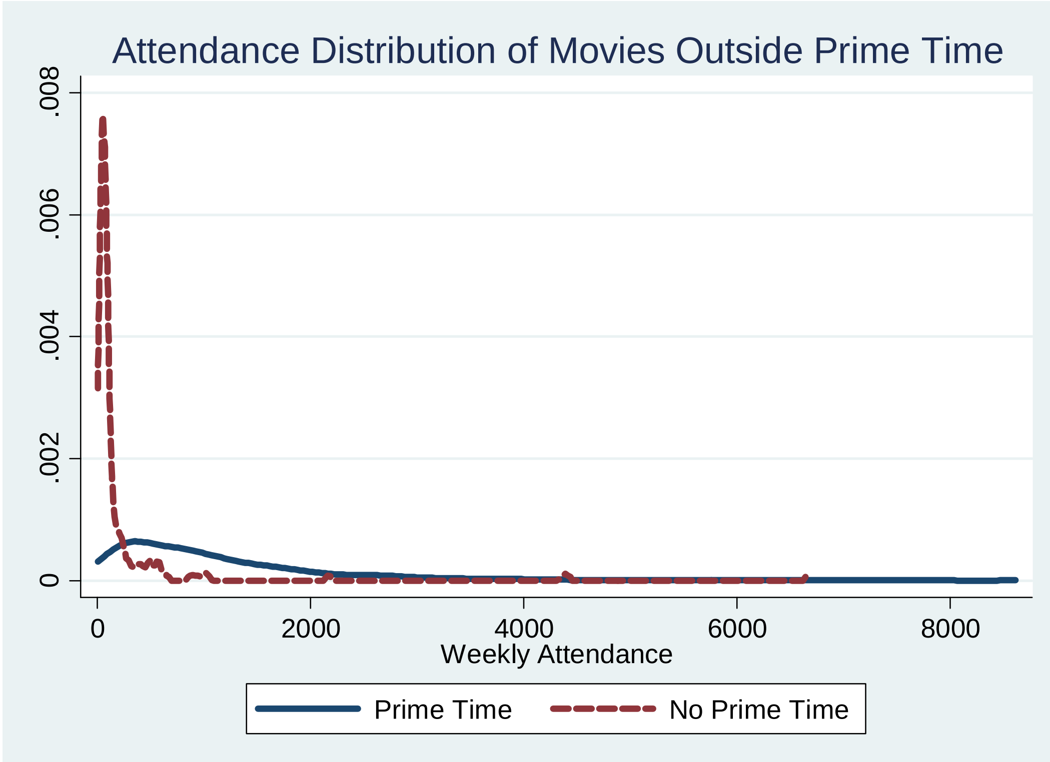
The purpose of this Appendix is to explore how reasonable is the threshold of 100 weekly attendees to separate "Prime-Time" shows from matinees and late night shows that do not necessarily compete for screen space. We must take a stand on this threshold because our data does not include show times or number of weekly shows per movie showing in a theater in a given week. Some movies are likely to show at all times while others may show only a handful of times and at odd times, therefore it is important to understand when a movie is competing for a screen when screen and capacity constraint are binding (that is, in prime time). For this reason, we collected data from two well-known Spanish newspapers (La Vanguardia and El Pais) with time schedules for 12 theaters in our data set located in the provinces of Barcelona and Madrid between January 2001 and June 2001. This subsample contains 2304 observations (out of 19291 in the total data set). In this appendix we aim to (1) note how different this subsample is from our full sample, and (2) how reasonable our threshold of 100 weekly attendees is given that we are able to observe what movies ONLY show outside of "Prime-Time".

Let us start by exploring differences between this subsample and our full sample. See in the graph below that the distribution of attendance of the subsample and the rest of the sample are very similar, and if anything, the rest of the subsample has more data points in the low range of the distribution. This can be explained by the fact that movie theaters outside Madrid and Barcelona (two largest cities in Spain) are newer and larger (more screens) and these screens tend to be smaller on average than those located in larger cities (older theaters with less screens).



When focusing on our subsample of theaters, we define time schedules by prime time (shows starting between 3pm and midnight) and outside prime time (either matinees that start before 3 pm, or late night shows starting after midnight). Out of the 2304 observations in this subsample, 215 week/theater/movie/screen observations (roughly 10%) belong to movies ONLY playing outside prime-time (either matinees) or/and late night shows). If anything, in this subsample Madrid theaters are more likely to play late night shows and Barcelona theaters more likely to play matinees.

In the graph below we explore differences in distribution of attendance for both groups of movies. One can easily see that the distribution of revenues of prime time and no prime time movies is radically different although they share almost the same support. While revenues of movies playing in "Prime Time" are evenly spread across the support, movies only playing outside "Prime Time" are heavily skewed and concentrated towards low levels of attendance.



Finally, let us now explore how different threshold levels affect the two distribution of movies ("Prime Time" versus outside "Prime Time"). So far in the paper we have chosen a cutoff of 100 weekly attendees. According to our subsample, 67% of observations of movies only playing outside of prime time are below 100 attendees, while 4.8% movies playing in prime time are below 100 attendees. We calculate the resulting percentages for other thresholds ranging between 50 and 200 weekly attendees in increments of 25 taking into account that movies playing outside "Prime Time" represent roughly 10% of our subsample. We show the results of this exercise in the table below.

	Percentile Prime Time Movies	Percentile No Prime Time Movies
X<50	1.8%	35%
X<75	3.2%	54%
X<100	4.8%	67%
X<125	6.4%	75%
X<150	8%	77.1%
X<175	9.9%	80.5%
X<200	11.4%	82.1%

Note that a cutoff of 100 seems a reasonable choice because only 4.8% of “Prime-Time” movies are below such threshold while more than two thirds of movies only screening outside “Prime-Time” fall in this category. Given the 9-1 ratio between both groups in the data, increasing the ratio does not seem to justify the increase in probability of eliminating movies outside “Prime-Time”.

Overall, movies in “Prime_Time” average 1120 weekly attendees while movies that only play outside “Prime-Time” average 206 attendees. The fact that the latter is way above 100 comes from the fact that this is highly skewed: the median is 837 for the former and 71 for the latter, so the distribution for the latter seems more skewed than that of the former. Note as well that there may be error in the reporting for the scheduling times of some of these movies that appear as only showing only OUTSIDE prime time. While the 95th percentile of no prime time movies is 571 attendees (very reasonable number), the 99th percentile is 4364 attendees and the four largest values are 2167, 4364, 4412 and 6665 attendees, respectively. We checked the identity of these movies scoring so high, and we found that these are US blockbusters such as “Unbreakable”, “What Women Want”, and “What Lies Beneath” during their first or second weeks after release. This anomaly, if anything, strengthens the likelihood of measurement and coding error and works in our favor when making the choice of 100 weekly attendees as our threshold.

APPENDIX 2

Allowing *x* or *d* to Be Contractible

(in the Relational-Contract Model of Section 3.1)

TO BE WRITTEN!

Broadly along the lines of Section 4.1 from Baker, Gibbons, and Murphy (2011).