

Relational Adaptation under Reel Authority

Daniel Barron

Northwestern University

Robert Gibbons

Massachusetts Institute of Technology

Ricard Gil

Johns Hopkins University

Kevin J. Murphy

University of Southern California

July 3, 2015

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 in what time slots). 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.

* We are very grateful for comments from Jon Levin, Rocco Macchiavello, Julie Mortimer, Pablo Spiller, Tommy Wang, and seminar participants at the AEA, Berkeley-Paris Workshop on Organizational Economics, ISNIE, and MIT Organizational Economics Lunch, and for financial support from MIT Sloan's Program on Innovation in Markets and Organizations. The usual disclaimer applies.

Relational Adaptation under Reel Authority

by Daniel Barron, Robert Gibbons, Ricard Gil, and Kevin J. Murphy

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, the half a century of work from Barnard to Williamson 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.

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 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 *relational adaptation* (i.e., self-enforcing agreements designed to facilitate efficient adaptation), combined with formal contracting, can induce state-dependent decision-making that improves upon the expected payoffs under formal 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.

We begin by providing evidence consistent with the arguments by Williamson and Klein—specifically, we document that informal renegotiations of formal contracts are related to earlier adaptation decisions (akin to a discretionary bonus in an agency problem). Next, we develop simple models to explain how formal contracts and informal renegotiation together facilitate efficient adaptation in an ongoing relationship. Finally, we derive predictions from these models about the incidence and magnitude of such renegotiation, which we then confirm empirically.

To analyze how firms use both formal and self-enforcing agreements to adapt to changes in their environment we exploit an attractive empirical setting: contracts between distributors and exhibitors in the movie industry. After a movie is produced, it is typically distributed to theaters before its release to other channels. When the distributor (i.e., the owner of the movie) and the exhibitor (i.e., the owner of one or more 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 is 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 solely with the exhibitor, not with the distributor.¹

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

Because the formal revenue-sharing contracts between distributors and exhibitors 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 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 adaptation decisions that may become relevant in a given week, it is not surprising that the formal revenue-sharing contracts signed well before the movie's release often are renegotiated. What *is* striking about this renegotiation, however, is that it occurs after the movie has finished its run.² The renegotiation thus occurs 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, to accommodate another movie. 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. Instead, the renegotiation is an informal (i.e., “relational”) payment that may be linked to the earlier adaptation decisions. In this sense, our paper studies relational adaptation under reel authority. We conclude this introduction with an overview of the paper and then a review of the literature.

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 detailed screen-by-screen box-office data during 18 months between January 2001 and July 2002. These data allow us to analyze both richer dependent variables and richer independent variables than in previous work. For

² See Filson et al. (2005) and Cones (1997) for the United States and Gil (2013) for Spain.

example, our dependent variables include two types of exhibitor decisions: not only the decision to show a reel for an additional week, but also the decision to show the reel on a dedicated or 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 shared with, the movie in question.

To motivate our subsequent theory and testing, we first document that, 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 then present evidence that both the probability of renegotiation and the magnitude of the negotiated discount are related to the exhibitor’s decisions whether to continue showing a particular reel for an additional week and, if so, whether to show a particular reel on its own screen (rather than sharing time slots on that screen with another movie). In short, the distributor’s discounts influence the exhibitor’s exercise of reel authority.

Before analyzing empirically the incidence and magnitude of these relational renegotiations, we develop two simple models that motivate our empirical approach. The first is a relational-contract model in which 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). The second is a multi-unit auction model in which multiple distributors compete for a limited number of screens and time slots. From the first model, we demonstrate that that relational renegotiation of formal sharing rates can achieve efficient adaptation: the ex post discounts reward the exhibitor for showing the distributor’s movie for more weeks (or in more time slots) than would have been induced by the formal contract alone. From the second model, we establish that, to achieve efficient adaptation, the ex post discounts should be positively related to the anticipated box-office revenues of the best-dropped and best-shared reels.

Finally, we estimate the probability of renegotiation and the magnitude of the renegotiated discount as a function of the exhibitor’s opportunity cost (the revenues of the best dropped and best shared reels, measured relative to the revenues of the reel subject to

renegotiation). We control for potential differences in bargaining power across theaters using theater fixed effects, and for distributor- or movie-specific factors affecting renegotiations across all theaters in a given week using movie-week fixed effects. Consistent with our hypotheses, we find evidence that both the incidence and magnitude of relational renegotiations are positively and significantly related to our proxies for exhibitor opportunity costs.

We conclude Section 1 with a literature review. Section 2 then describes the institutional setting and data used in our analysis and offers evidence that future renegotiation outcomes are related to continuation decisions. Section 3 develops the relational-contract model (where a single distributor contracts with a single exhibitor) and the multi-unit auction model (where multiple distributors compete for screens and time slots). Section 4 then estimates the frequency and magnitude of renegotiated discounts as a function of the exhibitor's opportunity cost. Section 5 concludes.

1.2 Literature

This paper contributes to several literatures. First, 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.³ 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

³ 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 document the incidence of ex post renegotiation in distribution contracts to video stores.

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

Second, there is some 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. Our multi-unit auction is a complementary approach to their 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.

Third, separate from the literature on movies, there is also a theoretical and empirical literature on *contract renegotiation*. For example, 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. In our paper renegotiation is a unilateral transfer from the distributor to the exhibitor, reducing the formal revenue share that must be paid to the distributor. This unilateral transfer occurs after all decisions about the movie have been taken, not as a simultaneous quid pro quo: the distributor would be unwilling to reduce its revenue share if there were not a valuable future relationship with the exhibitor.

Fourth, there is also 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.⁴ Again, our paper emphasizes the distributor's valuable future relationship with the exhibitor, whereas

⁴ And 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.

the formal models in these papers analyze adaptation in one-shot transactions such as take-or-pay contracts.

Fifth, our paper relates to the literature on the causes and consequences of *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 provided early empirical work. See Malcomson (2013) and Gil and Zananone (2015) for surveys of theory and evidence, respectively.

Finally, our paper contributes to a nascent empirical literature that explores the *decisions* that relational contracts induce. For example, Macchiavello and Morjaria (2015) use unexpected shocks as a source of variation for the actions flower growers and buyers take; in contrast, we use routine (in fact, weekly) 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.

2 Relational Renegotiation in Spanish Exhibitor/Distributor Contracts

2.1 Institutional Details and Data Description

As described in detail below, our empirical analysis is based on distributor-exhibitor contracts from a large movie exhibitor owning a chain of 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.⁵

⁵ 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,

The first step in this negotiation process occurs 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 agree formally 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, 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. Finally (and most importantly, for our purposes), the formal sharing rates are often renegotiated *after* the movie has finished its run (that is, after the exhibitor has made all decisions related to showing the movie).⁶ These renegotiations (when they exist) are initiated by the exhibitor and are characterized as “discounts” from the distributor’s formal sharing rate.

Institutional evidence from the United States (as well as Spain) suggests that renegotiations of sharing rates—often called “settlement transactions”—are typically oral agreements between parties in an ongoing repeated relationship.⁷ For example, Caves (2002, p. 167) concludes that the ex post settlement transaction “reflects the balancing of equities over time that commonly occurs between partners in repeated transactions—a practice reinforced by the distributor’s interest in keeping the exhibitor in the game.” Cones (1997)

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. We do not observe this alternative payment mechanism in our data.

⁶ For example, Squire (1992, p. 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.”

⁷ Cones (1997), Chapter 5 (especially pp. 42-51) provides a rich description of ex post settlement transactions, also called “selling subject to review,” “adjustments,” and “look sees.” Cones 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).

concludes that settlement transactions help distributors get mediocre firms into theaters or obtain more-favorable exhibition terms on future movies.

Figure 1 illustrates 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.

We explore the incidence and magnitude of ex post renegotiations in distributor-exhibitor contracts using detailed weekly data 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.⁹ 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, 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 models in Section 3 and our empirical approach in Section 4 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). In order for the outside

⁸ Theater names are concealed to preserve confidentiality.

⁹ 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.

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), the constraint is less likely to bind for movies shown in daytime matinees or after midnight. Ideally, we would constrain our analysis to prime-time showings, but our data do not include specific show times or screenings per week. We therefore explored using weekly attendance as an imperfect proxy for prime-time movies, using detailed show-time data from local newspapers between January and June 2001 for twelve theaters in Barcelona and Madrid. As described in Appendix 1, we determined that a weekly attendance of 100 was a reasonable cutoff for separating Prime Time and non-Prime Time reels: less than 5% of movies showing during prime time had weekly attendance less than 100, while 67% of movies showing only outside of prime time had attendance less than 100. We therefore exclude 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.¹⁰

Table 1 presents sample means for selected variables used in our analysis: Panel A summarizes data from our entire sample, while Panel B summarizes data from the sample after excluding theater-reel-weeks with weekly attendance less than 100. The sample means are reported for three categories of reels based on contract terms: (1) reels under contract for their entire run; (2) reels switching once from being under contract to not being under contract; and (3) reels not fitting into the previous categories, including reels never under contract, reels initially not under contract but under contract later, and reels switching contractual status more than once. Since our focus is on ex post renegotiation of formal contracts, our primary empirical analysis below is based on reels in the first two categories (indeed, for reels in the second category, we focus on theater-reel-weeks where there is a formal contract), but we use all available theater-reel-weeks when measuring opportunity costs.

As shown in Panel B of Table 1, the average formal share of box office revenues going to the distributor is 53.5% and 50.8% in Categories 1 and 2, respectively.¹¹ Approximately

¹⁰ In (unreported) robustness tests, we determined that the results below are not sensitive to the specific threshold used as a proxy for Prime Time movies, provided that the threshold exceeded 25.

¹¹ 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.

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 rate). Imagining that these negative discounts may be coding errors, we exclude these nine observations from our subsequent analysis.

Finally, Panels A and B in Table 1 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 still about 30% after dropping theater-week-reels with attendance below 100 in Panel B. Such screen-sharing plays an important role below, so we interpret it further here. As one example, a theater might have 5 screens but show 6 reels in a given week, with four reels on dedicated screens and two sharing the last screen (and 33% of the reels thus on shared screens).

To investigate screen-sharing in more detail, Figure 3 shows the distribution of the number of reels shown in each theater-week (with theaters grouped by number of screens), after excluding reel-weeks with fewer than 100 attendees. Roughly speaking, in small theaters (those with 1 to 4 screens) the median number of reels is equal to the number of screens, in mid-sized theaters (those with 5 to 8 screens) it is one greater than the number of screens, and in large theaters (those with 9 or more screens) it is two greater than the number of screens. But the distribution of reels is not symmetric around this median; instead, the distribution has a thick right tail—very few theater-weeks have fewer reels than screens, but at least 25% have at least one more reel than the median number (and, for mid-size and large theaters, this median is already above the number of screens).

2.2 Relational Renegotiation and Continuation Decisions

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). 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

Table 2 illustrates both types of continuation decisions for the 22 theaters in our sample showing "A Beautiful Mind" between February 22 and April 19, 2002.¹³ In particular, the table entries report the negotiated discounts (if any) for weeks the movie was shown in a given theater. Discounts in **bold** indicate theater-weeks in which "A Beautiful Mind" shared a screen with at least one other movie during Prime Time (as inferred from our attendance-based proxy for Prime Time). Table entries of "n/c" (for "no contract") reflect cases where the movie's run extended beyond its original formal contract (e.g., reels in Category 2 in Table 1).

Table 2 shows that 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.¹⁴ 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 Prime Time 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

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.

¹³ 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).

¹⁴ The distribution of ultimate 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.

three stylized facts are not specific to “A Beautiful Mind;” rather, they are broadly representative of the movies in our sample.

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 (assuming that the marginal box-office or merchandizing revenue for each additional screening is strictly positive).¹⁵ 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, surprising hits or flops, 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:

¹⁵ The distributor might also prefer that the reel be transferred to a theater with higher expected revenues from additional screening. 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.

the anticipation of a discount provides incentives for exhibitors to incorporate new information in their continuation decisions.

If the observed renegotiations occurred on a weekly basis, as exhibitors decided which reels to show on which screens and in which time slots, we could interpret the renegotiations as a simultaneous (and likely contractible) quid pro quo—such as an 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 at the end of the reel's run, weeks after the exhibitor has taken any continuation decisions, so the continuation decisions cannot be the result of contemporaneous payments. To the extent that the eventual renegotiations are anticipated by the exhibitor and, as a consequence, affect exhibitor continuation decisions weeks before the renegotiations, the renegotiations must (by definition) be relational: continuation decisions are affected by non-contractual (and hence relational) commitments by the distributor to offer discounts from contractual sharing rates in order to provide incentives for distributor-preferred continuation decisions.

Tables 3 and 4 present evidence suggesting that both the probability of renegotiation and the magnitude of an eventual discount are related to the exhibitor's earlier continuation decisions. Table 3 reports results from linear probability models predicting whether a reel is continued for an additional week (or continued on a dedicated screen for an additional week), using independent variables meant to proxy for the exhibitor's incentives under the formal contract. Table 4 then shows that the probability and size of an eventual discount are negatively related to the reel's predicted continuation probability: reels that were continued in spite of being predicted not to be continued (or continued on a dedicated screen in spite of being predicted to be sharing the screen with another movie) are more likely to be associated with renegotiated discounts after the reel's run is over.

More specifically, columns (1) and (2) of Table 3 report results from linear probability models showing the probability that an exhibitor showing a reel in week t will continue showing the reel in week $t+1$. The independent variables are the number of screens in the theater (which we expect to be positively related to continuation, since more screens increases the exhibitor's degrees of freedom in continuing marginal reels), 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 contracted revenues of the reel in week t (that is, the exhibitor's share multiplied by the total box office revenues). In addition, we include a dummy variable equal to one if the exhibitor's contracted revenues of the reel in week t rank the reel as among the " n " reels with the lowest contracted revenues (where n is the number of new releases coming to the theater in week $t+1$). We expect this last variable to be negatively correlated with continuation decisions, since the n new releases will occupy at least n Prime Time slots, and the n existing reels with lowest contracted revenue will be obvious candidates for elimination, unless the contracts are renegotiated. Column (1) includes no fixed effects, while column (2) includes both theater and movie-week fixed effects.¹⁶ Consistent with our expectations, the probability of continuing a reel for an additional week is positively related to the number of screens in the theater (in Column (1)) and to the current-period contracted revenues, but negatively related to the number of new releases coming to the theater in week $t+1$ and to the dummy variable for being among the n reels with lowest contracted revenue.

Similarly, columns (3) and (4) of Table 3 report results from linear probability models showing the probability that an exhibitor showing a reel on a dedicated screen in week t will continue showing the reel on a dedicated screen in week $t+1$. The sample in columns (3) and (4) is restricted to reels actually shown in week $t+1$; we are thus examining the second continuation decision—continuing to show the reel on a dedicated screen—for the subset of reels that we know will survive the first continuation decision. The independent variables and the use of fixed effects in columns (3) and (4) parallel those in columns (1) and (2), with one difference: our dummy variable for likely displacement is now equal to one if the exhibitor's contracted revenues rank the reel as among the n reels shown *on dedicated screens* with the lowest contracted revenues (where n is again the number of new releases coming to the theater in week $t+1$). As shown in the table, the probability of continuing a reel on a dedicated screen for an additional week is negatively related to the number of new releases coming to the theater in week $t+1$ and to the dummy variable for being among the n reels shown on dedicated screens with lowest contracted revenues; the coefficient on the number of screens in column (3) (without theater or movie-week fixed effects) is insignificant.

¹⁶ Since the number of screens in the theater does not change over time for a given theater, we do not include $\ln(\# \text{ of Screens in Theater})$ in regressions with theater fixed effects.

The purpose of Table 3 was not to test any hypothesis, but rather to estimate the predicted continuation probabilities based on the exhibitor's formal contracts. We then use these probabilities in Table 4 to analyze whether future renegotiations are related to current continuation decisions. Specifically, Panel A of Table 4 reports the average frequency and magnitude of subsequent renegotiations for theater-reel-weeks grouped by quintiles of the predicted continuation probability estimated in column (2) of Table 3.¹⁷ We use this two-step approach because we observe contractual terms (including discounts) only for reels that are actually continued. That is, while Table 3 is based on all theater-reel-weeks in week t , independent of whether the reel is continued in week $t+1$, Panel A of Table 4 is based only on reels that were shown in both week t and week $t+1$. Therefore, since all the theater-reel-weeks in Panel A were continued, observations in the lowest quintile are 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 evident from Panel A of Table 4, the frequency of renegotiation, the average discount (including theater-reel-weeks with no discount), and the average positive discount (excluding including 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 quintiles in column (3) are not significantly different from each other. We interpret these results as strong motivational evidence that future renegotiation outcomes are related to current decisions of whether to continue showing or drop a reel.

Panel B of Table 4 reports the average frequency and magnitude of subsequent renegotiations for theater-reel-weeks grouped by quintiles of the predicted continuation probability estimated in column (4) of Table 3. The sample in Panel B of Table 4 includes only theater-reel-weeks where the reel is shown on a dedicated screen in both weeks t and $t+1$. Observations in the lowest quintile are interpreted as reels that were continued on dedicated screens in spite of being predicted to share a screen with another reel, while

¹⁷ These predicted continuation probabilities are perfectly correlated with the residuals from Table 3 because the sample available for Table 4 has a fixed value of the dependent variable in Table 3.

observations in the highest quintile are reels that were expected to be continued on a dedicated screen and were, indeed, continued.

Similar to the qualitative features of Panel A in Table 4, Panel B shows that the frequency of renegotiation and the average discount decline monotonically across quintiles: reels shown on a dedicated screen that were predicted to be shown on a shared screen are more likely to receive discounts. The positive discounts (i.e., after excluding zeros) in column (3) generally decline as well except for in the lowest quintile. The quantitative results in Panel B are not as strong as in Panel A: in columns (1) and (2), the first and second quintiles are significantly different from the third, fourth, and fifth quintiles at the 1% level or better, but no other pairs (e.g., Quintile 1 vs Quintile 2, or Quintile 3 vs. Quintile 4 or 5) are significantly different from each other. In column (3), the first and second quintiles are significantly different from the fifth quintile at the 5% level, and different from the fourth quintile at the 10% level; no other pairs are significantly different from each other. 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.

The results in Table 4 suggest that discounts associated with a given reel-week are an omitted variable in Table 3's regressions for whether that reel continued to be shown in that week or continued to be shown on a dedicated screen in that week. In the next section, we present a model in which the anticipation of such discounts induces the exhibitor to continue a movie he would have dropped or moved to a shared screen if the exhibitor's decisions had been based solely on the formal contract.

3 Two Simple Models

3.1 Introduction

This section develops two simple models to illustrate separate aspects of our empirical approach. The first is a relational-contract model in which a distributor and an exhibitor can enter into a formal revenue-sharing contract before the movie has been released. At the time of formal contracting, there is uncertainty over the exhibitor's opportunity cost—e.g.,

revenues from an alternative movie. After uncertainty is resolved, efficient adaptation means showing the movie if and only if its value exceeds its cost.

Two related results emerge from this first model. First, for intermediate discount factors, a relational contract without a formal contract is not optimal; the parties can do better if they also sign a formal contract to support the relational contract, because the formal contract can reduce the renegeing temptation in the relational contract.¹⁸ Second, again for intermediate discount factors, relational renegotiation of this formal contract can achieve efficient adaptation: *after the movie has finished its run*, the distributor allows the exhibitor to retain a greater revenue share than the formal contract specifies (i.e., the distributor allows a “discount” from what the formal contract would allow the distributor to receive), as a reward for the exhibitor showing the distributor’s movie more than would have been induced by the formal contract alone.

Our relational-contract model considers only a single distributor offering a single movie to a theater with a single screen and time slot and assumes that the exhibitor’s opportunity cost is exogenous. In our second model, we consider multiple distributors, thereby endogenizing the exhibitor’s opportunity cost of showing one distributor’s movie in terms of the potential revenue from showing another distributor’s movie. In addition, we enrich the modeling of the exhibitor, allowing both multiple screens and multiple time slots. The cost of these enrichments, however, is that we abandon both relational contracts and ex ante formal contracts. That is, our second model focuses on the one-shot version of the ex post 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?

To solve this ex post problem, we analyze a multi-unit auction where distributors’ bids are sharing rates. We show that winning bids will be positively related to the anticipated box-office revenues of the “best dropped” reel (that is, the reel with the highest revenues that was dropped in the prior week) and the “best shared” reel (that is, the reel with the highest revenues that shares a screen with other reels in the same theater).

¹⁸ See Baker, Gibbons, and Murphy (1994) for an early result in this spirit, in an agency setting, and Malcolmson (2013) for a review of subsequent work.

In principle, one could imagine combining these two simple models, investigating the role of ex ante formal contracts in a relational multi-unit auction. We do not attempt this task here. Instead, we take from the first 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 take from the second model an understanding of what pricing (via this relational renegotiation) would induce the efficient allocation of movies to screens and time slots. These two understandings then guide the empirical work in the following section.

We also take one more thing from each of these simple models: an interpretation of the empirical work in the *previous* section. As we discuss at the end of each sub-section below, each model offers an interpretation of what is in the residual from the estimation of continuation decisions in Table 3 that then has explanatory power for the estimation of renegotiation outcomes in Table 4.

3.2 *Relational Adaptation Supported by Formal Contracting*

In this first model 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 with sharing rate β , meaning that the exhibitor receives βv and the distributor $(1 - \beta)v$ if the movie is shown; (2) E's outside option, x , is publicly realized, where $x = L$ or M or H with probabilities q_L , q_M , and q_H , and $L < M < v < H$; (3) E chooses either to show D's movie ($d = 1$) or to take her outside option ($d = 0$); and (4) D can make a payment b to E (where a payment instead from E to D is $b < 0$). The payoffs are then $d(1 - \beta)v - b$ to the distributor and $(1 - d)x + d\beta v + b$ to the exhibitor. The first-best decision rule, maximizing $(1 - d)x + dv$, is thus $d = 1$ if $x = L$ or $x = M$ and $d = 0$ if $x = H$.¹⁹

Before analyzing this model, we describe its goal: an understanding of why the parties might write a formal contract ex ante, only to renegotiate it after the movie has finished its

¹⁹ Without the formal contract (β), this static model would be an elemental "adaptation" model, where there are no contracts ex ante or ex post, so renegotiation ex post cannot induce first-best adaptation after uncertainty is resolved. See Gibbons (2005) for 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 decision rights ex ante (but not a formal contract) to help enforce their relational contract.

run. Several potential enrichments to the model might add realism but seem unlikely to overturn the model's intended message. First, as we have noted, 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 times, and so on. Second, the movie's box-office revenue is of course both uncertain and potentially a function of the exhibitor's decisions beyond whether to show the movie. Third, both parties may have payoffs beyond their share of the movie's revenues—such as from concessions for the exhibitor and from merchandising for the distributor.

Other potential enrichments to the model could threaten our intended lesson from the model, so these enrichments need to be discussed. For example, the timing above assumes that neither x nor d is contractible.²⁰ In reality, both x and d probably are contractible, but at a cost. If x were contractible, then formal revenue-sharing could depend on x , such as via $\beta(x)v$; similarly, if d were contractible, then the ex post payment could depend on d , such as via $b(d)$. In both cases, the question is whether a model that allowed x and/or d to be contractible at a plausible cost would still deliver our intended lesson. To address these questions, in Appendix 2 we present two enrichments of the model above—one where x is contractible at a cost, and another where d is contractible at a cost. We then show that, if the cost is high enough, and if the parties are patient enough, then the results of the model above remain intact: the parties use their relationship to avoid the costs of making x or d contractible; instead, as in the model above, they write a formal contract ex ante and renegotiate it ex post, thereby achieving efficient adaptation through their relational contract.

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, $\beta v \geq x$. The distributor's payoff is negative if $\beta = H/v$, so the distributor chooses either $\beta = L/v$ or $\beta = M/v$, depending on parameters. We assume that $q_L(M - L) \geq q_M(v - M)$, so that the distributor's optimal formal contract in the one-shot game is $\beta^{\text{os}} = L/v$. That is, under this parameter assumption, the distributor prefers to offer the exhibitor a small

²⁰ Given the simplifications that d is binary and v is certain, d is *indirectly* contractible through appropriate choice of β , just as the agent's effort is indirectly contractible in agency models where any given effort level can be induced by an appropriate compensation contract.

share and have the movie shown only if $x = L$, rather than offer a share large enough to have the movie shown when $x = M$ but thereby overpay when $x = L$.²¹ The parties' payoffs in the one-shot game are thus $E^{os} = E(x)$ to the exhibitor and $D^{os} = q_L(v - L)$ to the distributor.

We now turn to the repeated game. The distributor's optimal formal contract in the one-shot game leaves room for relational contracting to 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 if $x = M$. Consistent with our empirical setting, such payments ($b > 0$) are provided after the movie has finished its run.

In the empirical work in Section 4, we study the incidence and magnitude of relational renegotiations in this equilibrium. Concerning incidence, there is no need for renegotiation if the exhibitor's revenue from the formal contract exceeds her outside option, $\beta v \geq x$. Concerning magnitude, provided $x > \beta v$, the observed discount should be (weakly) increasing in $x - \beta v$.²² Thus, the key *parameters* are x , v , and β , which we explore below; the key *behavior* is the exhibitor's decision, d , which we explored in Table 3 above.

The relational-renegotiation equilibrium we construct assumes stationarity (i.e., it involves the same actions each period on the equilibrium path) and Nash threats (i.e., following a deviation, the parties revert to the equilibrium of the one-shot game described above). In every period: the distributor offers the formal contract β , which the exhibitor

²¹ The parties are risk-neutral, so agency theory might lead one to expect that an optimal contract could achieve the first-best for any parameters. Formally, the distributor's optimal contract in our one-shot model does not achieve the first-best because the contract includes only a sharing rate (β), not a non-contingent payment (akin to a salary in an agency model). However, the agency analogy is misleading here; instead, distributor-exhibitor transactions face a two-sided moral-hazard problem, for at least two reasons. First, the distributor engages in (unmodeled) marketing effort that affects v . Second, the distributor has multiple (unmodeled) reels of the movie, so the first reel may be worth v if no other reels are shown by surrounding exhibitors, but it may be worth much less than v if many reels are shown nearby. Adding either of these two-sided moral-hazard considerations to the model would make it impossible for a formal contract to achieve the first-best even with a non-contingent payment. Similarly, enriching the model to include a non-contractible private benefit for the distributor when the movie is shown—such as from merchandizing rights or revenues from potential sequels—would also make it impossible for a formal contract to achieve the first-best even with a non-contingent payment; we consider private benefits in Appendix 3.

²² Our model has only one value of x that should lead to renegotiation ($x = M$), so there will not be any variation in the observed discount if the model is taken literally. In a richer model there could be more values of x that lead to renegotiation—such as $L < M_1 < M_2 < v < H$. Also, in the data, there could be variation in the parameter M across movie-theater-weeks, so there could be different observed discounts for different movie-theater-weeks, with the estimated discount thus increasing in $x - \beta v$.

accepts; the exhibitor then observes x and takes the first-best decision; and the distributor pays the exhibitor $b > 0$ iff $x = M$ and $d = 1$. On the equilibrium path, the continuation payoffs to the distributor and the exhibitor are therefore $V^D = q_L(1-\beta)v + q_M[(1-\beta)v - b]$ and $V^E = q_L\beta v + q_M[\beta v + b] + q_H H$ per period. If there is a deviation, the parties receive payoffs D^{os} and E^{os} in all future periods, so the parties face two incentive constraints. First, the exhibitor must be willing to choose $d = 1$ when $x = M$:

$$\beta v + b + \frac{1}{r} V^E \geq M + \frac{1}{r} E^{os} \quad . \quad (3.1)$$

Second, the distributor must be willing to pay $b > 0$ if $x = M$ and $d = 1$:

$$-b + \frac{1}{r} V^D \geq \frac{1}{r} D^{os} \quad . \quad (3.2)$$

There exists a b satisfying these two conditions only if

$$M - \beta v \leq \frac{1}{r} (V^D + V^E - D^{os} - E^{os}) \quad , \quad (3.3)$$

where $V^D + V^E - D^{os} - E^{os} = q_M(v - M)$.

Our equilibrium thus imposes a lower bound on the exhibitor's formal share:

$$\beta \geq \frac{M}{v} - \frac{1}{r} q_M \left(1 - \frac{M}{v}\right) \quad . \quad (3.4)$$

For r sufficiently close to 0, the righthand side of (3.4) is negative, implying that if the parties are sufficiently patient then they can implement efficient adaptation without using a formal contract ($\beta = 0$).²³ At the other extreme, for very large r , the righthand side of (3.4) approaches M/v , implying that if the parties are very impatient then they cannot implement first-best decisions without a formal contract that induces the exhibitor to show the movie even if $x = M$. Finally, for intermediate values of r (determined in part by the distributor's participation constraint), our equilibrium mimics our data: a non-trivial formal contract ($\beta > M/v$) is used to support the relational contract, but the formal contract is relationally renegotiated to achieve efficient adaptation ($b > 0$ when $x = M$ and $d = 1$).

²³ Indeed, the parties can achieve the first-best without using a formal contract for higher values of r by using a relational contract with payments b_L if $x = L$ and payments b_M if $x = M$, instead of only the latter as we have analyzed. But even this richer approach fails at some critical value of r . Therefore, above this critical value, a relational contract without a formal contract is not optimal; the parties can do better if they sign a formal contract that supports the relational contract by reducing the reneging temptation in the relational contract.

As in any repeated game, there are of course other equilibria. In particular, two equilibria that also achieve the first-best (and that also exist when our equilibrium exists) are worth noting. Both of these alternative equilibria again use formal contracts to support relational contracts, but their renegotiation patterns do not fit our data. First, the formal contract might sometimes be renegotiated in favor of the distributor; for example, the exhibitor might refund the distributor part of the formal contract if $x = L$. Second, there may be no discounts at all: the distributor might instead offer the exhibitor a generous formal contract and use the threat of reverting to the one-shot contract to induce first-best decision-making. But when our equilibrium exists, there is no obvious reason that the parties will play another equilibrium—which, at best, would redistribute the first-best payoffs between the parties.

To conclude this discussion of relational contracting, we return to the issue of what might be in the residual from Table 3 that then has explanatory power in Table 4. In Appendix 3 we enrich our relational-contract model to provide two possible explanations, both based on the idea that Table 3 omits variables correlated with the renegotiated payments that influence continuation decisions. First, private benefits to the distributor (e.g., sequels or merchandizing rights) or the exhibitor (e.g., concessions) might make total box-office revenues a poor proxy for joint exhibitor-distributor surplus. Second, variations in contracted revenue shares across movies shown by the exhibitor in the current week might create discrepancies between rankings by total revenues versus by the exhibitor's contracted revenue.

3.3 *Endogenous Opportunity Costs in a Multi-Unit Auction*

We now consider multiple distributors, thereby endogenizing the exhibitor's opportunity cost of showing one distributor's movie by considering the potential revenue from showing another distributor's movie. As explained in Section 3.1, we now focus on the following 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?

We analyze D distributors, each with one movie, bidding to have one exhibitor show their movie in one or more of T time slots.²⁴ The exhibitor has $S < D$ screens, so not every movie can be shown in all time slots. We further simplify by assuming that screens and time slots are equivalent, but a movie generates less revenue from showing in its second time slot than in its first, and likewise for subsequent showings. In particular, the total revenue from showing movie m in n time slots is $\gamma_n v_m$ where $\gamma_0 = 0$, $\gamma_1 = 1$, $\gamma_{n+1} > \gamma_n$, and $\gamma_{n+1}/(n+1) < \gamma_n/n$. All movies experience the same proportional diminishing returns—i.e., γ_n is independent of m . Movies are indexed by their first-slot expected revenue: $v_1 > \dots > v_m > \dots > v_D$. These revenues are common knowledge.

To solve for the efficient allocation of movies to screens and time slots, as well as the prices that will induce this allocation, we analyze a multi-unit Vickrey auction. Each distributor submits T bids and the ST highest bids are awarded a time slot on a screen. A bidder who is awarded t time slots pays the sum of the t highest losing bids made by other distributors. (Of course, were this a single-unit auction, this payment rule would define a second-price auction.) Parallel to a single-unit Vickrey auction, Krishna (2009) shows that in a multi-unit Vickrey auction it is a weakly dominant strategy to bid one's valuations (Proposition 13.1) and that the resulting allocation is efficient (Proposition 13.2). In our setting, bidding one's valuation means bidding the marginal value $(\gamma_{n+1} - \gamma_n)v_m$ for the n^{th} slot for movie m , for $n = 1, \dots, T$.

The following example forges a connection to the empirical work below. Suppose four distributors want to show their movies at a theater with two screens and two time slots. Furthermore, suppose $v_1 > (\gamma_2 - 1)v_1 > v_2 > v_3 > (\gamma_2 - 1)v_2 > v_4 > (\gamma_2 - 1)v_3$. Then distributor 1 gets two time slots, generates $v_1 + (\gamma_2 - 1)v_1$ in revenue, and pays $(\gamma_2 - 1)v_2 + v_4$ (the sum of the two highest losing bids made by other distributors), whereas distributor 2 gets one time slot, generates v_2 in revenue, and pays v_4 (the highest losing bid made by another

²⁴ For simplicity, the exhibitor has only one theater and each movie has only one reel. In reality, a distributor may have more than one movie at once in a given theater, but if these movies are from different producers then contracts between the distributor and each producer may force the distributor to treat the movies independently.

distributor), and distributor 3 gets one time slot, generates v_3 in revenue, and pays $(\gamma_2 - 1)v_2$.²⁵

Empirically, there is an important distinction between the payments $(\gamma_2 - 1)v_2$ and v_4 : both are losing bids (and so not directly observed in our data), but v_4 is based on a movie that was not shown at all, whereas $(\gamma_2 - 1)v_2$ is based on a movie that was shown once but not twice. Put differently, v_4 defines the extensive margin (i.e., deciding whether to show the movie at all), whereas $(\gamma_2 - 1)v_2$ defines the intensive margin (i.e., deciding whether to give the movie an additional time slot).

In the empirical work below, we take the set of “dropped” movies to be those that were shown in a given theater last week but not this week. In the example above, imagine that movies 2, 3, and 4 were shown last week, but movie 1 is a new arrival this week. Given the bidding outcome computed above for this week, the only movie dropped this week is movie 4, but more generally there could be many dropped movies. One result from the multi-unit auction is that the bid paid by a movie that is shown this week could depend on the expected revenue from any dropped movie, but a second result is that if this bid depends on any dropped movie then it depends on the best dropped movie, so we use the best dropped movie in our empirical work. Similarly, a third result from the auction is that the bid paid by a movie that is shown this week can depend on the expected revenue of any (other) movie that shares a screen this week, but a fourth result is that if this bid depends on any movie that shares a screen then it depends on the best movie that shares a screen, so we use the best shared movie in our empirical work.

Thus far in this sub-section, we have focused on the distributors’ bids in the multi-unit auction, ignoring ex ante formal contracts. To connect this analysis to the data, we now reintroduce formal contracts in the simplest possible way: we assume that the distributors’ 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. Given this assumption, the example above illustrates that a distributor may need to bid more than the formal contract

²⁵ As Krishna notes, the Vickrey auction can seem unfair, in the sense that distributor 2 values time slots more than distributor 3 does (and acknowledges this by bidding higher), but 2 nonetheless pays less than 3 does because the highest failed bid was submitted by 2.

specifies to win a *second* time slot for a movie, even if the formal contract is sufficient to induce the exhibitor to show the movie in one time slot.

4 The Determinants of Relational Renegotiation

In Section 2.2 we offered evidence that future renegotiation outcomes are related to 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). In Section 3.2 we showed that relational renegotiation can achieve efficient adaptation (for suitable parameters): after the movie has finished its run, the distributor allows the exhibitor to retain a greater revenue share than the formal contract specifies, as a reward for the exhibitor showing the distributor's movie longer (or, in an unmodeled extension, in more time slots) than would have been induced by the formal contract alone. In Section 3.3 we showed that winning bids in a multi-unit auction are positively related to the anticipated box-office revenues of the "best dropped" reel (that is, the reel with the highest revenue that was dropped after the prior week) and the "best shared" reel (that is, the reel with the highest revenue that shares a screen with other reels in the same theater this week). In this section, we combine the implications of these models by analyzing empirically whether the frequency and magnitude of relational renegotiations are related to the anticipated box-office revenues of the best-dropped and best-shared reels.

The anticipated box-office revenues of the best-dropped reel is a measure of the opportunity cost the exhibitor faces from showing the distributor's reel instead of an alternative reel. Similarly, the box-office revenues of the best-shared reel is a measure of the opportunity cost the exhibitor faces from showing the distributor's reel on a dedicated screen rather than a shared screen. Implicit in these examples of opportunity costs is the assumption (consistent with our understanding of the institutional setting) that the best reel available to the exhibitor in a particular theater in a particular week may differ substantially from the best reel showing in or arriving at other theaters that week.

Of course, we cannot observe the current-period box-office revenues of the best-dropped reel since, by construction, the best-dropped reel was not shown during the current week. We proxy for what the box-office revenues of the best-dropped reel would have been by using the reel's revenues from the prior week; we therefore likely overestimate the

opportunity cost of the best-dropped reel, since revenues predictably decrease over time. Similarly, while we can measure the current-period box-office revenues of best-shared reel, we cannot measure the revenues that reel would have realized if it had been shown on a dedicated screen (i.e., in all the Prime Time slots). We proxy for the box-office revenues the best-shared reel would have realized if it had been shown on a dedicated screen by using the reel's revenues from the current week; we therefore likely underestimate this opportunity cost, since revenues likely increase when the reel is shown in additional Prime Time slots on the same screen.

Table 5 illustrates our approach by returning (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, (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 (declining) discounts; Theater 1 is not included because the movie was discontinued in that theater after Week 6.

Even within this movie-week, Table 5 shows substantial variation across theaters in all four numbered columns. Weekly box-office revenues for this movie this week range from €873 to €13,172; 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). And most importantly, 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 empirical approach exploits such variation within movie-weeks to analyze the relation between discounts, revenues, and opportunity costs. To do so, the regressions below include movie-week fixed effects, thereby controlling for the national (or international) success of the movie, the predictable depreciation in box-office revenues over time (which varies considerably across movies), the success or failure of new releases (effectively a week-specific “common shock” to the industry), and any other factors affecting all reels of

the same movie in the same week. In addition, to control for theater-specific factors (such as location, managerial talent, or other factors), the regressions include theater fixed effects.

In fact, we use not just movie-week fixed effects but instead the richer “reel-movie-week” fixed effects, because the factors affecting a movie’s first reel in a given theater (which we define as the reel with the highest revenues) are different from the factors affecting additional reels of the same movie.²⁶ In our empirical analysis, we are therefore comparing first reels with other first reels, second reels with other second reels, and so on. This approach allows us to treat the anticipated box-office revenues of an available second reel of one movie as the opportunity cost for a different movie. Results available upon request show that our conclusions are robust to (a) dropping all but the first reels, or (b) keeping all reels but including movie-week (rather than reel-movie-week) fixed effects.

As shown in Section 3.2, formal contracts are expected to be renegotiated if

$$\beta v < x < v , \quad (4.1)$$

where v is the total box-office revenues of the current movie, β is the exhibitor’s contracted share of box-office revenues, and x is a measure of the opportunity cost. Table 6 reports results from linear probability models 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 $x - \beta v > 0$, 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), and both measures of opportunity cost are regressors in column (3). The regressions include theater and reel-movie-week fixed effects. 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.

²⁶ Regarding Table 5, note that there were no theaters in our sample showing “A Beautiful Mind” on more than one screen (i.e., using more than one reel) in the seventh week.

Consistent with our predictions, 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 6, 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.

Conditional on renegotiation, the smallest discount satisfying equation (3.1) is

$$b = \frac{M}{v} - \beta - \frac{(V^E - E^{os})}{rv}, \quad (4.2)$$

where, to coincide with the data, we have now expressed b as a sharing rate, rather than in Euros. As discussed in Section 3.2, our model predicts renegotiation for only one value of x —namely, $x = M$, as shown in the M/v term of equation (4.2)—but a richer model could have renegotiation for multiple values of x , resulting in multiple values of b . Table 7 reports results from ordinary least-square regressions where the dependent variable is the renegotiated discount (i.e., the difference between the exhibitor's final share of the box-office revenues and the contracted share) and the independent variables are measures of x/v (where we predict a positive sign) and the exhibitor's contracted share, β (where we expect a negative sign). Analogous to Table 6, in Table 7 the independent variable x/v in column (1) is the revenues of the best-dropped reel in week $t-1$ divided by the revenues of the focal movie in week t , while the independent variable x/v 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 , and both measures of x/v are regressors in column (3). We again cluster standard errors at the theater-week level, for the same reasons mentioned above.

Consistent with our predictions, the magnitude of the discount is positively and statistically significant 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 7 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.

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: 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 models predict, 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. In short, the parties appear to be using relational renegotiation to approximate 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?

Compared to the more familiar model of relational incentive contracting, one advantage of the relational-adaptation model is that many of the variables may be either observable or relatively easy to proxy. In relational incentive contracting, the agent takes a hidden action, which influences a non-contractible output, which determines a relational bonus payment. 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 movies data, an empiricist studying supply transactions might be able to observe or proxy for all the variables of interest: 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.

References

- Arrow, Kenneth. 1953. "Le role des valeurs boursieres pour la repartition la meilleure des risques." *Econometrie*, Centre National de la Recherche Scientifique, Paris, 41-48.
- Baker, George, Robert Gibbons, and Kevin J. Murphy. 1994. "Subjective Performance Measures in Optimal Incentive Contracts," *The Quarterly Journal of Economics* 109 (4): 1125-1156.
- Baker, George, Robert Gibbons, and Kevin J. Murphy 2011. "Relational Adaptation." Unpublished manuscript.
- Benmelech, Efraim, and Nittai Bergman. 2008. "Liquidation Values and the Credibility of Financial Contract Renegotiation: Evidence from U.S. Airlines," *The Quarterly Journal of Economics* 123(4): 1635-1677.
- Bull, Clive. 1987. "The Existence of Self-enforcing Implicit Contracts." *Quarterly Journal of Economics* 102; 147-59.
- G rard Cachon, Martin Lariviere. 2005. "Supply chain coordination with revenue sharing: strengths and limitations," *Management Science* 51(1), 30 – 44.
- Cai, Hongbin, Hongbin Li and Li-An Zhou. 2010. "Incentives, Equality and Contract Renegotiations: Theory and Evidence in the Chinese Banking Industry," *Journal of Industrial Economics* 58: 156-189.
- Caves, Richard E., 2002. *Creative Industries: Contracts between Art and Commerce*. Harvard University Press.
- Cones, John W., 1997. *The Feature Firm Distribution Deal: A Critical Analysis of the Single Most Important Firm Industry Agreement*. Southern Illinois University Press.
- Crocker, Keith and Scott Masten. 1988. "Mitigating Contractual Hazards: Unilateral Options and Contract Length." *Rand Journal of Economics* 19(3): 327-43.
- Crocker, Keith and Scott Masten. 1991. "Pretia ex Machina? Prices and Process in Long-Term Contracts." *Journal of Law and Economics* 34(1): 69-99.
- Crocker, Keith and Kenneth Reynolds. 1993. "The Efficiency of Incomplete Contracts: An Empirical Analysis of Air Force Engine Procurement." *RAND Journal of Economics* 24(1): 126-46.
- Dana, James, and Kathryn Spier. 2001. "Revenue Sharing and Vertical Control in the Video Rental Industry," *Journal of Industrial Economics* 49(3): 223-45.
- Filson, Darren, David Switzer, and Portia Besocke. 2005. "At the Movies: The Economics of Exhibition Contracts," *Economic Inquiry* 43(2): 354-69.
- Forbes, Silke and Mara Lederman. 2009. "Adaptation and Vertical Integration in the Airline Industry." *American Economic Review* 99: 1831-49.

Gibbons, Robert. 2005. "Four Formal(izable) Theories of the Firm?" *Journal of Economic Behavior and Organization* 58: 200-245.

Gil, Ricard. 2013. "The interplay of formal and relational contracts: Evidence from movies," *Journal of Law, Economics, and Organization* 29(3): 681-710.

Gil, Ricard, and Francine Lafontaine. 2012. "Using revenue sharing to implement flexible prices: Evidence from movie exhibition contracts," *Journal of Industrial Economics* 60 (2): 187-219.

Gil, Ricard, and Giorgio Zanarone. 2015. "On the Determinants and Consequences of Informal Contracting." Unpublished manuscript.

Grossman, Sanford. 1981. "An Introduction to the Theory of Rational Expectations Under Asymmetric Information." *Review of Economic Studies* 48: 541-59.

Hanssen, F. Andrew. 2002. "Revenue-Sharing in Movie Exhibition and the Arrival of Sound," *Economic Inquiry* 40(3): 380-402.

Klein, Benjamin. 1996. "Why Hold-ups Occur: The Self-Enforcing Range of Contractual Relationships." *Economic Inquiry* 34: 444-63.

Klein, Benjamin. 1999. "Distribution Restrictions Operate by Creating Dealer Profits: Explaining the Use of Maximum Resale Price Maintenance in *State Oil v. Khan*." *Supreme Court Economic Review* 7: 1-58.

Klein, Benjamin. 2000. "The Role of Incomplete Contracts in Self-Enforcing Relationships," *Revue D'Économie Industrielle* 92: 67-80.

Klein, Benjamin, and Kevin M. Murphy. 1988. "Vertical Restraints as Contract Enforcement Mechanisms." *Journal of Law and Economics* 31: 265-97.

Levin, Jonathan. 2003. "Relational Incentive Contracts." *American Economic Review* 93: 835-57.

MacLeod, Bentley, and James Malcomson. 1989. "Implicit contracts, incentive compatibility, and involuntary unemployment." *Econometrica* 57: 447-80.

Macaulay, Stewart. 1963. "Non-Contractual Relations in Business: A Preliminary Study." *American Sociological Review* 28: 55-67.

Masten, Scott and Keith Crocker. 1985. "Efficient Adaptation in Long-Term Contracts: Take-or-Pay Provisions for Natural Gas." *American Economic Review* 75(5): 1083-93.

McMillan, John, and Christopher Woodruff. 1999. "Interfirm Relationships and Informal Credit in Vietnam." *Quarterly Journal of Economics* 114: 1285-320.

Macchiavello, Rocco, and Ameet Morjaria. 2015. "The Value of Relationships: Evidence form a Supply Shock to Kenyan Rose Exports." Unpublished manuscript.

Macneil, Ian. 1978. "Contracts: Adjustment of Long-Term Economic Relations Under Classical, Neoclassical and Relational Contract Law." *Northwestern University Law Review* 72: 854-906.

Malcolmson, James. 2013. "Relational incentive contracts," In Robert Gibbons and John Roberts (eds.), *The Handbook of Organizational Economics*, chapter 25, pp. 1014-1065 (Princeton University Press).

Mortimer, Julie. 2008. "Vertical Contracts in the Video Rental Industry," *The Review of Economic Studies* 75(1): 165-199.

Mukherji, Ananda and John Francis. 2008. "Mutual adaptation in buyer-supplier relationships." *Journal of Business Research* 61: 154-61.

Poppo, Laura and Todd Zenger. 2002. "Do Formal Contracts and Relational Governance Function as Substitutes or Complements?" *Strategic Management Journal* 23(8): 707-25.

Raut, Sumit, Sanjeev Swami, Eunhyu Lee, and Charles B. Weinberg. 1998. "How Complex Do Movie Contracts Need to Be?" *Marketing Science* 27(4): 627-641.

Simon, Herbert. 1951. "A Formal Theory of the Employment Relationship." *Econometrica* 19: 293-305.

Squire, Jason E. 1992. *The Movie Business Book: The Inside Story of the Creation, Financing, Making, Selling and Exhibition of Movies*. 2nd edition. Simon & Schuster.

Swami, Sanjeev, Jehoshua Eliashberg, and Charles B. Weinberg. 1999. "SilverScreener: A Modeling Approach to Movie Screens Management," *Marketing Science* 18(3): 352-372.

Williamson, Oliver. 1971. "The Vertical Integration of Production: Market Failure Considerations." *American Economic Review* 63: 316-25.

Williamson, Oliver. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*, New York, NY: Free Press.

Williamson, Oliver. 1991. "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives." *Administrative Science Quarterly* 36: 269-96.

Williamson, Oliver. 2000. "The new institutional economics: Taking stock, looking ahead." *Journal of Economic Literature* 38: 595-613.

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

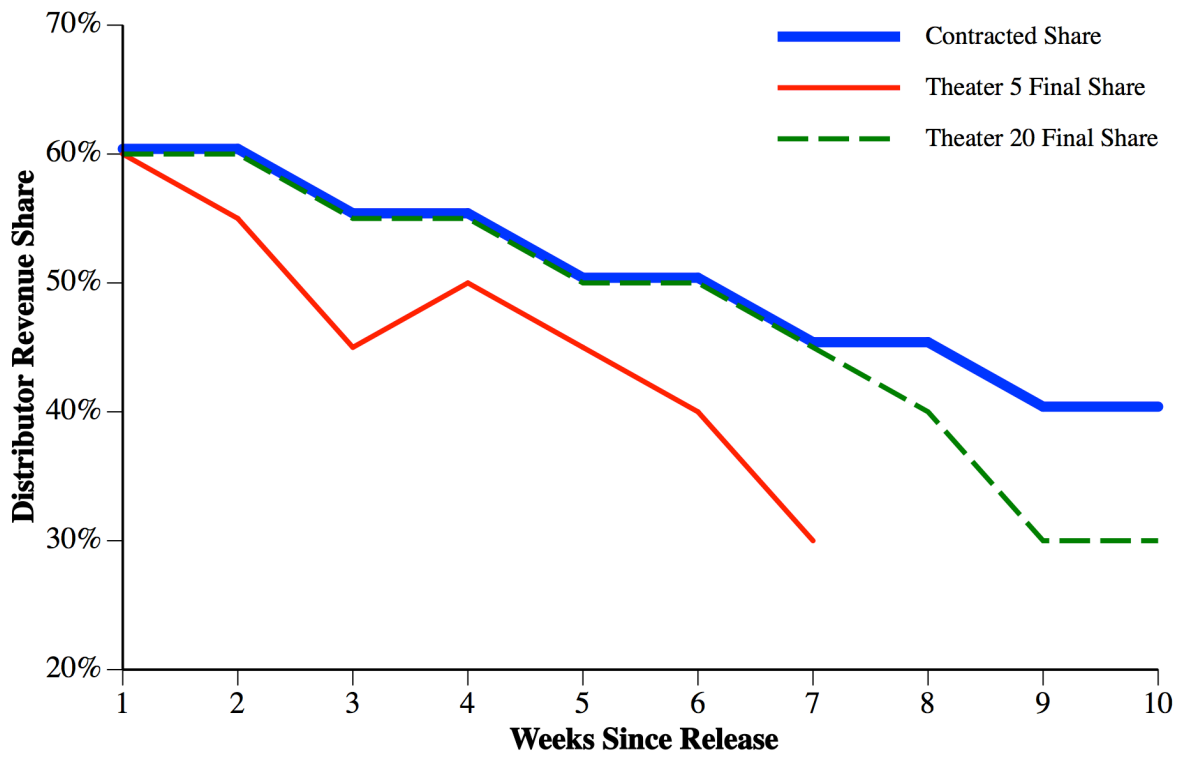
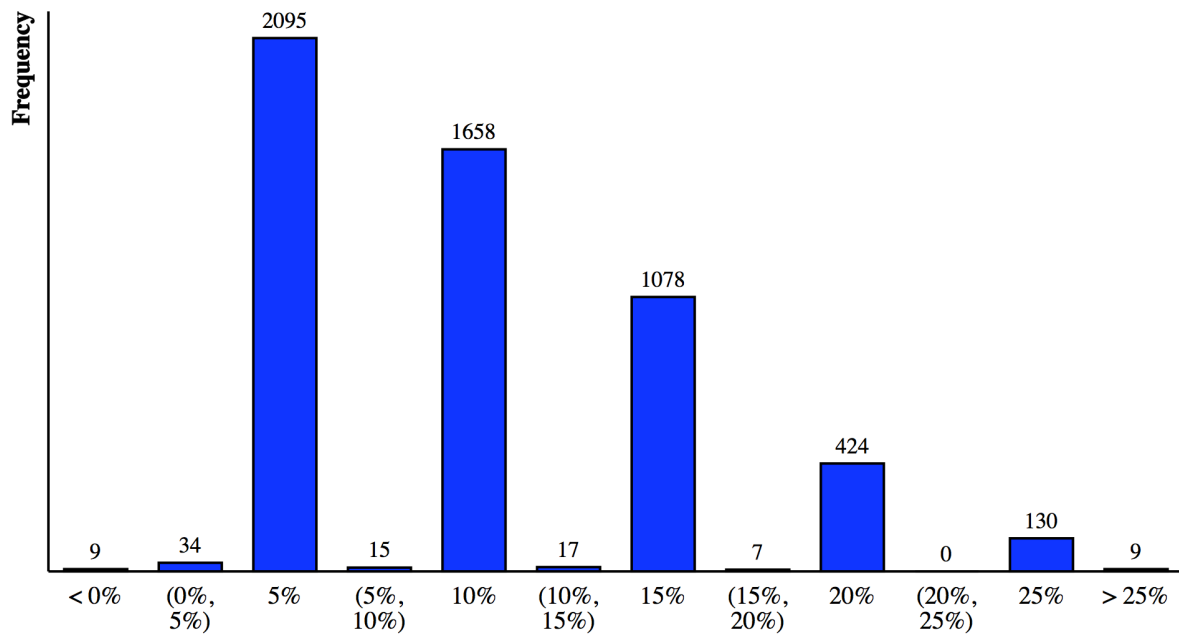
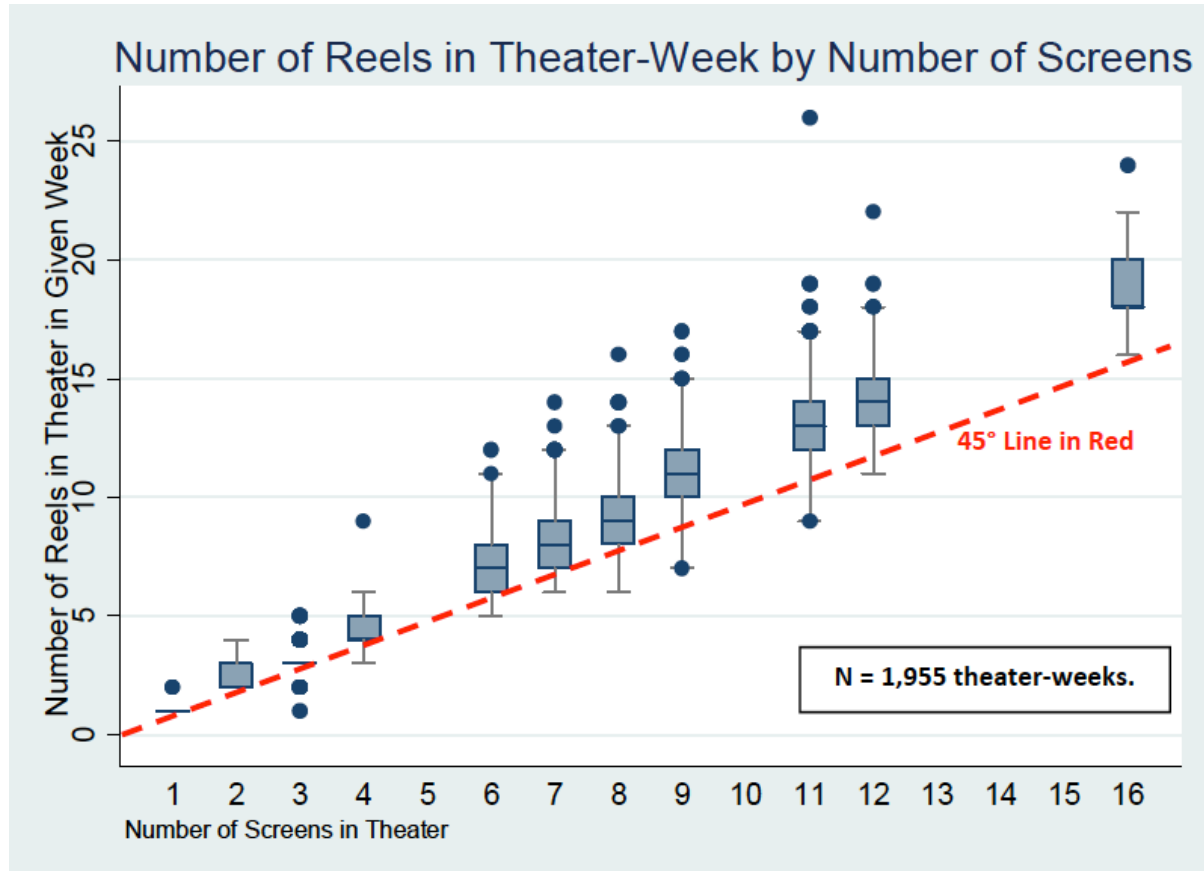


Figure 2. Frequency distribution for observed discounts



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 in Theater-Week by Number of Screens in Theater



Note: As described in the text, the sample is the result of dropping all reels with less than 100 attendees in a week and then counting the number of reels used in a theater in a given week. The result is a sample of 1955 theater-weeks.

Table 1. Sample Means for Selected Variables, by Type of Contract

	<i>Category 1</i>	<i>Category 2</i>	<i>Category 3</i>
<i>PANEL A</i> <i>All Theater-Reel-Weeks</i>	Under Contract for Entire Run 3,017 reels 8,332 reel-weeks	Switches once from Contract to No Contract 715 reels 4,964 reel-weeks	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
	<i>Category 1</i>	<i>Category 2</i>	<i>Category 3</i>
<i>PANEL B</i> <i>Subsample of Theater-Reel-Weeks with Attendance ≥ 100</i>	Under Contract for Entire Run 2,974 reels 8,275 reel-weeks	Switches once from Contract to No Contract 498 reels 3,451 reel-weeks	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 2 Negotiated Discounts for “A Beautiful Mind,” February 22, 2002 – April 19, 2002

Theater	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
<i>Formal Sharing Rate:</i>	60%	60%	55%	55%	50%	50%	45%	45%	40%
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 of “A Beautiful Mind” shown in 22 theaters over its first nine weeks of release. “Negotiated Discount” is the difference between the ex ante and ex post share of box office revenues paid to the distributor. Bold face font indicates the reel shared the screen with one or more movies during the week (reels with fewer than 100 attendees were excluded). “n/c” denotes that the reel was shown, but we do not have contract data.

Table 3 Linear Probability Models for Continuing Reel (or Continuing on an Unshared Screen) for an Additional Week

Dependent Variables:	Reel Shown in week t Continued in week t+1		Reel shown on unshared screen in week t continues on unshared screen in t+1	
	(1)	(2)	(3)	(4)
Intercept	-.7187*** (15.48)	–	.3249*** (4.76)	–
Ln(# of Screens in Theater)	.0213** (2.00)	–	.0050 (0.34)	–
Ln(1+New Releases in week t+1)	-.0742*** (-7.73)	-.0936*** (-6.65)	-.1186*** (-8.61)	-.1406*** (-6.86)
Ln(Contracted Revenues in week t)	.2122*** (37.06)	.2017*** (19.41)	.0884*** (9.88)	.1591*** (7.84)
Reel is among the n reels with lowest Contracted Revenues (where n is the number of New Releases in week t+1)	-.2829*** (-22.94)	-.2055*** (-15.27)	–	–
Reel is among the n reels on dedicated screens with lowest contracted revenues (where n is the number of New Releases in week t+1)	–	–	-.3280*** (-24.31)	-.1785*** (-11.02)
Theater Fixed Effects?	No	Yes	No	Yes
Reel-Week Fixed Effects?	No	Yes	No	Yes
R ²	.3807	.6548	.2272	.5183
Sample size	11,720	11,720	6,496	6,496

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. Dependent variables are (0,1) dummies. Contracted Revenues defined as the exhibitor's contracted share multiplied by the box office revenues. 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 4 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)
<i>Panel A. Predicted Continuation Probability from Table 3, Column (2) (n=6,909)</i>			
	(1)	(2)	(3)
Lowest Quintile (least likely to continue)	66.4%	7.7%	11.6%
Second Quintile	62.3%	6.6%	10.6%
Third Quintile	55.0%	5.2%	9.5%
Fourth Quintile	47.3%	4.4%	9.3%
Highest Quintile (most likely to continue)	39.1%	3.3%	8.4%
<i>Panel B. Predicted Probabilities of Continuing on Unshared Screen (conditional on continuation) from Table 3, Column (4) (n=2,819)</i>			
	(1)	(2)	(3)
Lowest Quintile (least likely to continue unshared)	48.0%	4.2%	8.8%
Second Quintile	47.0%	4.2%	8.9%
Third Quintile	39.0%	3.3%	8.4%
Fourth Quintile	35.8%	2.9%	8.1%
Highest Quintile (most likely to continue unshared)	37.8%	3.0%	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 3, 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 3, 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 no significantly different from each other.

The table entries in each column in Panel B are not all significantly different from each other. Columns (1) and (2) are similar: the first and second quintiles are significantly different from the third, fourth, and fifth quintiles at the 1% level or better, but no other pairs (e.g., Quintile 1 vs Quintile 2, or Quintile 3 vs. Quintile 4 or 5) are significantly different. In column (3), the first and second quintiles are significantly different from the fifth quintile at the 5% level, and different from the fourth quintile at the 10% level; no other pairs are significantly different.

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

Table 6 Linear Probability Models for the Probability of Renegotiation

	<i>Dependent Variable = 1 if Contract is Renegotiated, 0 Otherwise</i>		
	(1)	(2)	(3)
Dummy if $(\text{Best Dropped Reel})_{t-1} > (\beta \times \text{Revenues}_t)$.1033*** (9.83)		.0983*** (8.24)
Dummy if $(\text{Best Shared Reel})_t > (\beta \times \text{Revenues}_t)$.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 7 OLS Regressions for the Magnitude of the Negotiated Discount for Contracted Reels

	<i>Dependent Variable = Ex Post Final Share less Ex Ante Contracted Share</i>		
	(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

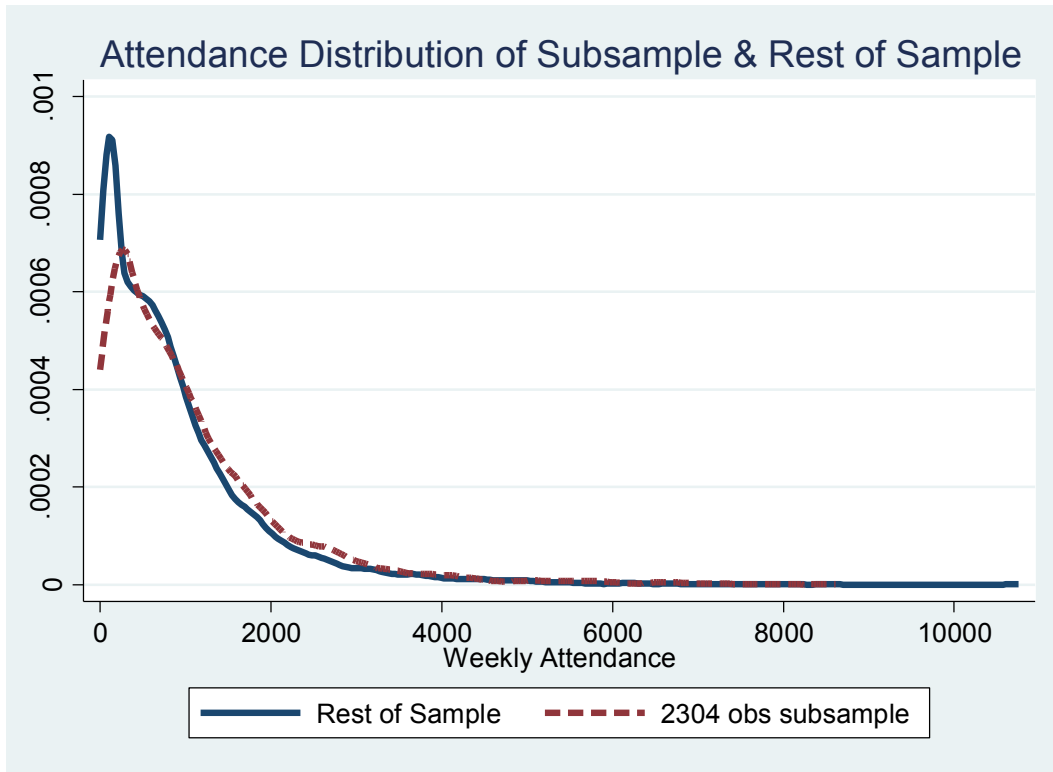
Note: t-statistics in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Standard errors are clustered by theater-week. Observations correspond to theater-week-reels. The dependent variable is the difference between the final ex post price paid to the exhibitor and the 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).

APPENDIX 1

Attendance Threshold

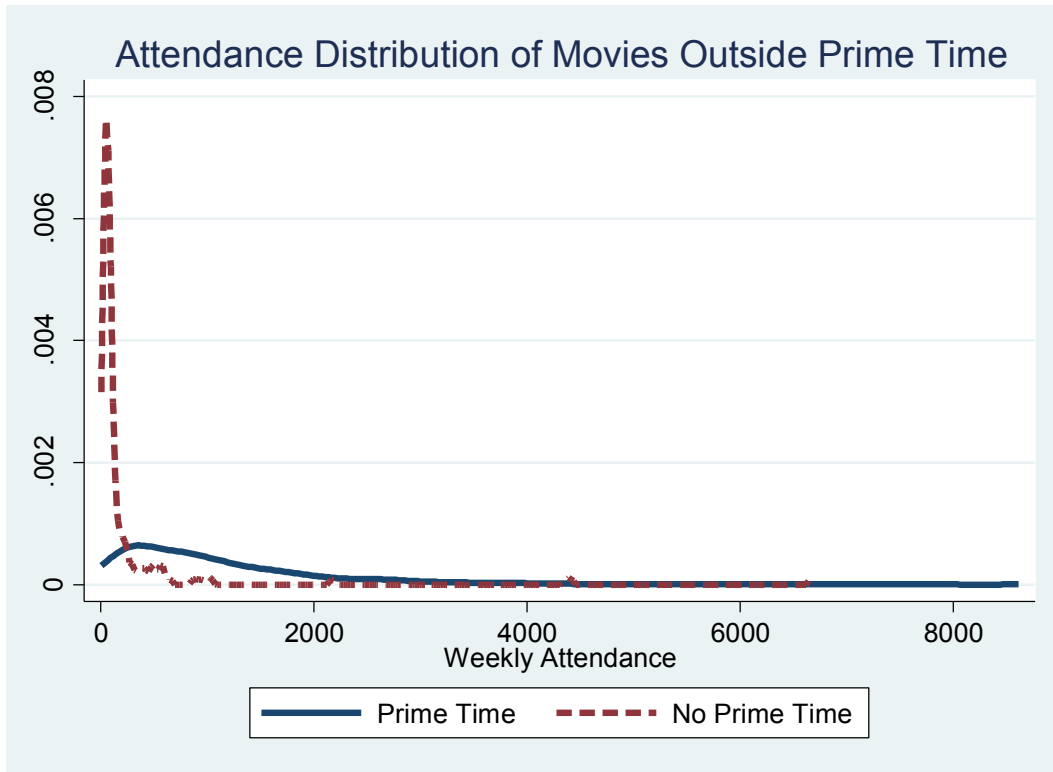
The purpose of this Appendix is to explore how reasonable is the threshold of 100 weekly attendees to separate “Prime-Time” shows from matinees and late night shows that do not necessarily compete for screen space. We must take a stand on this threshold because our data does not include show times or 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 3.2)

TO BE WRITTEN!

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

APPENDIX 3

Interpreting Tables 3 and 4

(in the Relational-Contract Model of Section 3.2)

Section 3.2 assumes that the value of showing a movie is determined entirely by its potential box-office revenue (v). In practice, both the exhibitor and distributor also receive private benefits when a movie is shown: the exhibitor receives concession revenue, and distributors (and the studios that contract with them) profit from DVD and merchandising sales.

This Appendix has two goals. First, we enrich the model in Section 3.2 to include private benefits. As in the original model, first-best can be attained by a combination of formal and relational contracts if exhibitor and distributor are sufficiently patient. However, the discount paid to the exhibitor now depends on the distributor's and exhibitor's private benefits.

Second, we use the results of this enriched model to provide two explanations for the estimated correlations in Tables 3 and 4. We argue that if either (i) the distributor earns private benefits, or (ii) different movies have different formal contracting shares, then the fitted residuals in Table 3 should be positively correlated with discount size in Table 4.

Consider a repeated game between a distributor (D) and exhibitor (E) with common discount rate r .

1. D chooses a sharing contract $\beta \in [0,1]$.
2. E's outside option x is realized, along with private benefits g_E, g_D to E and D, respectively. Assume $x - g_E \in \{L, H\}$ with probabilities p_L, p_H , while $g_D \in \{l, h\}$ with probabilities q_l, q_h .
3. E chooses whether or not to show D's movie: $d \in \{0,1\}$.
4. D and E pay one another, with net payment $b \in \mathbb{R}$ to E.

Payoffs in this game are

$$\begin{aligned} u_D &= d((1 - \beta)v + g_D) - b \\ u_E &= d(\beta v + g_E) + (1 - d)x + b \end{aligned}$$

The first-best decision rule is: $d^{FB} = 1$ if and only if $v + g_D \geq x - g_E$. We assume $v + h > H > v + l > L > 0$, so $d^{FB} = 1$ only if $g_D = h$ or $x - g_E = L$.

A note about the interpretation of x . Unlike Section 3.2, the exhibitor's outside option consists of his *formal* box-office share from the outside movie, *plus* his private benefits from that movie, *plus* the discount paid by that movie's distributor. If need be, the outside distributor is willing to pay a bid equal to her private benefits plus her share of the box-office revenue. So E's outside option x equals the total box office of the outside movie plus the sum of private benefits accruing to the exhibitor and the outside distributor.

In the one-shot game, $b = 0$ in equilibrium and so the exhibitor is willing to show the movie with revenue v if $\beta v \geq x - g_E$. No formal contract can attain first-best; the distributor will choose $\beta v = L$ if

$$p_L \geq \frac{v - H + q_l l + q_h h}{v - l + q_l l + q_h h}.$$

Otherwise, the distributor will choose $\beta v = H$.

Now, assume that the optimal static contract is $\beta v = L$ and consider the repeated game. Let V^{NE} be the sum of payoffs in the one-shot equilibrium. We construct an equilibrium that induces first-best decisions. In each period, the distributor offers a sharing rate β^* , the exhibitor chooses $d^* = d^{FB}$, and the distributor pays a discount $b^* > 0$ if $x - g_E = H$ and $g_D = h$ but pays nothing otherwise. Following a deviation, players revert to the one-shot equilibrium.

If V^{FB} is the first-best total payoff, then there exists a discount b^* such that the above strategies are an equilibrium if

$$\beta^* v \geq H - r(V^{FB} - V^{NE}).$$

This inequality holds for sufficiently patient players. As in Section 3.2, first-best decision-making might require $\beta^* > 0$ if players are not extremely patient. Therefore, first-best is attained by a combination of a formal revenue-sharing contract and a relational discount ex post.

We now turn to the empirical results in Tables 3 and 4. Assume that each screen can show exactly one movie in each week (i.e., movies cannot share screens). Consider the following stylized version of the regression in Table 3:

$$Continue_i = \alpha_0 + \alpha_1 1\{\beta_i BO_i \text{ one of } N \text{ lowest } \beta BO\} + \epsilon.$$

If there were no private benefits ($g_D = g_E = 0$) and every movie had the same formal share β , then the N movies with the lowest box-office would be dropped each week, where N equals the number of new movies arriving in that week. Therefore, this regression would produce estimated coefficients $\alpha_0 = 1$, $\alpha_1 = -1$, and $\epsilon = 0$. Contrary to Table 4, the fitted residual would not be correlated with the observed ex post discount.

Table 4 can be explained by assuming either (i) the distributor earns private benefits, or (ii) different movies have different formal shares β . Suppose the distributor earns private benefits from his movies. Then a movie with low box-office would be continued exactly when it has large private benefits. Therefore, $\alpha_0 + \alpha_1 < 1$ in the regression and $\epsilon > 0$ exactly when $g_D = H$. But $b^* > 0$ exactly when $g_D = H$, so we would observe a positive correlation between the residual of this regression and observed discount. This is the empirical regularity we document in Tables 3 and 4.

Alternatively, suppose that the distributor does not earn private benefits, but β differs across movies. For simplicity, consider a theater with two movies $i \in \{1, 2\}$ and a single incoming movie. Movie i has box-office revenue v_i and contracted share β_i , where $v_1 \geq v_2$. Under efficient adaptation, the exhibitor stops showing movie 2. If $\beta_1 \geq \beta_2$, then $1\{\beta_i BO_i \text{ one of } N \text{ lowest } \beta BO\}$ is negatively correlated with $Continue_i$. However, if $\beta_1 < \beta_2$ so that $\beta_1 v_1 < \beta_2 v_2$, then $1\{\beta_i BO_i \text{ one of } N \text{ lowest } \beta BO\}$ is positively correlated with $Continue_i$.

Table 4 includes only those movies for which $Continue_i = 1$. If $\alpha_1 < 0$, then those movies that continue despite being among the N lowest exhibitor shares will have particularly large residuals. These movies will also tend to have large observed discounts, because by definition they have lower formal shares $\beta_i v_i$ than at least one of the movies that the exhibitor stopped showing. So this argument provides a second justification for the positive correlation between residuals and ex post discounts documented in Table 4.