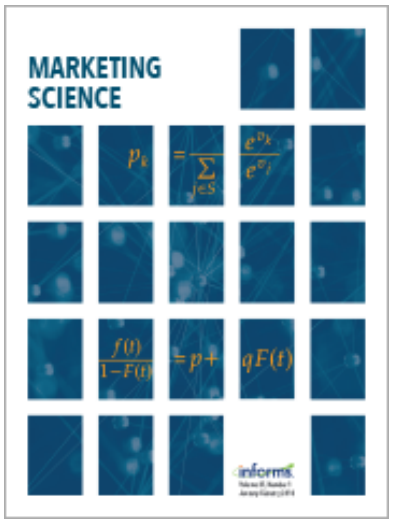

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A. Yeşim Orhun, Sriram Venkataraman, Pradeep K. Chintagunta

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Impact of Competition on Product Decisions: Movie Choices of Exhibitors

A. Yeşim Orhun
Stephen M. Ross School of Business, University of Michigan, Ann Arbor, Michigan 48109,
aorhun@umich.edu

Sriram Venkataraman
Kenan-Flagler Business School, University of North Carolina, Chapel Hill, North Carolina 27599,
venkats@kenan-flagler.unc.edu

Pradeep K. Chintagunta
Booth School of Business, University of Chicago, Chicago, Illinois 60637,
pradeep.chintagunta@chicagobooth.edu

We empirically study the impact of the entry of a new theater on two important product decisions that incumbents in the movie exhibition industry face: (1) whether to invest in screening movies that are expected to be popular, and (2) when to adopt new releases. For theaters, both of these decisions feature a cost-demand trade-off inherent in quality decisions: Although screening popular and recent movies brings more patrons to the theater, distributors take a higher share of the revenue for such movies. The impact of competitive entry on the incumbent's quality decisions is ambiguous, as it may simultaneously increase the competitive pressure to invest more in these dimensions of quality and also change the demand conditions that incumbents face. We find that incumbent theaters do not increase the provision of popular and recent movies in response to rival entry. To identify the role of competitive incentives, we study the differential impact of entry based on whether the entrant belongs to the same parent firm as the incumbent theaters. This comparison reveals that competitive incentives push incumbents to screen movies with high expected success more frequently and to adopt movies sooner. The product responses we document have important implications for the revenue impact of entry and the conclusions that researchers can draw from this impact. Ignoring the provision of these quality dimensions suggests cannibalization to exceed business stealing, a conclusion that is reversed when we account for endogenous product responses. We also show that our findings on popularity and recency cannot be explained by concomitant changes in theaters' other product decisions, such as the variety of movies screened.

Keywords: product competition; quality; entry; cannibalization; business stealing; retailing
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1. Introduction

Researchers have studied the relationship between competition and different elements of the marketing mix, such as prices (Pauwels and Srinivasan 2004), advertising (Gatignon et al. 1989), and channels (Anderson and Coughlan 1987) to examine the mechanisms through which competition affects firm profits and consumer welfare. Notwithstanding a vast array of theoretical research establishing the pivotal relationship between product offerings and competition (e.g., Moorthy 1988, Shaked and Sutton 1990, Gilbert and Matutes 1993, Desai 2001, Johnson and Myatt 2003), empirical research investigating the impact of competition on the product choices of firms remains essentially unexplored (Draganska et al. 2009). To date, there are a few cross-sectional studies of the degree of competition as measured by the number of firms compared to the number of products provided (Berry and Waldfogel 2001); and the variety (Ellickson 2007, Olivares and Cachon 2009) and quality of offerings (Dranove and White 1994, Mazzeo 2003, Cohen and Mazzeo 2007, Dick 2007, Berry and Waldfogel 2010). More recently, researchers have studied how changes in market structure lead to changes in the product provision of an incumbent firm to control for unobserved market heterogeneity that may lead to endogeneity concerns in cross-sectional approaches. Sweeting (2010) studies the impact of mergers on variety in the music radio industry, and Matsa (2011) studies how competitive entry in the supermarket industry changes the prevalence of stockouts (a quality dimension).

In this paper, we study the incumbent theaters' movie choices in response to the entry of a rival or

a co-owned theater in the same geographically isolated market.[1] The movie exhibition industry offers a particularly suitable empirical context in which to study product responses to market structure changes for three reasons. First, theaters make frequent (weekly) movie-choice decisions because movies are short-lived products and their supply replenishes weekly (Luan and Sudhir 2010). This relatively high frequency in product decisions makes it empirically possible to detect potential strategic product responses, surpassing the lack of relatively frequent product choices as an empirical barrier that often prevents researchers from addressing the impact of changes in the market structure on product responses in other industries.

Second, the main driver of a theater's demand is the appeal of the movies it screens (Sawhney and Eliashberg 1996). Therefore, movie selection is likely to be one of the main strategic decisions impacted by the changes in the competitive environment, especially because admission prices do not respond to entry (Davis 2005). Movies vary greatly in their appeal, and their appeal declines in the weeks following their release. As a result, theaters' movie choices reflect two main considerations of product provision on a weekly basis: (1) how much to invest in securing movies that are expected to be popular, and (2) when to adopt new releases. Clearly, all else equal, theaters would prefer to screen movies that bring as many patrons into the theaters as possible. By increasing the patronage, not only do they sell more tickets, but they also increase their concession revenues, which are not shared with the distributor (Gil and Hartmann 2007).

However, a third reason this industry offers an interesting context in which to study product responses is that movies that are expected to bring in the highest number of patrons are also costlier to screen for the exhibitors. Distributors retain a higher share of the admission revenues for movies that are expected to be more popular and for recently released movies (Gil and LaFontaine 2012, Eliashberg 2005, Weinberg 2005). Furthermore, since admission price does not vary across titles (Orbach and Einav 2007, Gil and Hartmann 2009), the margins that theaters obtain from screening a movie decrease with the expected popularity of the movie and its recency of release. This cost-demand trade-off implies that a theater may not always choose the movies that would bring the highest number of patrons (i.e., those that are recently released or are expected to be popular); the benefit from the additional patronage may not justify the increased costs. Therefore, theaters need to trade off the additional patronage that a movie would bring to the theater against the per-ticket fees that the theater pays to screen it. Entry of a new theater is expected to influence this trade-off, both by increasing competitive pressure and by changing the demand conditions that the incumbent faces.

Note that theaters' investment decisions as to the popularity and recency of movies reflect a strategic cost-demand trade-off inherent in other quality decisions (Spence 1975).[2] This observation motivates our interest in documenting how the optimal provision of these product dimensions varies with market structure and competitive incentives. Previous literature has established that the impact of entry on the quality provision is ambiguous (Olivares and Cachon 2009, Economides 1993) even though we expect the impact of competitive incentives to be positive (Chamberlin 1933). In the appendix of this paper, we present an illustrative model that incorporates the key features that distinguish our empirical context from contexts considered in previous theoretical models, such as the lack of price competition and opportunities to price discriminate.[3] We show that there are two (potentially opposing) forces that shape an incumbent's optimal investment decision. On one hand, the increase in competitive incentives due to entry generates incentives for the incumbent to increase the level of investments in these dimensions and attract consumers away from rivals. Therefore, all else equal, we expect increased competitive pressure to increase the quality provision of the incumbent. On the other hand, entry may also reduce the returns on investments for the incumbent if it decreases the incumbent's demand sensitivity to these dimensions. As a result, the impact of entry on the provision of popular and recently released movies depends on the relative changes in the intensity of competitive incentives versus those

[1] Throughout the paper, we use "rival entry" to denote the opening of a new theater by a competitive chain and "co-owned" entry to mean the opening of a new theater by the incumbent chain in that market.

[2] Products that generate higher levels of consumer demand at a given price level are generally defined as higher quality products in the marketing and industrial organization literatures. Note that provisions of these dimensions reflect a quality investment decision from the perspective of the theaters and not the consumers; exhibitors do not price discriminate, whereas distributors do. The colloquial use of the term "quality" in this industry describes a movie's artistic quality. We further examine whether artistic quality changes in response to entry in the robustness checks presented in the online appendix (available as supplemental material at http://dx.doi.org/10.1287/mksc.2015.0909). We do not find any change in the review scores in response to entry or as a function of ownership (Table OA10 in the online appendix). Therefore, we conclude that changes in the provision of popular and recent movies are not accompanied by changes in the prevalence of movies that have more favorable reviews potentially because there are no known cost-demand trade-offs in this dimension.

[3] We thank the editor for encouraging us to pursue the theoretical underpinnings of our empirical analysis.

in the marginal returns to these investments (Hauser and Shugan 1983, Gal-Or 1983, Gatignon et al. 1989). Hence the composite effect of entry in this industry is also ambiguous.

This theoretical ambiguity motivates our empirical focus on the changes in incumbents' popularity and recency provision in response to entry. In particular, we compare previously monopolistic incumbent theaters' popularity and recency investments before and after entry. We control for time-invariant differences across theaters and markets (for example, differences in demand for movies of different types, as well as theater amenities) with theater fixed effects, and for differences in movie supply over time and demand seasonality with week fixed effects. Assuming that the timing of the entry of a new theater is exogenous, the change in the incumbent's product provision decisions identifies the incumbent's strategic response to entry. We study the average delay (in weeks) of adoption of the new releases and several different measures of popularity of movies in a theater's portfolio.

We find that, in response to rival entry, incumbents decrease their provision of popularity or fail to increase it across the numerous specifications of popularity we consider. For example, we calculate the *average weekly national box office* of the movies that the incumbent screens each week. This average popularity metric decreases by 17% in response to entry by a rival chain of average size. Similarly, the weekly national box office success of the incumbent's *top movie* is lower by 21% in response to entry by an average rival chain. In addition, incumbents are 13% less likely to show the top-selling movie of the week after a rival entry, although this contrast is not significant. We also find a marginal and insignificant increase in the adoption delay of new releases.

A casual interpretation of these results may seem surprising, as they suggest that entry of a rival theater lowers or fails to increase the quality provision of the incumbents. Does this mean that the increase in competitive pressure does not lead to increased investments in these dimensions by the incumbent? As we argued previously, entry may simultaneously increase competitive pressure and change the demand conditions that the incumbent faces. To parse out these two potentially countervailing forces, we isolate the role of competitive incentives by contrasting the incumbent responses to rival and co-owned entry, while controlling for heterogeneity of response as a function of theater observables. All else constant, compared with rival theaters, co-owned theaters are expected to have weaker incentives to make costly investments to compete for patronage, since shifting consumers from one co-owned location to another is much like taking money from one pocket and putting it in the other.

Our empirical results yield support for *competitive incentives* exerting an upward pressure on the provision of the quality dimensions we study. We find that entry of a co-owned theater increases the incumbents' adoption delay by an additional 10.4% (almost half a week) compared with incumbents' responses to the entry of a rival theater, and decreases their popularity provision by an additional 20%–30% (the range across all of the popularity measures we consider). Therefore, we conclude that, while the composite effect of entry on the popularity and recency provision of incumbents is slightly negative, the impact of competitive incentives on the provision of these product dimensions is positive. This finding suggests that the composite effect of entry is significantly influenced by the change in demand conditions that an additional firm induces. One particular reason could be that the sensitivity to quality of the consumers that the incumbent serves after entry may be lower than that of the consumers that the incumbent used to serve as a monopolist.[4] We also present evidence of heterogeneity in the quality response to entry across observable differences in theater characteristics. Of particular importance, we show that the patterns we document at the incumbent level also hold for quality provisioning at the market level. The results indicate that the market prevalence of top-selling movies increases and adoption time declines by a larger degree as a result of competitive entry compared to that of co-owned entry.

In addition to our main analyses, this paper features several analyses to evaluate potential alternative explanations. For example, we examine changes in the variety provision of the incumbent theaters in response to competitive and co-owned entry. We show that while screening less popular movies, incumbents do not provide a wider selection of genres that are targeted to specific tastes; they also do not screen a larger number of titles. Therefore, we conclude that responses in variety provision are unlikely to account for the quality provision changes we document in this paper. Also, we consider the potential that incumbents

[4] The change in demand sensitivity is driven by selection of the type of consumers who continue to frequent the incumbent after the entry of a new theater. For example, imagine that consumers cared only about the distance to the theater and the appeal of movies shown at the theater. After entry, the consumers who live far from the incumbent, but closer to the entrant, may switch to the entrant, leaving the incumbent with consumers who have higher valuations (due to proximity) for the incumbent. The quality sensitivity of these remaining consumers is lower because they are less likely to stop coming to the incumbent location for the same level of quality degradation compared to the population that the incumbent was serving before. In general, this type of selection can occur in markets where firms are differentiated on more than one dimension. For more details, please see the specific demand example presented in the online appendix.

increase the artistic quality of movies they screen, which may drive the decrease in general popularity, but we do not find any significant change in response to entry or as a function of ownership.

Our study contributes to the literature in three ways. First, we provide additional and causal evidence for the impact of entry on the quality provision decisions of incumbents. Unlike earlier cross-sectional studies, we rely on a change in market structure to control for firm- or market-level unobserved heterogeneity by taking advantage of frequently observed product decisions in an industry where product provision is a main driver of demand. Second, we argue that the composite effect of entry of an additional theater fails to identify the impact of competition. We separately identify this competitive effect by taking advantage of the difference in response to entry of a theater as a function of ownership. Third, in light of our results on product responses, we highlight the role of endogenous product choices in interpreting revenue responses to entry. Traditionally, ownership differential in the revenue impact of entry has been interpreted as reflecting the co-owned theaters' disincentive to engage in fierce price competition to steal consumers from one another (Kalnins 2004, Davis 2006b, Wilson 2015). We show that much of the incumbent's revenue loss is due to its own product response to entry, and that the traditional interpretation of revenue differential is misleading as to the impact of ownership. Regulatory agents assessing mergers of theater chains focus on the impact of competition on prices[5]; they fail to consider the impact on product provision. This paper suggests that the larger impact of competition may be, on equilibrium, product provision.

Section 2 describes the data, our sample, and the construction of quality metrics. Section 3 presents our main empirical analyses and results. We discuss the broader implications of our findings in §4.

2. Industry and Data Details

2.1. The Industry and Data Overview

The data track weekly ticket sales of each movie shown at 3,037 theaters in all designated metropolitan areas (DMAs) in the North American motion picture industry between September 2003 to December 2004. In addition to ticket sales, the data show when a theater enters or exits a market, and provide theater characteristics such as chain affiliation, number of screens, and exact geographic location. There are six big theater chains in the period we study: AMC, Carmike, Cinemark, Cineplex, Century, and Regal Entertainment, as well as many smaller regional chains and independent theaters. We supplement this theater-specific data with market-level demographic information from the U.S. Census, movie characteristics data from IMDB.com, and prerelease advertising spending data across 18 media channels (such as TV, Internet, national newspapers, local newspapers, outdoor, etc.) from TNS Global.

In the United States alone, around 700 movies are produced each year (Eliashberg et al. 2006). Movies differ greatly in their box office success; a movie's expected success is uncertain at the time of contracting. Distributors form their expectations of a movie's general success based on prerelease predictors such as cast, director, budget, and any market tests that they conduct. Based on this performance forecast, they decide on the timing of the movie release, the number of screens at the time of rollout, how much they want to spend on advertising before the movie opens, and general contractual terms with exhibitors. The assignment of movies to theaters happens via direct negotiations between the distributor and exhibitors or via bids that exhibitors place (Eliashberg et al. 2006). Distributors are mandated to structure their revenue-sharing contracts with exhibitors on a movie-by-movie and theater-by-theater basis. As contracts are not negotiated on a chain-wide basis, there are no clear sources of chain-level scale economies that would favor national chains (Davis 2005). The distributor-exhibitor contracts specify the share of ticket revenues that the exhibitor will cede to the distributor. This revenue share varies across movies and weeks. Of particular importance, the shares of the distributor increase with the expected popularity of the movie and decline over time (Gil and LaFontaine 2012, Eliashberg 2005, Weinberg 2006),[6] reflecting the two dimensions of variation in expected box office success: across movies (popularity), and within a movie over time (i.e., age of the movie). The trade-off that this cost structure induces motivates our interest in the popularity and recency choices of theaters.

Construction of popularity metrics. An average sized theater (in our analyses) screens 10 movies a week on average. In some of our empirical analyses to follow, we summarize the popularity of the movies in a theater's weekly portfolio with a uni-dimensional metric to analyze how popularity choices of the theater

[5] See, for example, the Department of Justice competitive impact statements in two merger cases: United States versus Sony (concerning the Loews and Cineplex merger), 1998 (http://www.justice.gov/atr/cases/f1600/1640.htm) and United States versus Regal Cinemas and Consolidated Theaters, 2008 (http://www.justice.gov/atr/cases/f232700/232769.htm).

[6] In addition to these papers that directly study this relationship, one can also show a positive and significant relationship between contract revenue and rental rate in the data presented in Table 2 of Filson et al. (2005). Industry publications, such as ifp.org, also mention that the revenues are split between the distributor and the exhibitors according to the magnitude of the expected overall national box office.

Table 1 Movie-Level Summary Statistics

	N	Source	Obs. level	Min	25th %	Median	Mean	75th %	Max
Total TV ad spend ($1,000)	756	TNS	Movie	0	0	142	6,002	12,400	42,538
Opening week box office ($1,000)	558	IMDB	Movie	0.8	38	448	9,789	12,230	115,817
No. of screens at opening week	554	IMDB	Movie	1	5	87	1,200	2,694	4,163
Budget ($1,000)	354	IMDB	Movie	25	8,000	25,000	36,785	54,000	200,000
Weekly box office ($1,000)	10,942	Data	Movie-week	0.01	1.6	10.7	893	91.1	124,647
No. of weeks' lag in adoption	528,041	Data	Movie-theater	0	1	2	4.18	5	66

respond to entry. We anticipate the expected popularity of the movie and the cost of screening it to increase in accordance with how new the movie is, its opening box office, weekly box office, production budget, prerelease advertising cost, and width of release.[7]

Table 1 provides summary statistics of these movie characteristics for the 756 movies screened by the theaters in our study, and of the delay of adoption across all movie-theater pairs.[8] It reveals a great deal of variance across all measures and a long tail of popularity. The top 40 movies of the time period account for 52%, and the top 100 movies account for 76%, of ticket sales in the data. This pattern is similar to other recent documentations of the film industry (Motion Pictures Association of America, Inc. 2011). In addition to these differences in movie characteristics related to expected popularity, Table 1 displays a large variation in the other quality dimension, i.e., timing of adoption, with a mean of slightly over a month of delay.

We construct separate metrics based on each of these variables to summarize the incumbent's weekly movie choices. Specifically, we calculate the average and the maximum of a given movie characteristic across the incumbent's weekly selection of movies. Movie characteristics that proxy expected popularity of the movie at the time of contracting, i.e., production budget, opening week box office, width of release, and advertising spend, are time-invariant. Therefore. they are well-suited for describing the quality of the new releases that the theater chooses to adopt each week. We construct unidimensional metrics to describe the average and maximum expected popularity of a selection of movies that a theater t may be screening in week w based on these movie-specific measures. For example, we define $avgbudget_{tw} = (1/M^{S^n_{tw}}) \sum_{m=1}^{S^n_{tw}} budget_m$ and $maxbudget_{tw} = \max\{budget_m\}$ where subscript $m \in \{1, \ldots, M^{S^n_{tw}}\}$ indexes the set S^n_{tw} of *new releases* that theater t adopts in week w. We also define average and maximum advertising spend, opening week box office, and width of release metrics ($avgadspend_{tw}$, $maxadspend_{tw}$, $avgopenbo_{tw}$, $maxopenbo_{tw}$, $avgopenscr_{tw}$, $maxopenscr_{tw}$) based on the movies in set S^n_{tw} in this fashion. Changes in the expected popularity metrics based on time-invariant movie descriptors over time reflect changes in the movie selection. In contrast, the national weekly box office varies over time for a given movie. Therefore, average and maximum national weekly box office sales among *all* of the movies (new and old) in the incumbent's weekly selection reflect the changing popularity composition of a theater's portfolio duo to: (i) changes in the movies that the theater screens and (ii) the diminishing popularity of the screened movies as they age. To this end, we define $avgwkbo_{tw} = (1/M^{S_{tw}}) \sum_{m=1}^{S_{tw}} wklybo_{mw}$ and $maxwkbo_{tw} = max\{wklybo_{mw}\}$, where subscript $m \in \{1, \ldots, M^{S_{tw}}\}$ denotes all movies in the weekly movie portfolio S_{tw} of theater t in week w. Note that, appropriately, the construction of a theater-week quality metric is based on the overall popularity of the movie in week w across all theaters that carry the movie, and not on the performance of the movie at theater t.[9]

[7] The production budget is an early indicator of the movie's eventual market success (Eliashberg et al. 2007, Zufryden 2000). Distributors, who are responsible for most of the movie's advertising, set their advertising budgets to an amount equal to 50%–100% of a movie's production costs, depending on their expectations of movie success and ability to recoup the ad costs from revenue-sharing contracts (Ravid 1999). Similarly, as Moretti (2011) argues, distributors decide on the width of release based on their expectations of the movie's popularity. In the industry, weekly box office and opening box office are accepted measures of *actual popularity* of the movie that are movie-week specific and movie-specific, respectively. Clearly, at the time of contracting, these two metrics are not available to either of the contracting parties. However, as long as their predictions about the relative popularity of movies are on average correct, movies with higher box office trajectories will be, on average, those movies that were expected to be popular and are therefore costlier for theaters to screen.

[8] These movies include all types of titles, such as new releases and re-runs, domestic and international titles, and independent films. The top movies released in this time period are memorable: Shrek 2, Lord of the Rings: The Return of the King, Spider Man 2, The Passion of The Christ, The Incredibles, Harry Potter and the Prisoner of Azkaban, etc. The movies with missing IMDB data (opening week box office, budget, and opening screens) or without any prerelease advertising tend to be smaller productions. The titles for which we could not find data about their opening week metrics (budget) represent less than 2% (11%) of the sales in our data. Productions without any prerelease advertising cost account for less than 3% of observations. Table OA1 in the online appendix provides additional summary statistics for new releases and the top 150 titles.

[9] For example, consider a theater showing three movies (Along Came Polly, Torque, and Elf) in the week of January 23–29, 2004.

Table 2 Summary Statistics of Weekly Theater Quality Metrics

	N	Min	25th %	Median	Mean	75th %	Max
			Average quality metrics				
Avg. weekly box office ($1,000) (avg wkbo)	32,008	1	5,121	8,332	10,035	12,896	124,647
Avg. prerelease ad spend ($1,000) (avg ad spend)	22,419	0	12,611	17,125	16,650	21,720	42,539
Avg. opening week box office ($1,000) (avg openbo)	22,174	1	8,758	15,194	19,170	22,832	115,817
Avg. no. of screens at opening week (avg openscr)	22,205	1	2,189	2,652	2,534	3,017	4,163
Avg. product budget ($1,000) (avg budget)	20,928	65	26,000	39,000	51,752	70,000	200,000
			Maximum quality metrics				
Top weekly box office ($1,000) (max wkbo)	32,008	1	13,665	24,039	30,872	43,154	124,647
Top prerelease ad spend ($1,000) (max ad spend)	22,419	0	15,320	19,954	19,335	24,966	42,539
Top opening week box office ($1,000) (max openbo)	22,174	1	9,486	20,040	25,257	29,438	115,817
Top no. of screens at opening week (max openscr)	22,205	1	2,609	2,984	2,821	3,245	4,163

Table 2 presents the popularity metrics we construct based on the movie characteristics in Table 1. Note that the average and top weekly box office metrics are constructed based on all movies (set S_{tw}) that theater t screens in week w. Therefore, these metrics are available for each of the 32,008 week-theater combinations in the data. On the other hand, all other quality metrics are based on time-invariant movie-specific dimensions and are constructed based only on the new releases that theater t adopts in week w (set S^n_{tw}).[10]

2.2. Estimation Sample and Changes in Market Structure

To characterize changes in market structure, we must first define the markets into which entry occurs. We define a market as a geographically isolated city or a cluster of cities that are farther than 10 miles from another city with a theater, in line with Davis' (2006a) finding that competitive effects dissipate quickly with distance.[11] Although a considerable number of the entry markets are eliminated due to the geographic isolation restrictions, we feel that foregoing richer variation in exchange for a clean market definition is a desirable trade-off, as it provides a more transparent analysis of the impact of the number of theaters and ownership on the market outcomes.

We focus on markets that experience an increase in the number of theaters from one to two, and which do not experience any closures.[12] There are 48 such markets in the data. Although the number of entry markets may seem small, note that we take advantage of the rich time variation in product outcomes before and after entry across these markets to identify the impact of entry. We also include 219 control markets i.e., those that have two theaters and do not experience any market structure change, to help identify seasonality effects. Table OA2 in the online appendix shows that the entry and control markets are statistically indistinguishable.

Note particularly some differences in theater characteristics by ownership type and national chain membership. Theaters in markets where the other theater also belongs to the same chain (i.e., co-owned) are more likely to belong to a top national chain than theaters facing a rival chain (52% versus 42%, $p = 0.038$). Theaters belonging to the top six national chains tend to have more screens than theaters that belong to smaller chains or are independent (10.9 versus 7, $p < 0.001$). We also find differences in these variables when we compare incumbent and entrant theaters in markets where entry occurs. The entrants have fewer screens than incumbents (entrant size: mean = 6 screens, incumbent size: mean = 8.6 screens, $p = 0.016$), and they are less likely to be one of the top six national chains (entrants: 10%, incumbents: 44%, $p = 0.001$). We will control for these differences in our empirical specifications.

During that week, the total box office across all theaters in our data playing these movies is calculated to be $17.8 M, $11.3 M, and $221 K, respectively. The average and maximum quality across all of the movies during this week based on weekly box office are as follows: avg(weekly box office) = $9.8 M, max(weekly box office) = $17.8 M.

[10] The quality metrics based on opening week box office, number of screens in opening week, and budget can also be missing if all new releases that a theater adopts in a given week have missing observations for these variables. Of particular importance, there are no differences in the number of missing observations in the opening week box office, the number of screens in opening week or budget metrics as a function of entry (see Online Appendix Table OA9). Therefore, our results based on these metrics are not driven by a systematic change in the prevalence of missing observations.

[11] Examples of geographically isolated markets in our study include Alpena, MI; St. Joseph, MO; Alamagordo, NM; Merced, CA; and Geneva, NY. To keep the market definition focused, we also eliminate markets with second-run theaters or theaters that play primarily independent and international movies.

[12] There are two reasons for focusing on this market structure change: (1) The majority (88.4%) of geographically isolated markets include one or two theaters, and the most entry happens in previously monopolistic markets (60% of all entries), and (2) We want to abstain from making ad-hoc assumptions about the interactive structure between existing firms and the entrant to reconcile data from markets with a different number of incumbents.

3. Empirical Analyses and Results

3.1. General Specification and Notation

We examine how incumbents adjust their product choices in response to entry. After controlling for unobservable cross-sectional differences with theater fixed effects and differences in movie supply over time with week fixed effects, comparisons of an incumbent's product quality provision before and after entry identify its strategic response. This event-study approach has been used to investigate the impact of competition on market outcomes of interest, such as revenues in the movie exhibition industry (Davis 2006b), product differentiation in the radio industry (Berry and Waldfogel 2001, Sweeting 2010), and entry in the fast food industry (Toivanen and Waterson 2005). In this approach, the identifying assumption is that the exact timing of entry, conditional on the decision to enter, is not correlated with simultaneous (and short-term) differences in demand conditions. We find it is reasonable to assume that entry is not a response to short-term demand shifts that also impact the product quality decisions of incumbents. The advantage of this approach is that we can study the impact of an additional firm in the market by comparing the incumbent's product choices before and after entry, whereas conditioning out any incumbent or market-specific unobservables. Therefore, the impact of an additional firm is identified from changes within a market over time, rather than from comparing markets cross-sectionally, avoiding the endogeneity concerns in cross-sectional approaches (Pancras et al. 2012).

We first analyze how the average and maximum expected popularity metrics describing the movie choices of the incumbent respond to entry. In particular, we consider

$$y_{tw} \in \{avgwkbo_{tw}, maxwkbo_{tw}, avgbudget_{tw}, maxbudget_{tw}, avgadspend_{tw}, maxadspend_{tw}, avgopenbo_{tw}, maxopenbo_{tw}, avgopenscr_{tw}, maxopenscrt_{wg}\}.$$

Since these y_{tw} are continuous and unbounded, we use the following log-linear fixed effects specification to estimate the impact of entry:

$$\log(y_{tw}) = \alpha_t + \tau_w + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t] + \epsilon_{tw}, \quad (1)$$

where observations vary at the theater and week level, and we control for week fixed effects (τ_w) and theater fixed effects (α_t). Week fixed effects control for time variations in the availability of movies with high success profiles, an important feature revealed by the large variance and skewness in the popularity of movies (Table 1) and the seasonality of release timing in this industry (Einav 2010). Theater fixed effects control for all baseline differences across theaters (and thus markets) in the outcome variable. Subscript e refers to the entrant, and NS_e denotes the number of screens of the entrant, mean centered at six screens. With a slight abuse of notation, Z_t denotes the vector of the mean-centered characteristics of the market to which the incumbent belongs, such as population, median household income, and distance between the entrant and the incumbent. The number of theaters operating in the market during week w is denoted by N_w. The data on the theaters in duopoly markets that do not experience any change in the number of competitive screens will not contribute to identification of the coefficients of interest. However, they help us estimate the week fixed effects with higher precision. In markets where entry is observed, $(N_w - 1)$ will switch from zero to one as a result of entry, separating pre-entry incumbent behavior from post-entry response. Davis (2006b) defines entry in terms of the number of screens of the entrant, accounting only for size and not for existence. Berry and Waldfogel (2001) define entry in terms of the number of entities, ignoring their size. We allow the impact of entry to have a fixed component (β_t) and a per-screen component ($\delta_t NS_e$) because the impact of entry is likely to vary with the size of the entrant. At the same time, the mere existence of a competitive firm may impact incumbent behavior regardless of the competitive firm's size. We also allow the impact of entry to vary with the characteristics of the market to which incumbent t belongs (γZ_t).

We recognize that the impact of entry may also depend on certain incumbent and entrant characteristics. Most important, we are interested in the differential impact of entry as a function of ownership. Therefore, we allow for potential differences in the average and per-screen impact of entry between co-owned and rival-chain entrants. We also allow for additional characteristics of the market and firms that may systematically vary with ownership differences. For example, if two theaters belong to the same chain in a market, it is also more likely that they belong to a national chain. Also, national chain theaters tend to be larger in size. Therefore, we define the heterogeneous average and per-screen impact coefficients as follows:

$$\begin{aligned}\beta_t &= \beta_0 + \beta_1 \mathbf{1}(B_t = B_e) + \beta_2 \mathbf{1}(B_e \in TC) \\ &\quad + \beta_3 \mathbf{1}(B_t \in TC) + \beta_4 scr_t, \\ \delta_t &= \delta_0 + \delta_1 \mathbf{1}(B_t = B_e) + \delta_2 \mathbf{1}(B_e \in TC) \\ &\quad + \delta_3 \mathbf{1}(B_t \in TC) + \delta_4 scr_t,\end{aligned}$$

where B_t denotes the brand name of the incumbent and B_e denotes the brand name of the entrant. The set of national brands, denoted by TC, includes AMC, Carmike, Century, Cineplex, Cinemark, and Regal

Entertainment. This specification allows the fixed (β_t) and per-screen (δ_t) impact of entry to vary with whether the entrant is of the same chain as the incumbent ($B_t = B_e$), whether the incumbent ($B_t \in TC$) or the entrant ($B_e \in TC$) belongs to a top national chain, and the number of screens of the incumbent (scr_t).

As a result, the coefficient β_0 captures the impact of a rival entrant (of the typical size of six screens) when neither the entrant nor the incumbent belongs to a top national chain, and when scr_t and Z_t are evaluated at their means. The impact of a co-owned entrant of six screens is $\beta_0 + \beta_1$ under the same evaluations of all other variables. Therefore, β_1 captures the differential impact of ownership for an average sized entrant. Similarly, the per-screen additional impact of a rival entrant (of the average size of six screens) when neither the entrant nor the incumbent belongs to a top national chain, and when scr_t and Z_t are evaluated at their means, is captured by δ_0, and the per-screen additional impact of a co-owned entrant is captured by $\delta_0 + \delta_1$.

We take Specification (1) to the data in §3.2 to study how popularity metrics discussed in the previous section respond to entry. We also examine the impact of entry on: the propensity to screen top-ranked movies, delays in movie adoption, and several variety measures. Across these analyses, our empirical approach encompasses fixed-effect linear, logit, fractional logit, and Poisson models to allow for continuous, discrete, proportional, and count-dependent variables, respectively. Extending Specification (1), we formulate a generalized linear model (GLM) specification to capture all of these regressions under one specification (Nelder and Wedderburn 1972, McCullagh and Nelder 1989)

$$H(E(Y \mid X, \lambda)) = \alpha_{tc} + \tau_w + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t], \quad (2)$$

where the appropriate link function $H(\cdot)$ of the conditional expectation of the dependent variable is linear in the impact of entry. In a GLM, each outcome of the dependent variable, Y, is assumed to be generated from a particular distribution in the exponential family. The link function, $H(\cdot)$, provides a relationship between the linear predictor and the mean of this distribution function. The distributional assumption and the link function choice determine the regression method. We will refer to the specifics of these assumptions in each analysis section.

3.2. Product Decisions and Competition

Impact of Entry on Popularity Metrics. We want to examine how popularity metrics describing the set of movies shown by incumbent t in week w respond to rival and co-owned entry. We specify a fixed-effects regression by assuming a log link function (to account for the skewness in the dependent variables) and a normal distribution for the mean of the dependent variables as in Specification (1).[13] In Specification (1), as y_{tw}, we consider the average and maximum metrics based on five variables we discussed in §2: weekly box office, production budget, ad cost, opening-week revenues, and the number of screens at opening week.

We report the coefficients and clustered robust standard errors (that allow for arbitrary correlation across time within theaters and are robust to heteroskedasticity) in Table 3.[14] The coefficients in Column 1 indicate that the average weekly box office success decreases by 17% ($\exp(-0.18) - 1$) in response to entry by a rival chain of six screens. Of particular importance, we find a very significant and large positive competitive incentive regardless of the popularity metric we consider, as illustrated by the systematic negative differential quality degradation if the entrant is co-owned. Incumbents decrease the average weekly box office success of their movies by an additional 30%—from a 17% to a 47% reduction ($(\exp(-0.46 - 0.18) - 1)$)—if the entrant is of the same chain as the incumbent. In Columns 2–5 of Table 3, we provide results from average metrics based on time-invariant movie characteristics, such as budget (Column 2), prerelease advertising expenditure (Column 3), opening-week box office (Column 4), and width of release (Column 5). The differential co-ownership effect reflects an additional, and statistically significant, 27% decrease in the average width of release (Column 5), an additional 25% decrease in the average budget metric (Column 2), and an additional 20% decrease in the average ad cost metric (Column 3) in response to entry. The magnitude of the effect is similar for the average opening-week box office metric, but not significant in this specification.

We explore the heterogeneity of the impact of co-owned and rival entry. Both the entry impact and the ownership differential across all five metrics increase

[13] In the online appendix, we provide robustness checks of our results using different metric constructions, i.e., without taking logs (Tables OA3 and OA4); and taking the average of the logarithm of quality metrics, instead of the logarithm of the average (Table OA5). All of our results in Table 3 are replicated by these alternative constructions of the dependent variable. Therefore our results are not sensitive to the functional form presented in the main text. In Table OA6 of the online appendix, we also offer results from a replication of our findings on the quality of new releases when we only consider the top 150 new releases rather than all new releases screened by the incumbent. This replication provides additional evidence that our results are not driven by the long tail of movies. We thank the area editor for suggesting this robustness check.

[14] Note that the number of observations reflects observations from 219 control markets as well as 48 markets that experience entry. The coefficients of interest are informed by the data from entry markets (over 4,000 observations), whereas data from control markets help pin down week fixed effects (over 26,000 observations).

Table 3 Impact of Entry on Incumbent's Weekly Average and Maximum Quality Metrics

	ln(avg wkbo)	ln(avg budget)	ln(avg ad spend)	ln(avg openbo)	ln(avg openscr)	ln(max wkbo)	ln(max budget)	ln(max ad spend)	ln(max openbo)	ln(max openscr)
$(N_w - 1) \times$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	−0.18**	0.00	−0.02	−0.05	−0.03	−0.19**	−0.01	−0.01	−0.05	−0.01
	(0.084)	(0.029)	(0.019)	(0.053)	(0.034)	(0.085)	(0.035)	(0.019)	(0.056)	(0.033)
NS_e	−0.08***	−0.02***	−0.01***	−0.02**	0.01	−0.08***	−0.02***	−0.01**	−0.02**	0.01
	(0.016)	(0.005)	(0.003)	(0.010)	(0.008)	(0.016)	(0.007)	(0.004)	(0.011)	(0.008)
$1(B_t = B_e)$	−0.46**	−0.29***	−0.20***	−0.29	−0.32**	−0.37*	−0.34***	−0.20***	−0.33*	−0.30**
	(0.224)	(0.094)	(0.078)	(0.181)	(0.130)	(0.198)	(0.090)	(0.075)	(0.198)	(0.146)
$NS_e \cdot 1(B_t = B_e)$	−0.09*	−0.04**	−0.04***	−0.07**	−0.10***	−0.07*	−0.06***	−0.04***	−0.08***	−0.09***
	(0.048)	(0.019)	(0.014)	(0.026)	(0.015)	(0.042)	(0.021)	(0.014)	(0.028)	(0.016)
$1(B_t \in TC)$	−0.46**	0.08**	0.11***	0.10*	0.15***	−0.44**	0.06	0.07**	0.09	0.12**
	(0.191)	(0.038)	(0.032)	(0.051)	(0.047)	(0.194)	(0.040)	(0.033)	(0.061)	(0.048)
$NS_e \cdot 1(B_t \in TC)$	−0.12**	0.01	0.00	−0.00	−0.01	−0.12**	0.01	0.00	0.00	−0.00
	(0.057)	(0.006)	(0.005)	(0.010)	(0.010)	(0.059)	(0.006)	(0.005)	(0.011)	(0.011)
$1(B_e \in TC)$	0.69***	0.10	−0.31***	−0.09	−0.13	0.73***	0.15	−0.29***	−0.04	−0.18
	(0.251)	(0.109)	(0.088)	(0.178)	(0.137)	(0.251)	(0.110)	(0.082)	(0.193)	(0.148)
$NS_e \cdot 1(B_e \in TC)$	0.12*	−0.03**	0.02*	0.01	−0.01	0.11*	−0.03**	0.02*	0.00	−0.01
	(0.062)	(0.014)	(0.011)	(0.019)	(0.016)	(0.065)	(0.014)	(0.010)	(0.021)	(0.017)
scr_t	0.05***	−0.00	−0.01***	−0.00	−0.00	0.06***	−0.00	−0.01**	0.00	0.00
	(0.018)	(0.003)	(0.004)	(0.009)	(0.007)	(0.018)	(0.004)	(0.004)	(0.010)	(0.006)
$NS_e \cdot scr_t$	0.01***	0.00***	0.00***	0.00**	0.00	0.01***	0.00***	0.00***	0.00**	0.00
	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)
dist	0.00	−0.01**	−0.00	−0.00	−0.00	0.00	−0.00	−0.00	0.00	−0.00
	(0.011)	(0.002)	(0.002)	(0.007)	(0.006)	(0.011)	(0.003)	(0.002)	(0.007)	(0.007)
popul	−0.02*	0.00	0.00	−0.00	−0.00*	−0.02*	0.00	−0.00*	−0.00	−0.00**
	(0.009)	(0.001)	(0.001)	(0.003)	(0.002)	(0.009)	(0.001)	(0.001)	(0.003)	(0.002)
hhinc	0.00	0.00***	0.00***	0.00	0.00	0.00	0.00***	0.00***	0.00	0.00
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Week FE, Theater FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,216	20,483	21,377	21,708	21,738	31,216	20,483	21,377	21,708	21,738
R-squared	0.849	0.683	0.614	0.711	0.650	0.839	0.660	0.616	0.701	0.747

Note. Clustered (theater) robust standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

in the size of the entrant. However, the results as to the effect of chain membership on the response to entry are not uniform across different metrics of expected success. These differences could arise from how the metrics based on time-invariant movie characteristics are formulated.

Average metrics provide a useful statistic to summarize the *overall* changes in the quality of an incumbent's movie selection. Another useful statistic to examine is the best movie, in terms of expected popularity, among the movies that the incumbent screens each week. We explore how the descriptors of the best movie (ranked based on that particular descriptor) respond to entry, and we report the coefficients and clustered robust standard errors in Columns 6–10 of Table 3. The coefficients in Column 6 show that the weekly national box office success of the incumbent's top movie is 21% lower ($\exp(0.19) - 1$) in response to entry by a rival chain of six screens and by an additional 22% (a total of a 43% decrease) in response to entry by a co-owned chain of six screens. This differential effect is again mainly driven by the difference in the per-screen impact of entry. The differential impact of ownership persists across all quality metrics that we consider, and the magnitudes are very close to those results provided in Columns 1–5 for the average popularity metrics. Observing that both the average and maximum popularity metrics respond to entry in the same manner, we can rule out the possibility that changes in the average metrics are merely driven by the incumbent adding (or removing) movies with low popularity to its weekly portfolio.

In sum, our results distinguish the role of competitive incentives and the role of the opening of a new theater. We find that entry does not lead to a response of increased quality. By identifying a differential response as a function of the ownership structure, we isolate the positive role of competitive incentives. We find that compared with rival incumbents, co-owned incumbents reduce quality by a much larger amount when faced with an additional theater in the market. We interpret this response difference to be driven by

the difference in the competitive incentives of incumbents that face an additional firm in the market.[15] It seems that rival incumbents try harder to retain their customers.

Impact of Entry on the Incumbent's Likelihood of Screening Top Movies. A decrease in the average weekly success of movies based on weekly box office measures (Table 3, Column 1) could be due to one or a combination of the following three scenarios: (1) The incumbent adds a long tail of unpopular movies, without perturbing the rest of the selection (or even increasing the prevalence of more popular movies); (2) The incumbent shows more unpopular and fewer popular movies; and (3) The incumbent adopts the movies later, saving on costs and achieving lower actualized ticket sales. Our finding that the top movie popularity follows the same pattern rules out the possibility that the best movie shown is increasing in its overall popularity. In this section, we present more detailed evidence of the availability of high-ranking movies in the incumbent's assortment. We present timing-choice analyses in the next section to examine the third scenario.

Our aim is to test how the likelihood of the incumbent showing the best selling movies changes as a result of rival and co-owned entry. We rank movies each week based on their ticket sales. The mean propensity of a theater in the sample to show the best selling movie of the week is 0.62 (std. dev. 0.49). On average, theaters screen 1.82 (std. dev. 1.15) of the top 3 movies, 2.93 (std. dev. 1.76) of the top 5 movies, and 5.31 (std. dev. 3.10) of the top 10 movies of the week. These counts translate to an average of 61% of the top 3 movies, 59% of the top 5 movies, and 53% of the top 10 movies being screened by each theater in a given week. We are interested in how these propensities change with entry.

First, we test whether the incumbent is more or less likely to show the best selling movie of the week (nationally) after entry. We assume a Bernoulli distribution and a logit link function in Specification (2), $H(E(y_{tw} \mid x_{tw})) = \alpha_t + \tau_w + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma_c Z_t])$ and $H(v) = \log(z/(1-z))$, where the dependent variable y_{tw} equals one if the incumbent screens the best selling movie of the week. Note that this specification is akin to a binary logit specification. We report the coefficients and clustered robust standard errors in Column 1 of Table 4. We see that the odds of showing the top-ranked movie (versus not) when facing a rival entrant of average size are 0.57 ($\exp(-0.554)$) times the odds of screening the top-ranked movie when the incumbent operates as a monopoly. The odds of showing the top-ranked movie when facing a co-owned entrant of an average size are 0.06 ($\exp(-0.544 - 2.321)$) times the odds of screening the top-ranked movie when the incumbent operates as a monopoly. The propensity of incumbents showing the top movie of the week is 77.7% before entry, 65.1% after rival entry, and 18.8% after co-owned entry.[16] The 12.6% contrast between the rival entry and monopoly predictions is insignificant ($\chi^2 = 2$). However, the contrasts between the rival and co-owned entry ($\chi^2 = 32.15$), and co-owned entry and monopoly predictions ($\chi^2 = 100.2$), are both highly significant. Note that our empirical approach accounts for any persistent cross-sectional differences across theaters in the propensity to screen top movies with theater fixed effects. Therefore, we interpret these differences in the reaction to entry as a function of the difference in competitive incentives that entry creates. Incumbents that face a rival entrant strive to keep the top movie on their screens, whereas theaters that face a co-owned entrant are much less likely to screen the top movie after entry of their sibling.

Second, we extend this analysis and study whether the incumbent changes its propensity to screen weekly top movies as a response to entry. We work with two sets of proportional dependent variables. We create ratio3, ratio5, and ratio10, which respectively reflect the proportion of the top 3, top 5, and top 10 movies nationwide that the theater has on its screens in a given week. We also create perc3, perc5, and perc10, which denote the percentage of the movies that a theater shows in a given week that belong to the weekly top 3, top 5, and top 10 lists (nationwide), respectively.

We follow Papke and Wooldridge (1996) in estimating a fractional logit (modeling the mean of these proportional dependent variables to follow a logistic function) using a quasi-maximum likelihood

[15] The estimated differential may be a lower limit on the actual impact of competitive incentives if co-owned theaters have cost advantages due to retaining a higher bargaining power with respect to the distributors. Bargaining theory would predict that entry would drive up the costs more in the case of rival entry than in the case of co-owned entry (Guo and Iyer 2013). Even though laws mandate that distributors must structure their contingency contracts with exhibitors on a movie-by-movie and theater-by-theater basis, the competition to acquire the rights to a movie may increase the bargained prices in markets with rival entry. To the extent that co-owned theaters refrain from bidding wars, they may end up with more favorable revenue-sharing contracts.

[16] The average impact of rival entry on the propensity to screen the top movie when neither the entrant nor the incumbent belongs to a national chain can be calculated by differencing the predicted probabilities $(1/T)(1/W)\sum_t \sum_w [\exp(\alpha_t + \tau_w + \beta_0 + \beta_4 \overline{scr} + \gamma \bar{z}_c)/(1 + \exp(\alpha_t + \tau_w + \beta_0 + \beta_4 \overline{scr} + \gamma \bar{z}_c)) - \exp(\alpha_t + \tau_w)/(1 + \exp(\alpha_t + \tau_w))]$. Similarly, the average impact of entry by a co-owned theater when neither the entrant nor the incumbent belongs to a national chain equals $(1/T)(1/W)\sum_t \sum_w [\exp(\alpha_t + \tau_w + \beta_0 + \beta_1 1(B_t = B_e) + \beta_4 \overline{scr} + \gamma \bar{z}_c)/(1 + \exp(\alpha_t + \tau_w + \beta_0 + \beta_1 1(B_t = B_e) + \beta_4 \overline{scr} + \gamma \bar{z}_c)) - \exp(\alpha_t + \tau_w)/(1 + \exp(\alpha_t + \tau_w))]$.

Table 4 Impact of Entry on Incumbent's Propensity to Screen Top Movies of the Week and Delay in Title Adoption

Specification	Logit	Fractional logit						Poisson
Dependent variables	Top	ratio3	ratio5	ratio10	perc3	perc5	perc10	Delay
$(N_w - 1)\times$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	−0.554*	−0.128	−0.150	−0.195***	−0.139**	−0.144**	−0.192**	−0.038
	(0.335)	(0.167)	(0.119)	(0.051)	(0.054)	(0.058)	(0.081)	(0.030)
NS_e	−0.120*	−0.114***	−0.115***	−0.051***	−0.094***	−0.096***	−0.117***	0.011**
	(0.065)	(0.031)	(0.025)	(0.010)	(0.011)	(0.011)	(0.016)	(0.005)
$1(B_t = B_e)$	−2.321***	−1.952***	−1.484***	−0.941***	−0.659***	−0.634***	−0.711***	0.099*
	(0.494)	(0.269)	(0.231)	(0.150)	(0.153)	(0.162)	(0.234)	(0.057)
$NS_e \cdot 1(B_t = B_e)$	−0.447***	−0.342***	−0.284***	−0.258***	−0.099***	−0.105***	−0.152***	−0.000
	(0.114)	(0.059)	(0.051)	(0.036)	(0.031)	(0.032)	(0.041)	(0.012)
$1(B_t \in TC)$	−1.258**	−1.288***	−1.068***	−0.362***	−0.532***	−0.696***	−0.854***	0.073*
	(0.529)	(0.253)	(0.173)	(0.080)	(0.072)	(0.078)	(0.112)	(0.043)
$NS_e \cdot 1(B_t \in TC)$	−0.224	−0.180**	−0.188***	−0.053**	−0.108***	−0.130***	−0.124***	0.002
	(0.168)	(0.080)	(0.054)	(0.021)	(0.016)	(0.017)	(0.023)	(0.011)
$1(B_e \in TC)$	2.681***	2.386***	2.006***	0.974***	0.642***	0.855***	1.023***	−0.164
	(0.768)	(0.400)	(0.253)	(0.155)	(0.196)	(0.196)	(0.264)	(0.105)
$NS_e \cdot 1(B_e \in TC)$	0.318	0.158*	0.210***	0.051**	0.126***	0.138***	0.132***	−0.000
	(0.194)	(0.095)	(0.061)	(0.026)	(0.025)	(0.025)	(0.034)	(0.015)
scr_t	−0.082	−0.005	−0.008	−0.013	0.046***	0.064***	0.107***	0.010**
	(0.086)	(0.044)	(0.031)	(0.011)	(0.009)	(0.010)	(0.012)	(0.005)
$NS_e \cdot scr_t$	0.032**	0.006	−0.006	−0.001	0.012***	0.010***	0.008***	−0.001
	(0.016)	(0.008)	(0.006)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
dist	0.099*	0.121***	0.077***	0.015**	0.009*	0.012**	0.002	−0.004
	(0.057)	(0.030)	(0.017)	(0.006)	(0.005)	(0.005)	(0.007)	(0.004)
popul	0.004	−0.021	−0.017	0.005	−0.021***	−0.022***	−0.021***	0.000
	(0.037)	(0.021)	(0.012)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
hhinc	−0.000	−0.000**	−0.000*	−0.000**	0.000***	0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Theater FE, week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Movie FE	No	No	No	No	No	No	No	Yes
Observations	30,424	29,457	28,963	28,699	29,457	28,963	28,699	65,792

Note. Clustered (theater) standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

approach. This is achieved by estimating a GLM specification as in (2), assuming a binomial distribution for $E(y_{tcw} \mid x_{tcw})$ and a logit link function $H(v) = \log(z/(1-z))$, while taking care to obtain fully robust standard errors. This method generates in-range predictions, does not require special treatment of boundary values, and does not rely on strong assumptions about the distribution of the error term.

The coefficients and clustered robust standard errors are presented in Columns 2–7 of Table 4. Rival entry decreases the percentage of the incumbent's movies that belong to the weekly top 3, top 5, and top 10 lists and also has a dampening effect on the proportion of the top lists that the incumbent screens. The differential ownership effect is large and negative. The predicted mean proportion of the top 3 list (top 5, top 10) that the incumbents screen is 69% (60%, 54%) before entry, 66% (56%, 49%) after rival entry, and 24% (24%, 28%) after co-owned entry for an entrant of six screens.[17] The contrast of co-owned-entry impact is significantly different than that of rival entry for all measures. The predicted mean percentages of the incumbent's movies that belong to the weekly top 3, top 5, and top 10 lists are 27%, 41%, and 66%, respectively, before entry. They are 26%, 39%, and 65%, respectively, after a rival entry and 15%, 26%, and 48%, respectively, after a co-owned entry. Again, the contrast of co-owned-entry impact is significantly different than that of rival entry for all measures.

In sum, these results show that the incumbent is less likely to screen movies from any of the top lists if the entrant is co-owned, compared with the case wherein the entrant is competitive. This finding supports the

[17] We average over theater fixed effects and week fixed effects when neither the entrant nor the incumbent belongs to a national chain, and holding all other variables at their mean values to calculate these values.

positive impact of competitive incentives. Without competitive incentives, the incumbent is much more likely to skip a movie from the top list when faced with entry. We also find that incumbents that belong to a top national chain are less likely to screen the top movies in response to entry, and that a lower percentage of the movies that they screen are on the top lists. On the other hand, incumbents that face an entrant from a top national chain are more likely to screen top movies in response to entry, and a higher percentage of the movies they screen are on the top lists.[18]

Impact of Entry on Timing Choice. Next, we take a different approach to provide direct evidence of how incumbents change *when* they adopt a movie as a result of entry, holding the choice of the movie fixed. From the perspective of the theaters, timing of adoption reflects a quality choice. The theater faces a trade-off between adopting movies early to take advantage of higher demand and adopting movies later to secure higher margins due to better revenue-sharing contractual terms. Let λ_{mtw} denote the count of weeks elapsed since movie m's release until incumbent t screens it in week w. We use a Poisson log-linear model to investigate how the mean of λ_{mtw} responds to entry. In particular, we assume the dependent variable to follow a Poisson distribution and the link function $H(\cdot)$ in Specification (2) to be a log function

$$\log(E(\lambda_{mtw} \mid X)) = \alpha_t + \tau_w + \kappa_m + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t]. \quad (3)$$

The coefficients of interest (β_t and δ_t) capture whether an incumbent's general adoption-timing propensity changes with entry.[19] The observations in this regression comprise movie-theater pairs in the first week of the movie m's screening at theater t. We include movie fixed effects κ_m to allow for movie-level unobserved heterogeneity, since some movies are wide releases and some are sleepers and may differ systematically in the average delay of adoption.

The coefficients and clustered robust standard errors are reported in Column 8 of Table 4. Rival entry of six screens does not have a significant impact on the delay of adoption, although the impact of rival entry depends on the size of the entrant. Of particular importance, competition provides additional incentives to adopt movies earlier. Co-owned entry, regardless of the entrant's size, increases the adoption delay by another 10.4% (almost half a week) compared with a rival entry of comparable size, suggesting that competition incentivizes theaters to adopt movies earlier.

Implications of Variety Response for the Quality Response Findings. We find that the incumbent is more likely to reduce the prevalence of movies with high success potential and adopt new releases later if it faces a co-owned entrant rather than a competitive entrant. One potential explanation for the popularity finding could be connected to the changes in variety in the incumbent's portfolio of movies in response to entry. For example, the co-owned incumbent may respond by increasing the variety of genres it screens. As the representation over different genres broadens, the expected success of each movie may decline if the incumbent introduces movies with a narrower target segment.

To determine whether the co-owned and competitive incumbents differ in their variety response to entry, we first consider the number of titles and the number of new adoptions that the incumbent screens each week. In the previous literature, product count variables are commonly studied as measures of variety (Broniarczyk et al. 1998, van Herpen and Pieters 2002, Hoch et al. 1999, Berry and Waldfogel 2001). We also constructed six additional variety metrics based on the genre composition of the movie assortment.[20] The top five common genres in the data, both by frequency of screenings and by sales, are Comedy, Drama, Action, Adventure, and Suspense. The next five genres are Romance, Horror, Family, Sci-Fi, and Animation.[21] The rest of the genres, such as Sports,

[18] These results are in line with the prediction of the model we present in the appendix, which predicts that the quality provision of the incumbent will be higher (lower) the larger (smaller) the decrease in the level of demand for the incumbent due to entry. As we show in our analyses of revenues to follow, we indeed find evidence that, all else equal, having a top national brand shields incumbents from business stealing and helps an entrant capture more consumers. Therefore, the finding that incumbents who face a national brand entrant invest more in popularity in response to entry, and that those who themselves carry a national brand invest less, is consistent with this prediction.

[19] Clearly, not all movies are immediately available to all theaters in the nation. Therefore, certain theaters in markets that are often in secondary distribution geographies may adopt movies later than those in primary distribution geographies. Because general geographic rules that distributors may have are unlikely to change immediately with entry into one of the small markets in that geographic location, any differences across theaters in their access to new releases are absorbed by theater fixed effects. Consequently, our results are robust to variance in the access to new releases.

[20] These measures are based on the variety literature in marketing (Broniarczyk et al. 1998; Dhar et al. 2001) and in economics (Alexander 1997; Berry and Waldfogel 1999, 2001). While there are other measures besides the ones we use, e.g., van Herpen and Pieters (2002), Hoch et al. (1999), Alexander (1997), Hwang et al. (2010), etc., those approaches are either inappropriate for our data or tend to capture information similar to our included measures.

[21] These genres account for the following proportion of the movies in our data: Comedy (42%), Drama (35%), Action (27%), Adventure (19%), Suspense (15%), Romance (14%), Horror (8%), Family (8%), Sci-Fi (7%), Animation (7%), and Sports (4%). If a movie is classified as Romance and Comedy, then both genres are considered in these frequency calculations. Because the number of genre combinations represented in the data is larger than 400, we work directly with genres to describe variety and construct measures that capture these variations.

Documentary, Fantasy, and Religion, can be considered fringe genres because they appeal to far more specific tastes. The first metric we construct is the uniqueness ratio, which captures the overlap across genres within the weekly portfolio of the incumbent, calculated as the ratio of the unique number of genres to the total number of genres spanned by the movies in that week. The second metric, the Herfindahl-Hirschman Index (HHI), is a concentration measure[22] that varies between $1/G$ and 1, where a lower value denotes a maximal diversity of genres. We also calculate HHI Top 10, the concentration of genres within the most common 10 genres. Finally, we calculate the ratios of the top 5, top 10, and fringe genres among all genres screened by the theater in a given week (Top 5 Ratio, Next 5 Ratio, and Fringe Ratio). These metrics are summarized in Table OA11 in the online appendix. We estimate a fractional logit using a quasi-maximum likelihood approach to account for the fact that all of the genre variety variables are between zero and one. We use a linear specification for the number of titles and new adoptions. Table OA12 in the online appendix presents coefficients and clustered robust standard errors.

First, by and large, there are no statistically significant effects of entry on the incumbent's genre variety provision or number of titles. Results from the fringe ratio, the one instance where entry plays a role, suggest that incumbents are, on average, less likely to show movies featuring fringe genres in response to rival entry. Second, on average, we see no differences between the effects of rival or co-owned entry for genre variety provision. However, we find that incumbents facing co-owned entry screen fewer titles as well as fewer new adoptions in response to entry. Third, we see a response only to entrants with more than eight screens. Incumbents increase the prevalence of the top five common genres at the expense of the next five common genres, especially if the new theater is co-owned.

The results show that the relative decrease in the prevalence of popular movies due to a lack of competitive incentives is unlikely to be driven by a parallel increase in the likelihood of showing movies that appeal to niche segments. Specifically, we do not find evidence of either a shift towards more diversity in genres or an increase in the number of titles in the incumbents' weekly movie selection.

Market-level quality provision. We also provide evidence that our incumbent-level results generalize to the market level. First, we determine whether the change in the likelihood of top selling movies and the delay in adoption after entry are different in markets that experienced rival entry compared to markets that experienced co-owned entry. In Table 5, Column 1, we present coefficients and clustered standard errors from a regression that compares the likelihood of the top movie of the week (nationally) being available in the market before versus after entry, across markets that experience competitive versus co-owned entry. The likelihood of the top movie being shown increases with the number of firms and screens in the market. Of particular importance, however, this increase is dampened if the entrant is co-owned, compared to competitive entry. Second, we study how the propensity to screen weekly top movies responds to entry. We work with two sets of proportional dependent variables based on counts of unique movies in a market during a given week. Variables mrkratio3, mrkratio5, and mrkratio10, respectively, reflect the proportion of the top 3, top 5, and top 10 movies nationwide that the market has available in a given week. Variables mrkperc3, mrkperc5, and mrkperc10, respectively, denote the percentage of movies in the market that belong to the weekly top 3, top 5, and top 10 lists (nationwide) in that week. The coefficients and clustered robust standard errors from a fractional logit model are presented in Columns 2–7 of Table 5. In all of these analyses, we see a significant dampening effect of co-owned entry compared to competitive entry. In other words, *the increase in the prevalence of top movies is greater in markets that experience competitive entry than in markets that experience entry of a co-owned theater*. Finally, in Column 10, we present the results from the analysis of the adoption timing of movies at the market level. We find that the *decrease in the delay of adoption in markets that experience competitive entry is reversed or dampened in markets that experience friendly entry*. In sum, these analyses show that the patterns we document at the incumbent level also hold for quality provisioning at the market level, pre- and post-entry. Therefore, the differential decrease in the quality of the co-owned incumbent cannot be driven entirely by the chain's decision to shift popular movies from the incumbent location to the new location so as to drive more traffic to the new location.

Summary of Main Product Response Findings. We find substantial product response to entry in the provision of popular and recent movies. We show that the incumbents slightly decrease their popularity and recency provision in response to rival entry, and that this effect is increasing in the size (number of screens) of the entrant. Of particular importance, incumbents who face a same-chain entrant provide fewer popular movies and delayed adoption of new releases more than they would have if they had faced a rival-chain entrant. This differential result isolates the impact of

[22] $\text{HHI} = \sum_{g=1}^{G} s_g^2$ where s_g is the share of genre g among all unique genres (indexed $g = \{1, \ldots, G\}$) screened during that week in the theater.

Table 5 Impact of Entry on Market Propensity of Top Movies of the Week and Delay in Title Adoption

Specification	Logit	Fractional logit						Poisson
Dependent variables	Top	mrkratio3	mrkratio5	mrkratio10	mrkperc3	mrkperc5	mrkperc10	Delay
$(N_w - 1)\times$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	8.52***	9.07***	7.97***	22.23***	1.10***	3.03***	21.54***	−0.120***
	(1.267)	(0.991)	(1.155)	(0.462)	(0.364)	(0.670)	(0.459)	(0.028)
NS_e	1.24***	1.25***	1.16***	4.75***	0.36***	0.86***	5.01***	−0.006
	(0.275)	(0.222)	(0.279)	(0.158)	(0.089)	(0.168)	(0.189)	(0.005)
$1(B_t = B_e)$	−1.63**	−2.80***	−2.47***	−2.06***	−0.62***	−1.31***	−1.73***	0.140***
	(0.813)	(0.528)	(0.536)	(0.350)	(0.220)	(0.394)	(0.648)	(0.052)
$NS_e \cdot (B_t = B_e)$	−0.10	−0.27**	−0.17	−0.03	−0.11*	−0.24**	−0.01	−0.018*
	(0.204)	(0.127)	(0.125)	(0.087)	(0.054)	(0.094)	(0.148)	(0.011)
$1(B_t \in TC)$	0.12	−0.41	1.02***	3.11***	0.02	0.49***	3.27***	0.105***
	(0.580)	(0.324)	(0.183)	(0.105)	(0.125)	(0.097)	(0.121)	(0.040)
$NS_e \cdot 1(B_t \in TC)$	0.58**	−0.02	0.07	0.77***	−0.13	0.09***	0.82***	0.007
	(0.229)	(0.342)	(0.055)	(0.033)	(0.083)	(0.033)	(0.046)	(0.010)
$1(B_e \in TC)$	−0.31	−1.69*	−0.45***	0.60***	0.20	0.01	0.77***	−0.161*
	(1.610)	(0.993)	(0.092)	(0.073)	(0.303)	(0.102)	(0.161)	(0.096)
$NS_e \cdot 1(B_e \in TC)$	−0.05	0.00	−0.41***	0.00	−0.04	−0.21*	0.00	−0.005
	(0.656)	(0.499)	(0.102)	(0.000)	(0.115)	(0.116)	(0.000)	(0.014)
scr_t	1.06***	1.09***	0.00***	0.00	0.18***	0.00**	0.00	0.011***
	(0.188)	(0.151)	(0.000)	(0.000)	(0.054)	(0.000)	(0.000)	(0.004)
$NS_e \cdot scr_t$	0.21***	0.09**	0.00	0.00	0.07***	0.00	0.00	0.000
	(0.049)	(0.041)	(0.000)	(0.000)	(0.022)	(0.000)	(0.000)	(0.001)
dist	−0.15*	−0.38***	0.00	—	0.07	0.00	—	0.003
				18.12***			16.14***	
	(0.075)	(0.067)	(0.000)	(0.276)	(0.045)	(0.000)	(0.269)	(0.003)
popul	−0.00	−0.30***	0.00	0.00	0.05	0.00	0.00	−0.001
	(0.044)	(0.090)	(0.000)	(0.000)	(0.058)	(0.000)	(0.000)	(0.002)
hhinc	0.00**	0.00***	−7.54***	0.00	−0.00	−2.51***	0.00	−0.000
	(0.000)	(0.000)	(0.746)	(0.000)	(0.000)	(0.382)	(0.000)	(0.000)
Theater FE, week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Movie FE	No	No	No	No	No	No	No	Yes
Observations	16,071	15,170	14,743	14,364	15,170	14,743	14,364	49,900

Note. Clustered (city) standard errors in parentheses.
*$p < 0.1$;**$p < 0.05$; ***$p < 0.01$.

competitive incentives on quality provision, which is economically significant and positive. We also show that the patterns we document at the incumbent level also hold for quality provisioning at the market level. The increase in the prevalence of top movies and the decrease in adoption delay is greater in markets that experience competitive entry than in markets that experience friendly entry.

3.3. Revenue Outcomes

The fact that incumbents respond to entry by changing the movies they screen and when they adopt them begs the question of whether the incumbent's ability to adjust product quality changes the degree to which entry impacts revenues. In particular, we are interested in documenting how our understanding of the impact of competition on revenues would change if product competition is taken into account. Studying the same industry, Davis (2006b) predicts the entry of a co-owned theater to reduce the revenues of the incumbent less than the entry of a rival theater would. This prediction is based on the notion that rivals do not internalize the impact of their competitive behavior to the incumbent. However, the revenue analysis presented in Davis (2006b) do not provide support for this prediction.[23] Using more granular data than Davis (2006b), but following a similar empirical strat-

[23] While Davis (2006b, p. 295) claims to "find a considerable amount of evidence that incumbent's revenues are stolen by new rival entrants, while . . . finding very little evidence of revenue cannibalization . . . by the same theater chain," a careful examination of this paper reveals that this conclusion is driven by the overrepresentation of rival entry, rather than how the impact of the entrant on a particular theater varies with its ownership structure. Davis (2006b, p. 315) notes: "It is not that the data suggest that rival theaters actually have a greater impact on my theater's revenues than my own local screens. Rather, the data indicate that the typical experience of a theater is that most of its local competition (and most new entrants) were owned by rival chains." This explanation shows that the per-screen impact of entry is not estimated to be larger if the entrant is a rival chain. Accordingly, Table 3 in Davis (2006b) exhibits a variety of specifications wherein the per-screen impact of entry on revenues is instead larger in magnitude if the entrant is co-owned. In independent research, Zentner (2011) also documents larger revenue declines for incumbents facing co-owned entrants versus rivals.

egy, we find that the decline of the incumbent's revenue is, in fact, larger in the case of co-owned entry compared to rival entry. We find that the incumbent loses an average of 13% of weekly revenues as a result of rival entry, but loses 39% of revenues per week if the entrant is owned by the same chain (Online Appendix, Table OA7, Column 1).

Interpreted at face value, this finding may seem surprising since co-owned theaters maximize joint profits and lack the incentives to steal business from one another to the extent that rival theaters do. Because of incumbents' additional incentives to compete when faced with a rival firm, the cannibalization effect is expected to be, and is often found to be, smaller than the business stealing effect (Ellickson et al. 2013). Traditionally, the difference between the estimated business stealing effect and the cannibalization effect is used to infer the impact of competitive incentives on conduct (Kalnins 2004, Davis 2006b, Wilson 2015). Using this traditional approach in cases where the incumbents can respond by changing the quality of their products could provide a misleading picture of the role of competitive incentives. In previous analyses, we have shown that competitive incentives lead to sooner adoption of movies and provision of movies with greater expected success. Therefore, we recognize that the decline of customer attendance might be driven by the quality response of the incumbent.

To tease out consumer defection to the entrant from changes in attendance due to endogenous changes to product quality decisions, we run revenue regressions that include progressively increasing controls for movie responses of the incumbent. The aim of this approach is to quantify how entry would affect revenues if the incumbent did not change its movie selection and timing of adoption. Having ticket sales data at the movie–theater–week level allows us to conduct a revenue analysis at this level to control for theaters' weekly movie selections. We model r_{mtw}, ticket sales of movie m at theater t during week w, with each of the following models that increase in the level of controls included:

$$\log(r_{mtw}) = \alpha_t + \tau_w + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t] + \varepsilon_{mtw}, \quad \text{(a)}$$

$$\log(r_{mtw}) = \alpha_t + \tau_w + \kappa_m + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t] + \varepsilon_{mtw}, \quad \text{(b)}$$

$$\log(r_{mtw}) = \alpha_t + \tau_w + \kappa_m + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t] + \theta X_{tmw} + \varepsilon_{mtw}, \quad \text{(c)}$$

$$\log(r_{mtw}) = \alpha_t + \xi_{wm} + (N_w - 1)[\beta_t + \delta_t NS_e + \gamma Z_t] + \theta X_{tmw} + \varepsilon_{mtw}. \quad \text{(d)}$$

In all models, the observations vary at the movie–theater–week level. Specification (a) is the baseline model that reflects the approaches taken in the literature that study the impact of entry on revenues. Specification (b) controls for potential changes in the movie choices of the incumbent by including κ_m, movie fixed effects, to account for differences in the revenue potential of movies. Specification (c) controls for theater-movie-specific variables that change over time, X_{tmw}, including the number of weeks the theater has been showing the movie and the number of weeks that the theater waited to adopt the movie, to account for timing choices of the incumbent. Finally, specification (d) includes ξ_{wm}, movie-week fixed effects, controlling for the inherent box office potential of a movie in any given week, thus conditioning out the changes in the success of the movie over time.[24]

Table 6 presents the coefficients and robust clustered standard errors.[25] Column 1 reports estimates from specification (a). We find that rival entry of six screens reduces the incumbent's average weekly movie revenues by 15% (Column 1, $\exp(-0.161) - 1$). More important, co-owned entry of six screens reduces the incumbent's average weekly movie revenues by 31% (Column 1, $\exp(-0.208 - 0.161) - 1$). This echoes earlier findings about higher rates of cannibalization versus business stealing. When we include movie fixed effects to control for the endogenous product response of incumbents, the percentage decline in revenue due to common ownership reduces by two thirds, to only 6% ($\exp(-0.061) - 1$, Column 2), which is not statistically distinguishable from zero. In other words, controlling for *which* movies the incumbent shows accounts for at least two thirds of the differential revenue loss due to ownership, on average. When we examine the results from specifications (c) and (d), which control for not only which movies are screened but also *when* they are screened, we see that the additional cannibalization effect is completely eliminated. The results provide additional insight on the relative importance of the two dimensions that theaters can

[24] In independent research, Zentner (2011) uses data from the Brazilian film exhibition industry to study movie-screen-level changes in the incumbents' revenues, ticket sales, and prices as a result of changes in the number of competitive screens over time. Similar to our analysis in this section, Zentner (2011) documents the impact of entry on incumbents' revenues with and without movie-week fixed effects. He finds business stealing to be smaller once the movie choices are accounted for. A potential shortcoming of the Brazilian data is that the theater locations in a city are not observed, which, according to Zentner (2011), affects his ability to find a significant difference between the impact of an entry by a rival versus a co-owned theater. Although Zentner (2011) does not study the product choices of theaters directly, his findings are consistent with the results that we present in this section.

[25] We chose a log-linear specification due to the skewness in the distribution of r_{mtw}. We provide results from a robustness exercise in Table OA8 in the online appendix when the dependent variable is r_{mtw}, and we show the same general pattern.

Table 6 The Impact of Entry on Weekly Movie Ticket Sales of the Incumbent

	Log(weekly movie ticket sales)			
$(N_w - 1)\times$	(1)	(2)	(3)	(4)
Intercept	−0.161***	−0.151***	−0.135***	−0.095***
	(0.033)	(0.030)	(0.026)	(0.028)
NS_e	−0.056***	−0.035***	−0.034***	−0.017***
	(0.005)	(0.005)	(0.005)	(0.005)
$1(B_t = B_e)$	−0.208***	−0.061	−0.017	0.020
	(0.051)	(0.050)	(0.044)	(0.049)
$NS_e \cdot 1(B_t = B_e)$	−0.054***	−0.031**	−0.020	−0.002
	(0.014)	(0.015)	(0.014)	(0.015)
$1(B_t \in TC)$	−0.026	0.066*	0.057*	0.148***
	(0.037)	(0.037)	(0.034)	(0.035)
$NS_e \cdot 1(B_t \in TC)$	0.004	0.022***	0.024***	0.027***
	(0.007)	(0.007)	(0.007)	(0.007)
$1(B_e \in TC)$	−0.139	−0.339***	−0.313**	−0.368**
	(0.117)	(0.124)	(0.126)	(0.143)
$NS_e \cdot 1(B_e \in TC)$	0.017	0.009	0.005	−0.009
	(0.014)	(0.014)	(0.014)	(0.015)
scr_t	0.020***	0.010*	0.009**	−0.002
	(0.004)	(0.005)	(0.004)	(0.006)
$NS_e \cdot scr_t$	0.003***	0.001	0.001	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)
dist	−0.007***	−0.008***	−0.008***	−0.007***
	(0.003)	(0.002)	(0.003)	(0.003)
popul	−0.001	0.004*	0.006**	0.003
	(0.002)	(0.002)	(0.003)	(0.002)
hhinc	0.000***	0.000***	0.000***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Time on screen, adoption lag	No	No	Yes	Yes
Week FE	Yes	Yes	Yes	No
Theater FE	Yes	Yes	Yes	Yes
Movie FE	No	Yes	Yes	No
Movie-week FE	No	No	No	Yes
Observations	271,990	271,990	271,990	271,990
R-squared	0.081	0.380	0.476	0.731

Note. Robust clustered (movie) standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

control to adjust movie success potential and costs, i.e., title choice and timing choice. We can say that about two-thirds of the average differential impact due to ownership stems from the incumbents' movie-choice responses (Column 1 to Column 2), while the other third is explained by their movie-timing responses (Column 2 to Column 4).

4. Discussion and Conclusion

In the movie exhibition industry, movies that are expected to bring more patrons, because of their inherent popularity or because they are recently released, are more expensive for theaters to screen. Thus, theaters face a trade-off between margins and volume when making weekly product decisions. We study how these dimensions of product decisions in the movie exhibition industry respond to entry in previously monopolistic, geographically isolated markets. By conducting market-, theater-, and movie-level analyses on a detailed and comprehensive data set, we show that competitive incentives, all else equal, lead incumbents to respond by screening movies that are more popular, and screening them earlier. Similarly, the increase in the prevalence of top movies and the decrease in the adoption delay is greater in markets that experience competitive entry than in markets that experience friendly entry. However, we do not find changes in the variety of movie genres that the incumbent offers. These findings complement a handful of previous results on the impact of competition on product quality provision, and present a different identification approach.

Our finding that incumbents respond to entry by altering the attractiveness of their products also highlights the inadequacy of studying the impact of entry on revenues to reach conclusions about the impact of entry on profitability. We contribute to the literature on the measurement of business stealing and cannibalization effects by documenting the role of endogenous product responses in reversing conclusions that researchers may draw from revenue analyses about the role of competitive incentives. We hope that these findings fuel a discussion about the conditions under which studying revenue responses is informative as to the impact of competition on outcomes that researchers are concerned with.

Our paper does not offer a measure of the welfare change as a result of endogenous product responses. However, our results highlight that the impact of competition on consumer welfare may operate through product responses instead of, or in addition to, price responses. In a related stream of work, Fan (2013) simulates the impact of mergers in the newspaper industry on quality provision based on estimates from a structural model of quality responsiveness of demand. She finds that ignoring newspapers' quality adjustment typically yields an underestimation of the loss in readers' welfare. Our work complements her work by providing direct evidence for market outcomes on quality as a result of a change in market structure. To determine whether consumer welfare is higher with the product provision stemming from fiercer competition in this industry, future research can integrate a movie demand model with our approach.

Although our empirical results about quality responses do not directly address results in other industries, there are clearly other contexts where entry evokes reactions on the quality dimension. One such context is pharmaceuticals, where the entry of generic competition triggers a variety of reactions among rivals. In some instances, firms launch lower-dosage, over-the-counter (OTC) versions of the drug (e.g., Prilosec OTC), whereas in others we see a move to

higher quality, extended-release versions (e.g., Seroquel XR). Of course, in the pharmaceutical industry, firm responses can also occur on the price dimension (see, for example, Regan 2008). A key benefit of the context we study is that some of the other factors such as price competition or price discrimination do not play a role. In the presence of such responses, it would be much harder to provide direct evidence of the trade-offs that firms face in quality provision by looking at product choices alone. Often, papers that study quality responses to entry ignore the potential of price discrimination and competition even if it is possible (for example, see Matsa 2011). The lack of price discrimination and stickiness of ticket prices due to industry features makes the movie industry a unique laboratory in which to study the impact of entry and competitive incentives on product choices and revenues.

In this industry, we did not find incumbents altering variety as reflected in the genre compositions of their portfolios. In other contexts, however, firms might also respond by changing the variety of their assortments. Examples of these include rivals' reactions to Walmart entry: "Dollar Tree is adding more food items and installing new freezers and refrigerators to a growing number of its stores. And Target is similarly adding a broader food assortment," according to its CEO (Wiederman 2012). Expanding our analysis to include these dimensions of variety and assortment and exploring the interactions between quality and variety responses would be fruitful directions for future research.

Our work also highlights interesting questions that future research can address in the movie industry with detailed data on revenue-sharing contracts and individual consumers' movie choices before and after entry. Data on revenue-sharing contracts would facilitate future research on how vertical contracting terms between distributors and exhibitors respond to entry, identity, and size of the entrant. These data will also allow researchers to observe, rather than infer, the trade-off between margin and expected quantity that theaters face for each movie title. Panel data on consumer movie choices can allow researchers to dig deeper into the targeting strategies of incumbents and draw welfare implications of the product changes that we document.

Supplemental Material

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Appendix

An Illustrative Theory-Model

The Setup. Previous literature (Olivares and Cachon 2009, Kranton 2003, Economides 1993) has established that the impact of entry on the quality provision is theoretically ambiguous under more general conditions. In this section we examine the conditions under which provision may decrease or increase with entry, considering the specific features of the industry we study. We show that this ambiguity is maintained even when firms do not change other strategic response variables in response to entry, such as their price or location choices. In this industry, prices do not respond to entry and do not vary across movies with different levels of popularity or recency. Other product choice decisions, such as location choice, brand, and theater amenities, do not respond swiftly enough to allow for an empirical study. We do not find that theaters change the variety of their portfolio in any meaningful way in response to entry. Therefore, for the purposes of this illustration, we focus on a single dimension of short-term quality competition, treating other long-term investments as fixed for the period we study and abstracting from price competition and horizontal differentiation that may take place in other industries. We also focus on the decision of choosing the quality level for one product because the trade-offs highlighted in the model for one product are the same across all products. In our empirical analyses, we reduce the dimensionality of the portfolio by studying how different summary statistics of quality respond to entry.

A Model of Product Competition Among Horizontally Differentiated Theaters.[26] The profits of firm j as a monopolist can be written as $\Pi_j^m = D_{1j}(q_j, p_j, k_j)(p_j - C(q_j)) - FC_j$, where the demand of firm j when it is the only firm in the market is a function of its own product quality (q_j), price (p_j), and other product or brand features (k_j). The profits of firm j after entry of a competitive firm can be written as $\Pi_j^d = D_{2j}(q_j, p_j, k_j, q_n^d, p_n, k_n)(p_j - C(q_j)) - FC_j$, where the demand function is now a function not only of its own quality, price, and product characteristics but also those of its competitor n. Also, the notation draws a distinction between the demand function with two ($D_2(\cdot)$) versus one firm ($D_1(\cdot)$) in the market, as both the level of demand and the sensitivity of demand to q_j are expected to change with the additional firm in the market. A more stylized example below illustrates how the demand function may change with the additional firm. The cost of providing quality, $C(\cdot)$, is assumed not to vary with the number or identity of firms in the market.

[26] A model with a specific demand parameterization is included in the online appendix. It highlights how the entry of a new theater can change the quality sensitivity of the residual demand that the incumbent faces.

The monopolist one-firm, duopolist, and co-owned two-firm first-order conditions for incumbent j, respectively, are

$$\frac{\partial \Pi_j^m}{\partial q_j^m} = \frac{\partial D_{1j}(q_j^m, p_j, k_j)}{\partial q_j^m}(p_j - C(q_j^m)) + D_{1j}(q_j^m, p_j, k_j)\frac{\partial C(q_j^m)}{\partial q_j^m} = 0, \quad \text{(FOC1)}$$

$$\frac{\partial \Pi_j^d}{\partial q_j^d} = \frac{\partial D_{2j}(q_j^d, p_j, k_j, q_n^d, p_n, k_n)}{\partial q_j^d}(p_j - C(q_j^d)) + D_{2j}(q_j^d, p_j, k_j, q_n^d, p_n, k_n)\frac{\partial C(q_j^d)}{\partial q_j^d} = 0, \quad \text{(FOC2)}$$

$$\frac{\partial \Pi_j^c}{\partial q_j^c} = \frac{\partial D_{2j}(q_j^c, p_j, k_j, q_n^c, p_n, k_n)}{\partial q_j^c}(p_j - C(q_j^c)) + D_{2j}(q_j^c, p_j, k_j, q_n^c, p_n, k_n)\frac{\partial C(q_j^c)}{\partial q_j^c} + \omega\frac{\partial D_{2n}(q_j^c, p_j, k_j, q_n^c, p_n, k_n)}{\partial q_n^c}(p_n - C(q_n^c)) = 0, \quad \text{(FOC3)}$$

where q_j^m is the optimal quality choice of firm j when operating as the only theater in town (monopoly case), q_j^d is its optimal quality choice after entry of a new theater indexed by n (duopoly case), and q_j^c is its optimal quality choice after entry of a sibling theater (co-owned case) where ω denotes the weight that theater j places on the profits of the entrant n (the degree of profit internalization). In the competitive duopoly case, ω is zero. In the co-owned case, ω lies between zero and one.[27] The notation highlights the fact that the firm is only optimizing over this quality dimension, whereas price (p_j) and other product or brand features (k_j) that may also affect demand are fixed in the short run.

Without making further assumptions on the shape of the cost and demand functions, one can deduce from these first order conditions (FOCs) that whether the optimal quality provision will increase or decrease is ambiguous. In fact, the direction will depend on the relative curvature of the demand and cost functions, their slopes at the optimal quality levels as well as how much the quality sensitivity of the demand function changes with entry. To gain more concrete intuition about when we may expect quality to increase or decrease with entry, let us look closer at these FOCs, assuming a linear demand function that is additively separable in its arguments and a linear cost function.

Let $(\partial D_1(\cdot))/\partial q = \gamma$, $(\partial D_2(\cdot))/\partial q = \lambda$ and $(\partial C(\cdot))/\partial q = c$. Let $q_j^d - q_j^c = \Delta_{dc}$ and $q_j^m - q_j^d = \Delta_{md}$. By the linearity and separability assumptions, $D_1(q_j^m) = D_1(q_j^d) + \gamma\Delta_{md}$ and $D_2(q_j^d) = D_1(q_j^c) + \lambda\Delta_{dc}$. We are interested in the signs of Δ_{md} and Δ_{dc}. Note that at the optimal quality provisions, all FOCs above equal zero. Equating FOC1 and FOC2, and solving for Δ_{md}, we get

$$\Delta_{md} = \frac{1}{2\gamma}\left\{\frac{\gamma - \lambda}{c}(p_j - cq_j^d) - [D_1(q_j^d) - D_2(q_j^d)]\right\}.$$

We can see that the difference between the optimal quality provision of firm j as a monopoly and its optimal quality provision after entry (Δ_{md}) can be positive or negative. In other words, the impact of entry on the quality provision of the incumbent is ambiguous. The larger the decline in the demand sensitivity to quality ($\gamma - \lambda$), and the smaller the decrease in the demand of the incumbent after entry for a given quality level ($D_1(q_j^d) - D_2(q_j^d)$), the more likely that quality provision will decline with entry. The reader may wonder why the sensitivity to quality of the consumers that the incumbent serves after entry may be lower than the demand sensitivity of the consumers it serves before entry. We include a stylized example below based on an adaptation of the model provided by Economides (1993) to study quality competition among differentiated firms that features such a change as a result of the endogenous sorting of consumers among the two firms.

To investigate the difference between the optimal quality provision of firm j when facing an additional competitive firm versus its optimal quality provision when facing an additional co-owned firm (Δ_{dc}), we equate FOC2 and FOC3 to solve for Δ_{dc}. We find

$$\Delta_{dc} = -\frac{\omega}{2c\lambda}\frac{\partial D_{2n}(q_j^c, p_j, k_j, q_n^c, p_n, k_n)}{\partial q_n^c}(p_n - C(q_n^c)).$$

Because profit maximization requires $(p_n - C(q_n^c))$ to be positive, we conclude that Δ_{dc} is positive under the usual circumstances where we expect $\partial D_{2n}(\cdot)/\partial q_n^c$ to be negative. In other words, as long as the quality provision of one firm decreases the demand of the other firm, when firms are co-owned, they will have lower incentives to provide quality compared to the case when they are competing.

Summary. This stylized model shows that:

1. The impact of entry on quality choice is ambiguous;
2. The co-owned entry provides lower incentives to the incumbent and thus leads to a lower quality than rival entry would; and
3. The characteristics of the entrant that lead to less erosion of the incumbent's consumer base decrease incentives to invest in quality as a response to entry.

The ambiguity of the impact of entry motivates our empirical interest. We rely on ownership differences to test for the role of competitive incentives. We do not observe k_j directly. However, we know the chain membership of each theater. A theater that belongs to a top national chain is more likely to have higher quality amenities, such as stadium seating and a digital sound system. Therefore, we test whether an incumbent facing an entrant of a top national chain (belonging to a top national chain) is more (less) incentivized to provide higher quality. To the extent that top national chains reflect differences in k_j, holding all else constant, we expect to find directional evidence for our third prediction.

[27] Empirical literature often assumes that this weight equals one when firms are co-owned (Nevo 2001, Sudhir 2001, Thomadsen 2005, Nevo et al. 2005) to reflect joint profit maximization across different brands that the firms owns or different outlets of the same chain. For our empirical purposes, we do not need to assume that this weight equals one. More than the specific value that this weight carries, what is important is that $\omega \neq 0$. A positive weight indicates at least some degree of profit internalization between the two theaters belonging to the same chain. As a result, for example, we expect two theaters of the same chain to be less incentivized to steal customers from one another at a significant cost to themselves since the profit that leaves one pocket of the chain simply enters the other.

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